

CONSTRUCTION DETAILS

Part 4-Flexible Surfaces

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SECTION 401-MINERAL AGGREGATE SURFACE

401.01-Description. This work shall consist of furnishing and placing 1 or more courses of aggregates, and an admixture if required, on a prepared surface in accordance with these Specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross sections shown on the Plans or established by the Engineer.

MATERIALS

401.02-Materials. Materials used in constructing Mineral Aggregate Surface shall meet the requirements of the following Subsections of these Specifications.

<u>Materials</u>	<u>Subsection</u>
Aggregate, Class B	903.05(b)
Calcium Chloride, Type I, Type 2, or Calcium Chloride Liquor	918.02
Sodium Chloride	918.03

When the stationary plant method of mixing is used, the aggregate will be accepted for gradation immediately following mixing or immediately prior to mixing, based on periodic samples taken from the pugmill output or from the belt feeding the pugmill.

When 2 or more materials are blended on the road by means of mechanical mixers, the aggregate will be accepted for gradation after mixing and before compaction, based on samples taken from each layer of base material. Aggregate that does not require blending will be accepted for gradation at the aggregate production plant, based on samples taken from stockpiles or plant production immediately prior to delivery to the road.

EQUIPMENT

401.03-Equipment. All equipment necessary for the satisfactory performance of this construction shall be on the project, and approved, before work will be permitted to begin. The equipment shall meet the requirements of **Subsection 303.05**.

CONSTRUCTION REQUIREMENTS

401.04-Construction Methods. The roadbed shall have been completed and approved by the Engineer before any surface material is deposited thereon. On projects where surface material is not required to be placed over the entire width of the roadbed, sufficient subgrade material shall be bladed from the subgrade and windrowed on the shoulders to complete the compacted shoulders to the required cross section after completion of the surface course.

The surface course material may be spread with mechanical spreaders, dumped in windrows or end dumped. Material dumped in windrows or end dumped shall be spread by approved machine methods, care being taken to destroy all compaction planes caused by dumping or hauling over the material.

Mineral aggregate surface shall be constructed in layers as indicated on the Plans with spreading, machining, sprinkling, and compaction operations progressing until the work is in reasonably close conformity to the lines, grades, and cross sections shown on the Plans or established by the Engineer. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregate firmly keyed. Water shall be uniformly applied over the surface material during compaction in the amount necessary for proper consolidation.

Each layer shall be rolled with approved rollers until thoroughly compacted, and approved by the Engineer. If the required compacted depth of the surface course exceeds 6 in. (150 mm), the surface course shall be constructed in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any 1 layer shall not exceed 6 in. (150 mm), except when vibrating or other approved types of special compacting equipment are used, the compacted depth of a single layer of the surface course may be increased to 8 in. (200 mm) upon approval.

When 2 or more sizes or types of aggregates are to be blended on the road, they shall be spread separately by means of an approved mechanical spreader capable of being adjusted to spread the separate materials in the proper proportions.

After spreading the material, and additive if specified, the mixing shall be performed by means of an approved mechanical mixer. The mixer shall be capable of producing a thorough and intimate mixture of aggregates, additive, and water.

Calcium chloride, when specified, shall be incorporated in accordance with **Subsection 303.07**.

401.05-Thickness and Surface Requirements. Thickness and surface of the completed Mineral Aggregate Surface shall meet the requirements specified in **Subsections 303.11** and **303.12**.

COMPENSATION

401.06-Method of Measurement. Mineral Aggregate Surface will be measured by the ton(metric ton) in accordance with the provisions of **Section 109**, Measurement and Payment. The weight of all surface moisture on the aggregate at the time of weighing in excess of 8% will be deducted.

Water added to the materials at the direction of the Engineer will be measured by the M. G. (1,000 gal.) (m³) by means of calibrated tanks or distributors, or by means of accurate water meters.

Calcium Chloride will be measured by the ton(metric ton) in accordance with the provisions of **Subsection 303.13**. Sodium Chloride

will be measured by the ton(m^3) in accordance with the provisions of **Section 109**, Measurement and Payment.

401.07-Basis of Payment. The accepted quantities of Mineral Aggregate Surface will be paid for at the contract unit price per ton(metric ton) for Mineral Aggregate, per ton(metric ton) for Calcium Chloride, per ton(metric ton) for Sodium Chloride, and per M. G. (1,000 gal.) (m^3) for Water, complete in place.

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SECTION 402-PRIME COAT

402.01-Description. This work shall consist of an application of bituminous material, and cover material if required, on a designated base, in accordance with the requirements of these Specifications and in reasonably close conformity with the lines shown on the Plans or established by the Engineer.

MATERIALS

402.02-Materials. Materials shall meet the requirements of the following Subsections of these Specifications:

<u>Materials</u>	<u>Subsection</u>
Emulsified Asphalt, Grade AE-P or CAE-P	904.03
Aggregate for Cover Material, Size 7, 8 or 78	903.13

The ranges of application temperatures in degrees F(C) shall be as follows: AE-P and CAE-P 60-140° F(15-60° C)

EQUIPMENT

402.03-Equipment. All equipment necessary for the satisfactory performance of this construction shall be on hand and approved before work will be permitted to begin.

The equipment shall include a power broom or other mechanical sweeping equipment, bituminous heating equipment, a water sprinkler, a pressure distributor and such other equipment and small tools as may be required to perform the work in a satisfactory manner.

The distributor shall be so designed, equipped, maintained and operated that bituminous material at even heat may be applied uniformly on variable widths of surface at readily determined and controlled rates from 0.2 to 0.5 gal./s.y. (0.9 to 2.3 liters/m²), with uniform pressure, and with an allowable variation from any specified rate of plus or minus 0.02 gal./s.y. (0.1 liter/m²). Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices, a calibrated tank, and a thermometer for measuring the temperature of the material in the tank. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

CONSTRUCTION REQUIREMENTS

402.04-Limitations. Seasonal and temperature limitations for applying bituminous prime coat shall conform to the same requirements as those specified for the succeeding stage of construction. The prime may be applied to a surface that is slightly damp, but never to a wet surface.

402.05-Preparation of Surface. The surface to be primed, shall be prepared in accordance with the provisions of **Section 303** or **Section 310**, whichever is applicable.

When delays in the priming operation occur, the prepared surface shall be satisfactorily maintained or reworked to meet the requirements of **Section 303** or **Section 310**, whichever is applicable, before the priming operation is resumed.

402.06-Application of Prime. All areas to be treated shall be approved by the Engineer before application of the treatment. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor at a uniform, continuous spread. The Engineer will designate the rate of application within the extreme limits indicated on the Plans. Application temperatures shall be within the ranges specified under **Subsection 402.02**. Any areas containing an excess or deficiency of priming material shall be corrected by the addition of blotter material or bituminous material, as directed by the Engineer.

The Contractor shall protect all structures and concrete surfaces from the bituminous material during the construction.

402.07-Application of Cover Material. If after the bituminous material has been applied, it fails to penetrate before the time that the roadway must be used by traffic, dry cover material shall be spread at a rate established by the Engineer, between 8 and 12 lbs/s.y. (4 and 6 kgs/m²), to prevent damage to the primed surface. An excess of cover material shall be avoided.

402.08-Maintenance and Protection. The Contractor shall maintain the prime coat and the surface intact until it has been covered by the wearing surface or until the project is completed. No succeeding stage of construction shall be placed upon the prime coat until it has properly cured.

The Contractor shall repair any spots where the prime coat may have failed due to disintegration of the underlying surface material or any other reasons. The exposed areas so produced shall be lightly dampened, refilled with approved material and thoroughly compacted to conform with the surrounding surface, after which bituminous prime shall be applied thereto with a hand spray. If satisfactory repairs cannot be accomplished by the above method, the Contractor shall fill the depressions with approved mixtures of bituminous material and fine aggregate, and compact them to conform to the surrounding surface.

Any mineral aggregate and bituminous material used for repairs will be paid for at their contract unit prices providing the cause of damage is beyond the Contractor's control.

COMPENSATION

402.09-Method of Measurement. Bituminous material and cover material will be measured by the ton in accordance with the provisions of **Section 109**, Measurement and Payment. Net certified weights may be used as a basis of measurement for cover material aggregate, subject to correction for aggregate that is lost, wasted or otherwise not incorporated in the work. Water used at the direction of the Engineer to dampen the base prior to applying bituminous materials shall be measured by the M. G. (1,000 gal.) (m^3) by means of calibrated tanks or distributors, or by means of accurate water meters.

402.10-Basis of Payment. The accepted quantities of Prime Coat will be paid for at the contract unit price per ton(metric ton) for Bituminous Material, per ton(metric ton) for Cover Material, and per M. G. (1,000 gal.) (m^3) for Water, complete in place.

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SECTION 403-TACK COAT

403.01-Description. This work shall consist of furnishing and applying bituminous material to a previously prepared base or surface, to provide bond for a superimposed course, in accordance with the requirements of these Specifications or as directed by the Engineer.

MATERIALS

403.02-Bituminous Materials. Bituminous materials shall conform to the requirements of the following Subsections of these Specifications:

Materials	Subsection
Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS 1h	904.03
Asphalt Cement, PG 64-22	904.01
Chemical Additive	918.09(B)

The ranges of application temperatures in degrees F(C) shall be as follows:

SS-1, SS-1h, CSS-1, TST-1P, CQS-1h,
and CSS-1h, 60-140° F (15-60° C)
PG 64-22, 70-22, 76-22, or 82-22 with Chemical
Additive 375-400° F (190-205° C)

When emulsified asphalt is used, water as approved by the Engineer may be added to the asphaltic emulsion and thoroughly mixed therewith in such proportion, not to exceed 30% by volume of added water, that the resulting mixture will give the desired cover of residual bitumen. The exact quantity of added water will be established by the Engineer.

EQUIPMENT

403.03-Equipment. All equipment necessary for the satisfactory performance of this construction shall be on hand and approved before work will be permitted to begin. The required equipment shall include a power broom, equipment for heating bituminous material, a pressure distributor meeting the requirements of **Subsection 402.03**, and such other equipment and small tools as may be required to perform the work in a satisfactory manner.

403.04-Preparation of Surface. The designated surface shall be prepared in accordance with the applicable provisions of **Subsection 404.05**. The surface shall be dry at the time the tack coat is applied.

403.05-Application of Bituminous Material. Immediately after cleaning the surface, bituminous material shall be applied with the pressure

distributor at a rate directed by the Engineer, but not to exceed 0.05 gal. (0.2 liters) of residual bitumen per s.y. (m^2) for all materials except asphalt cement. If the bituminous material is to be placed upon a milled surface, the rate of application shall be determined by the Engineer but shall not exceed 0.20 gal. (0.9 liters) of residual bitumen per square yard (square meter).

When Asphalt Cement is used as a tack coat, the application rate shall be 0.05 to 0.10 gal./s.y. (0.2 to 0.5 liter/ m^2).

The surfaces of trees and structures adjacent to the area being treated shall be protected in such a manner as to prevent their being splattered or marred.

The tacked surface shall be allowed to dry until it is in a proper condition to receive the next course. Tack coat shall be applied only so far in advance of the paving operations as is necessary to obtain this proper condition of tackiness. The Contractor shall protect the tack coat from damage until the next course is placed.

Proper application of tack coat shall be achieved through the use of equipment and methods demonstrated on a tack coat test strip. This test strip shall be demonstrated at the same time an initial roller pattern and density test strip is set up for the first layer of asphalt mixture. This test strip application rate shall be between 0.05 and 0.15 gallons of residual bitumen per square yard. If the bituminous material is placed upon a milled surface, the test strip rate of application of tack material shall be between 0.05 and 0.20 gallons of residual bitumen per square yard. In all cases the application will result in a minimum double overlap of the actual track spray as it lands on the surface. The adjustment of the spray-bar and the nozzles may be necessary to achieve this minimum double overlap. Under no circumstances will corn-rows or any other pattern which would result in less than double overlap coverage of the tack coat be acceptable for the tack application. The goal is a very thin but uniform coating of asphalt left on the surface when the emulsion has broken.

Once the test strip has been demonstrated and approved by the Engineer, then this same procedure and application rates shall be applicable for the entire project or until another design is proposed and accepted./

COMPENSATION

403.06-Method of Measurement. Bituminous Material for Tack Coat will be measured by the ton (metric ton) in accordance with the provisions of **Section 109**, Measurement and Payment.

Water used for dilution of Asphalt Emulsion will not be measured for payment.

403.07-Basis of Payment. The accepted quantities of Tack Coat will be paid for at the contract unit price per ton (metric ton) for Bituminous Material complete in place.

The work required for preparing the designated surface as provided for under **Subsection 403.04** will be measured and paid for in accordance with the provisions of the applicable Section or Subsection under which the work is performed.

**SECTION 404-DOUBLE BITUMINOUS SURFACE
TREATMENT**

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SECTION 404-DOUBLE BITUMINOUS SURFACE TREATMENT

404.01-Description. This work shall consist of a bituminous mat composed of mineral aggregate bonded with bituminous material. It shall be constructed on a designated surface in accordance with these Specifications and in reasonably close conformity with the lines, grades and cross sections indicated on the Plans or established by the Engineer.

MATERIALS

404.02-Materials. Materials used in this construction shall meet the requirements of the following Subsections of these Specifications:

<u>Materials</u>	<u>Subsection</u>
Emulsified Asphalt, RS-2p, CRS-2p, RS-2 or CRS-2	904.03
Mineral Aggregate	903.14

The ranges of application temperatures in degrees F(C) shall be as follows:

RS-2p, 125-185° F(50-85° C)

EQUIPMENT

404.03-Equipment. All equipment necessary for the satisfactory performance of this work shall be on hand and approved before work will be permitted to begin. The required equipment shall include a power broom or other mechanical sweeping equipment, equipment for heating bituminous material, a pressure distributor meeting the requirements of **Subsection 402.03**, pneumatic-tire and steel-wheel rollers, self-propelled mechanical aggregate spreading equipment that can be so adjusted as to spread accurately at the specified rate, and such other equipment and small tools as may be required to perform the work in a satisfactory manner.

404.04-Limitations. Bituminous material shall be applied only when the designated surface is dry, firm, and properly cured; only between April 15 and October 1; and, unless otherwise directed, and only when the ambient temperature in the shade and away from artificial heat is 70° F(20° C) or above.

404.05-Preparing Designated Surface. The Plans will indicate whether the surface is to be constructed on a treated or untreated sub-base, on a granular base, an asphalt base or on an existing surface. The surface of the base or sub-base upon which the construction is to be placed shall meet the requirements of the applicable Section of **Division II, Part 2-Bases and Subgrade Treatments**. Conditioning of existing surface, when called for on

the Plans, shall be in accordance with the provisions of **Subsection 407.10**. Conditioning existing mineral aggregate base shall be in accordance with the provisions of **Section 310**.

Prime Coat, or Tack Coat, when specified on the Plans, shall be in accordance with the provisions of **Section 402** or **403**, respectively.

404.06-Applications of Bituminous Material and Mineral Aggregate.

The first application of emulsified asphalt shall be applied by pressure distributors at a uniform rate of between 0.30 and 0.38 gal./s.y. (1.35 and 1.70 liters/m²). Each width of application of bituminous material shall not be more than 6 in. (150 mm) wider than the width covered by the immediate spread of cover aggregate. The definite rate within that range will be established by the Engineer. Each width of spread shall not be less than 1/2 the surface to be treated.

Before beginning each spread, building paper shall be laid across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Distributors shall be started on the paper, the width of which shall be such that the full force of all nozzles shall be in effect before the forward edge of the paper is reached. The spread shall also be stopped on building paper if required by the Engineer and the paper shall be removed immediately after its use and shall be properly disposed of. All defects in any application shall be corrected at once.

Areas which are inaccessible to the distributor shall be treated either with hand sprays or pouring pots as the Engineer may direct.

If less than the full width of roadway is being treated, the aggregate shall not be spread on the inside 6 in. (150 mm) of either the 1st or 2nd application until the adjacent lane has been treated. Immediately after each application of bituminous material has been made, it shall be covered uniformly with Size No. 7 mineral aggregate. The aggregate shall be reasonably free of surface moisture.

The aggregate shall be spread at a rate between 24 and 30 lbs./s.y. (13 and 16 kgs/m²) as established by the Engineer using a self-propelled mechanical spreader; except on short projects 1/2 mile(1 km) in length or less, self-propelled mechanical spreading equipment will not be required. The truck shall be backed on the aggregate being spread and shall not be driven on or over uncovered bituminous material.

The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover material can immediately cover.

The second application of bituminous material shall be applied in the same manner as the first application, at a uniform rate between 0.38 and 0.46 gal./yd²(1.70 and 2.10 l/m²). The definite rate within that range, will be established by the Engineer. Mineral aggregate, Size No. 8, shall then be spread in the same manner as the first spread at a rate established by the Engineer within the range of 16 to 28 lbs./s.y. (9 to 15 kgs/m²).

Immediately after each spread of cover aggregate, uniform coverage shall be achieved by brooming. The revolving brooms of mechanical sweeping equipment shall be powered by a source independent of the drive train that propels the equipment. Additional aggregate shall be placed by hand on thin or bare areas.

404.07-Rolling and Curing. Immediately after spreading and brooming the cover aggregate, the entire surface shall be rolled, beginning at the edges and progressing to the center. Rolling shall begin within 30 minutes after the aggregate has been spread. Initial rolling shall be done with a pneumatic tire roller, followed by steel wheel rolling. All pneumatic tired rollers shall be self-propelled. The amount and sequence of rolling shall be as directed by the Engineer.

The first application of bituminous material and aggregate shall be allowed to cure for such length of time as deemed necessary by the Engineer before the second application is begun. Immediately before the second application of bituminous material, the surface shall be rolled with a steel-wheel roller.

The same rolling and curing procedures required in making the first application of bituminous material and cover aggregate shall be repeated in making the second application.

Slow-moving traffic may be allowed to use sections of the roadway where the bituminous material has been covered with mineral aggregate.

404.08-Shoulders. Shoulders that have been disturbed by the Contractor's construction operations shall be restored at his own expense. All objectionable material placed on the shoulders by the Contractor shall be removed as directed. Shoulder construction, when specified, shall be performed as provided for under **Section 208**.

404.09-Maintenance and Protection. After the final application, the Contractor will be required to maintain the work in a satisfactory condition for a period of at least 10 calendar days. If all other requirements of the Contract have been fulfilled, working days will not be charged against the contract time during this maintenance period. While the construction is in progress, the Contractor shall maintain each completed section until the entire project has been completed. This maintenance shall include making repairs where failures occur, and maintaining the surface in a smooth, uniform condition. It shall include brooming, dragging and rolling when required.

Final cleanup shall include sweeping up all excessive quantities of loose, dislodged cover aggregate that has collected along the edge of the completed surface treatment, and disposing of this material as directed.

COMPENSATION

404.10-Method of Measurement. Mineral Aggregate and Bituminous Material will be measured by the ton(metric ton) in accordance with the provisions of **Section 109**, Measurement and Payment. Net certified weights may be used as a basis of measurement for mineral aggregate, subject to correction for aggregate that is lost, wasted or otherwise not incorporated in the work.

404.11-Basis of Payment. The accepted quantities of Double Bituminous Surface Treatment will be paid for at the contract unit price per ton(metric

ton) for Bituminous Material and per ton(metric ton) for Mineral Aggregate, complete in place.

The work required for preparing the designated surface as provided for under **Subsection 404.05** will be measured and paid for in accordance with the provisions of the applicable Section or Subsection under which the work is performed.

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SECTION 405-BITUMINOUS SEAL COAT

405.01-Description. This work shall consist of an application of bituminous material followed by an application of cover material in accordance with these Specifications and in reasonably close conformity with the lines, grades, and cross section shown on the Plans or established by the Engineer.

MATERIALS

405.02-Materials. Materials used in this construction shall meet the requirements of the following Subsections of these Specifications:

<u>Materials</u>	<u>Subsection</u>
Emulsified Asphalt, RS-2p CRS-2p, RS-2 or CRS-2	904.03
Asphalt Cement PG 64-22, 70-22, 76-22, or 82-22	904.01
Mineral Aggregate, Size No. 7	903.13

Application temperatures for bituminous materials in degrees F(C) shall be as follows:

RS-2p or CRS-2p, 60-140° F(15-60° C)
PG 64-22

EQUIPMENT

405.03-Equipment. The equipment for this construction shall meet the requirements specified in **Subsection 404.03**.

CONSTRUCTION REQUIREMENTS

405.04-Limitations. The limitations for this construction shall be those stipulated in **Subsection 404.04**. If approved by the Engineer, the limitations for construction to be covered by a succeeding stage of pavement after October 1 and prior to April 15 shall be as follows:

- 1 The seasonal limitations shall be in accordance with **Subsection 407.09**.
2. Asphalt cement shall be used for the bituminous seal coat.

405.05-Preparing the Designated Surface. The surface to be sealed shall be prepared in accordance with the applicable provisions of **Subsection 404.05**.

405.06-Application of Bituminous Material. Emulsified asphalt shall be applied by pressure distributor at a uniform rate of between 0.26 and 0.36 gal./s.y. (1.2 and 1.6 liters/m²); the definite rate within that range will be established by the Engineer. Asphalt cement shall be used when specified

by the Plans or as stipulated in **Subsection 405.04**. The asphalt cement shall be applied at a uniform rate of between 0.10 and 0.25 gal./s.y. (0.5 and 1.1 liters/m²) upon the milled surface as directed by the Engineer.

Before beginning each spread, building paper shall be laid across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Distribution shall be started on the paper, the width of which shall be such that the full force of all nozzles shall be in effect before the forward edge of the paper is reached. The spread shall also be stopped on building paper if required by the Engineer. The paper shall be removed immediately after its use and shall be properly disposed of. All defects in any application shall be corrected at once.

The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover material can immediately cover.

The spread of bituminous material shall not be more than 6 in. (150 mm) wider than the width covered by the cover material. Under no circumstances shall operations proceed in such manner that the bituminous material will be allowed to chill or otherwise impair retention of the cover material.

All traffic shall be prohibited until the bituminous material has been covered with mineral aggregate.

Areas which are inaccessible to the distributor shall be treated either with hand sprays or pouring pots as the Engineer may direct.

405.07-Spreading and Rolling Aggregate. Mineral aggregate cover shall be spread and embedded in the bituminous material. Spreading of the aggregate shall be maintained as close to the application of bituminous material as is practicable, and each distributor load applied shall be covered immediately.

The mineral aggregate cover shall be reasonably free of surface moisture. The aggregate shall be spread at a rate between 8 and 26 lbs./y² (4 and 14 kgs/m²) as established by the Engineer using a self-propelled mechanical spreader; except on short projects 1/2 mile (1 km) in length or less, self-propelled mechanical spreading equipment will not be required. The truck shall be backed on the aggregate being spread and shall not be driven on or over uncovered bituminous material. If less than the full width of roadway is being treated, the aggregate shall not be spread on the inside 6 in. (150 mm) of the bituminous spread until the adjacent lane is treated. Immediately after spreading the aggregate, uniform coverage shall be achieved by hand-brooming. Additional aggregate shall be placed by hand on thin or bare areas.

Immediately following distribution of the aggregate, the entire surface shall receive its initial rolling moving in a longitudinal direction, beginning at the outer edges and progressing toward the center of the roadway, with each trip of the roller overlapping the previous trip by 1/2 the width of the rear wheel. The initial rolling of the aggregate shall have been completed within 1 hour after the bituminous material was applied.

Irregularities shall be corrected with hand brooms by sweeping the aggregates from areas of thick or heavy distribution to areas of thin or light distribution. Rolling shall then be continued using both steel-wheel and pneumatic rollers until the aggregate is thoroughly embedded in the

bituminous material. Additional rolling shall be required at a later date if directed by the Engineer. The Contractor shall further be required to redistribute any excess or loose aggregate that has been thrown out of place.

Slow moving traffic may be allowed to use the section or roadway upon which the aggregate has been spread.

405.08-Shoulders. Shoulders that have been disturbed by the Contractor's construction operations shall be restored by him at his expense. All objectionable material placed on the shoulders by the Contractor shall be removed as directed. Shoulder construction, when specified, shall be performed as provided for under **Section 208**.

405.09-Maintenance and Protection. The Contractor shall be required to maintain in a satisfactory condition each completed section of seal coat until the entire project has been completed. After the final application, the Contractor shall be required to maintain the work in a satisfactory condition for at least 10 calendar days. If all other requirements of the Contract have been fulfilled, working time during the 10 day maintenance period will not be charged against the contract time.

Maintenance shall include making repairs where failures occur, and maintaining the seal coat in a smooth uniform condition.

Final cleanup shall include sweeping up all excessive quantities of loose, dislodged cover aggregate that has collected along the edge of the completed seal coat, and disposing of this material as directed.

405.10-Method of Measurement. Mineral Aggregate and Bituminous Material will be measured by the ton(metric ton) in accordance with the provisions of **Section 109**, Measurement and Payment. Net certified weights may be used as a basis of measurement for mineral aggregate, subject to correction for aggregate that is lost, wasted or otherwise not incorporated into the work.

405.11-Basis of Payment. The accepted quantities of Bituminous Seal Coat will be paid for at the contract unit price per ton(metric ton) for Bituminous Material and per ton(metric ton) for Mineral Aggregate, complete in place.

The work required for preparing the designated surface as provided for under **Subsection 405.05** will be measured and paid for in accordance with the provisions of the applicable Section or Subsection under which the work is performed.

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**SECTION 407-BITUMINOUS PLANT MIX
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SECTION 407-BITUMINOUS PLANT MIX PAVEMENTS (GENERAL)

407.01-Description. These Specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type, irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement used. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work shall consist of 1 or more courses of bituminous mixture constructed on the prepared foundation in accordance with these Specifications and the specific requirements of the type under contract, and in reasonably close conformity with the lines, grades, typical cross sections and rate of application or thickness shown on the Plans or established by the Engineer.

MATERIALS

407.02-Materials. The individual materials shall meet the applicable requirements of the following Sections or Subsections of these Specifications:

<u>Material</u>	<u>Section or Subsection</u>
Aggregates	903
Mineral Filler	903.16
Bituminous Materials	904
Chemical Additive	918.09(B)

Aggregate shall be separated into coarse and fine aggregate stockpiles. When coarse aggregate is stockpiled by means causing segregation, it shall be separated into coarse and medium coarse stockpiles.

Each size and type of aggregate shall be stocked in a separate pile, bin, or stall. The storage yard shall be maintained in an orderly condition with a walkway between stockpiles that are not separated by partitions. The stockpiles shall be readily accessible for sampling.

The mineral aggregate will be conditionally accepted for quality in the stockpile at the producer's site. The bituminous material may be conditionally accepted at the asphalt terminal. Acceptance of the aggregate gradation and asphalt cement content shall be determined from hot bin samples or sample(s) taken from the completed mix at the asphalt plant after it has been loaded onto the trucks for transport to the project as specified herein.

When anti-stripping additive, other than hydrated lime, as described in **Subsection 918.09(B)** is required, it shall be added by approved in-line blending equipment at the Contractor's mixing plant or by injection at the asphalt terminal. When a Performance Grade(PG) Asphalt mix with properties greater than that of PG 64-22 is called for on resurfacing plans and is the only asphalt grade on the project, the contractor has the option of using either the asphalt grade shown on the plans or an asphalt grade equal

to or better than PG 64-22 for driveways and business entrances unless otherwise directed by the Engineer. The material will be paid for at the same unit price as bid for the asphalt and/or asphalt mix. The material tickets shall be marked "**FOR DRIVEWAYS AND BUSINESS ENTRANCES ONLY**" at the point of delivery.

407.03-Composition of Mixtures.

(A) General:

The bituminous mixture shall be composed of a combination of aggregate(coarse, fine, or mixtures thereof), mineral filler if required, anti-strip additive if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture will meet the grading and physical properties of the approved Job Mix Formula.

(B) Gradation and Bituminous Material Requirement:

In all cases, the requested aggregate gradation and bituminous material percentages shown on the Job Mix Formula shall be within the Design Ranges shown in **Section 903** and **Sections 307** and **411**, respectively. The Contractor will set a recommended asphalt cement content on all mixes with the final optimum asphalt cement content to be determined by the Engineer.

(C) Job Mix Formula:

1. General:

At least 14 working days prior to the scheduled start of production of any asphaltic paving mixture, the Contractor shall submit in electronic form(e-mail or on a floppy disk) a proposed Job Mix Formula and Laboratory Design, where applicable, prepared in accordance with the Marshall Method of Mix Design (AASHTO T 245), as modified by TDOT, or by Gyrotory Compaction (AASHTO T 312, Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by means of the Superpave Gyrotory Compactor). When the gyrotory compaction method is used, trial blends with at least 4 different asphalt contents (at least 2 above the optimum and 2 below the optimum) shall be made and the specimens shall be compacted to 65 gyrations with the optimum asphalt content and mixture volumetrics determined at that compaction level. If the specification requirements are not met, it will be necessary to make adjustments to the aggregate types and proportions. In addition the Contractor shall submit an asphalt barge certification with temperature-viscosity curve for each mixture to the Engineer for approval. A sample of each material to be used in the mix shall be delivered to the location designated by the Engineer

The following information shall be furnished:

- a. The specific project on which the mixture will be used.
- b. The source and description of all materials to be used in the mix.
- c. The gradations and approximate proportions of the raw materials as intended to be combined in the paving mixture.
- d. A single percentage of the combined mineral aggregate passing each specified sieve. The combined aggregate gradation shall be plotted on a gradation chart with sieve sizes raised to the 0.45 power to assure a well graded mix.
- e. The Loss on Ignition (L.O.I.) results on the combined aggregate of the 411 Grading D mix used as a wearing course.
- f. The Bulk Specific Gravity, Apparent Specific Gravity and absorption on the combined mineral aggregate in the paving mixture (AASHTO T 84 and T 85)
- g. The fractured face count and glassy particle count of the plus No. 4 material, if applicable.
- h. A single percentage of asphalt by weight of total mix intended to be incorporated in the completed mixture.
- i. The dosage rate and source of anti-stripping additive, if required, meeting the requirements of **Section 918.09 (B)**, to be added to the asphalt.
- j. The maximum specific gravity of the asphalt mixture (AASHTO T 209).
- k. A single temperature at which the mixture is intended to be discharged from the plant.
- l. Evidence that the completed mixture will conform to all specified physical requirements set forth in **Subsections 903.06 and 307.03 (a)** or **903.11 and 411.03 (b)**, except the stability and flow requirements will be waived for mixes designed following AASHTO T312 and the resistance to rutting requirements for surface mixtures must be met.
- m. The tensile strength ratio (TSR) indicating the stripping and moisture susceptibility characteristics of the mix.
- n. In order to identify critical mixes and make appropriate adjustments, the mix design shall have the required design properties for the bitumen content range of Optimum Asphalt Cement $\pm 0.25\%$.

The laboratory mix and compaction temperatures shown on the Job Mix Formula shall be established in accordance with the following Table A:

Table A

PG Binder Grade	Lab Mix Temp.	Lab Compaction Temp.
64-22, 67-22	Per temp./visc. chart	Per temp./visc. chart
70-22	320° - 345° F	295° - 320° F
76-22	320° - 345° F	305° - 330° F
82-22	320° - 345° F	305° - 335° F

Any additional testing of the mix in a laboratory shall be performed using the laboratory mix and compaction temperatures listed on the approved Job Mix Formula. A tolerance of $\pm 5^\circ$ for each temperature will be allowed.

The Laboratory Design must be prepared and signed by a Certified Laboratory Technician. To be certified, the technician must have completed the Marshall Method of Mix Design School conducted by the Department, including the written and lab performance testing.

2. Revision of Job Mix Formula:

The approved job mix formula shall remain in effect until a change is authorized in writing by the Engineer. The Contractor, at any time after construction has started, may request that the job mix formula be revised, providing evidence is shown that the revision is necessary and the revised aggregate gradation will meet all applicable gradation requirements.

A revised Job Mix formula will be necessary, if during the test strip construction and mix design/production verification procedure, changes to the mixture are made to comply with the specified criteria.

A new design will be required for any change in source of materials. All requests for design mix adjustments, redesigns and new design mixes will be submitted in writing to the Engineer for approval.

3. Resistance to Plastic Flow:

The submitted job mix formula shall include test data showing that the material as produced will meet the requirements specified in **Subsections 307.03 (a)** or **411.03 (b)** when tested in accordance with AASHTO T-245. The bulk specific gravity of the laboratory compacted bituminous mixture (Marshall specimens) shall be determined in accordance with AASHTO T-166. Mixes designed

according to AASHTO T-312 shall be exempt from AASHTO T-245.

For surface mixtures with greater than 5000 ADT, designed with the gyratory compactor, AASHTO T-312, the submitted job mix formula shall include enough raw materials (aggregate and asphalt cement) so that the TDOT Central Laboratory may conduct rut testing using the Asphalt Pavement Analyzer (APA). TDOT will compact specimens to 7 ± 1 % air voids and conduct the tests. Tests will be conducted at 147° F, with 100-psi hose pressure and 100 pounds wheel load. After 8000 cycles the maximum allowable rut depth will be 0.35 in. for roads with $\geq 10,000$ ADT and 0.40 in. with roads with 5,000 to 10,000 ADT. A new mixture design will be required if the mixture fails to meet the APA rut testing requirements.

The percent voids in the total mix shall be based on the maximum specific gravity of the bituminous mixture (Rice Gravity) as determined by AASHTO T-209. The voids in the mineral aggregate (VMA) shall be calculated using the effective specific gravity of the aggregates.

(D) Contractor's Quality Control:

All materials will be approved for acceptance through the Department's Acceptance Procedures specified herein. The Engineer will be responsible for determining the acceptability of the construction and materials incorporated therein. The Contractor will be responsible for the quality of construction and materials incorporated therein. All quality control sampling and testing will be accomplished on a random basis in accordance with the Contractor's approved quality control plan. The Department will perform all necessary sampling and testing for acceptance purposes on a random basis in addition to monitoring and observing the Contractor's quality control test procedures and results. The requirements for the Contractor's quality control sampling and testing will remain in effect until final project acceptance.

LOT sizes will be as specified in **Subsection 407.20(B) (1)**.

All sampling and testing of materials for the Contractor's Quality Control and the Department's Acceptance shall be performed in strict conformance with the Department's Policies on Sampling and Testing Procedures and Sampling of Asphalt Mixes for Verification of Laboratory Design.

1. Acceptance Plans:

(a) Payment Based on Acceptance Results:

The payment for each LOT of material will be adjusted on the basis of acceptance test results in accordance with the requirements specified hereinafter in the various sections of these specifications.

(b) Resampling of LOTS:

It is the intent of these specifications that each LOT of material will meet specification requirements at the time of acceptance testing. No check samples will be taken for acceptance purposes.

(c) Referee System:

All acceptance samples will be split and 1/2 of the sample will be retained by the acceptance inspector. In the event that the results of an acceptance test are questioned, the remaining 1/2 of the acceptance sample will be submitted to the central laboratory for testing. The results obtained by the central laboratory will be used in the evaluation of the quality of the lot.

2. Quality Control by the Contractor:

When reclaimed asphalt pavement is approved for use as a component material in a hot bituminous mixture, the Contractor's Quality Control Plan shall include determination of the gradation and asphalt content of the reclaimed asphalt pavement material at a minimum frequency of 1 stockpile sample per 2,000 tons (2,000 metric tons) used in the mixture.

After the job mix formula has been approved, the Contractor shall furnish material that meets the approved job mix formula within the acceptance range shown in **Table 407-2**. The process will be considered out of control when test results from a LOT fall below the 90% pay factor limit for the values in **Table 407-2**. The Contractor shall cease plant operations until such time as he can demonstrate that he can and will control the process.

The Contractor shall provide and maintain a quality control system that will provide reasonable assurance that all materials conform to specification requirements. This quality control system shall conform to the "Contractor Quality Control System", which is defined as follows:

CONTRACTOR QUALITY CONTROL SYSTEM

(a) Scope:

This establishes minimum requirements and activities for a Contractor Quality Control System. These requirements pertain to the inspections and tests necessary to substantiate material and product conformance to contract requirements and to all inspections and tests required by the contract.

(b) Functions and Responsibilities:

1. The Contractor will submit all mix designs to the Engineer for approval. The Department will approve

design mixes, conduct acceptance tests, inspect plants, and monitor control of the operations to assure conformity with the specifications. The Contractor will be responsible for setting of all dials, gauges, scales, and meters.

2. At the preconstruction conference, the Contractor shall submit in writing his proposed Quality Control Plan for approval of the Engineer. The plan shall contain the sampling, testing, inspection and the anticipated frequencies of each that the Contractor will follow to maintain process control. The required series of sampling, testing, and inspecting activities are shown in **Table 407-1** below.

Table 407-1

REQUIRED ITEMS FOR A
CONTRACTOR QUALITY CONTROL PLAN

A. All Types of Plants

1. Stockpiles

- (a) Determine gradation of all incoming aggregates
- (b) Inspect stockpiles for separation, contamination, segregation, etc.
- (c) Conduct a fractured face count when gravel is used as coarse aggregate
- (d) Determine the percent of glassy particles in slag coarse aggregate
- (e) Determine gradation and asphalt content of reclaimed asphalt pavement when used as a component material

2. Cold Bins

- (a) Calibrate the cold gate settings
- (b) Observe operation of cold feed for uniformity
- (c) Insure that bins have proper dividers to prevent materials from spilling over into adjacent bins.

3. Dryer

- (a) Observe pyrometer for aggregate temperature control
- (b) Observe efficiency of the burner.
- (c) Determine the percent dust coating on +4 material
- (d) Check dried aggregate for contamination due to incomplete combustion of fuel

Table 407-1
(Cont'd)

<p>4. Hot Bins</p> <ul style="list-style-type: none"> (a) Determine gradation of aggregates in each bin (b) Determine theoretical combined grading <p>5. Bituminous Mixture</p> <ul style="list-style-type: none"> (a) Determine percent bitumen (b) Determine mix gradation (c) Check mix temperature (d) Determine percent moisture in mix when reclaimed asphalt pavement is a component material (e) Determine Loss-On-Ignition (L.O.I.) of aggregates in mix where applicable (f) Check the mix for uncoated (g) Insure that handling procedures do not contribute to segregation of the mix. <p>B. Batch Plants</p> <ul style="list-style-type: none"> 1. Batch Weights--Determine percent used and weight to be pulled from each bin to assure compliance with Job Mix Formula 2. Check mixing time (both dry and wet) 3. Check operations of weigh bucket and scales 4. Document accuracy of all weighing and metering devices for <ul style="list-style-type: none"> (a) Asphalt cement (b) Aggregate (c) Anti-strip additive <p>C. Drum Mixer Plant</p> <ul style="list-style-type: none"> 1. Calibrate the cold feed and prepare a calibration chart for each cold gate 2. Develop information for the synchronization of the aggregate feed and the bituminous material feed 3. Determine moisture content of aggregate being fed into dryer 4. Determine the percent dust coating on dried +4 material 5. Check dried aggregate for incomplete combustion of fuel 6. Document accuracy of all weighing and metering devices for: <ul style="list-style-type: none"> (a) Asphalt cement (b) Aggregate (c) Anti-strip additive
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The activities shown in **Table 407-1** are considered to be normal activities necessary to control the production of asphalt concrete at an acceptable quality level. It is recognized, however, that depending on the type of process or materials, some of the activities listed may not be necessary and in other cases, additional activities may be required. The frequency of these activities will also vary with the process and the materials. When the process varies from the defined process average and variability targets, the frequency of these activities will be increased until the proper conditions have been restored.

The Contractor or Producer shall plot and keep up-to-date control charts for all Quality Control Sampling and Testing. Control charts shall be provided for the following:

- (a) Extracted asphalt content
- (b) Mix gradation
- (c) Dust to asphalt ratio
- (d) Maximum theoretical gravity (when required)
- (e) Voids in total mix (when required)
- (f) Stability (when required)

The Contractor shall post all current control charts in the asphalt lab where they can be seen.

The Contractor shall be responsible for the formulation of all design mixes with the exception of plant mix seal coat mixes. No lab design is required for 307 Grading A, AS and ACRL mixes. However, the Contractor shall establish the anti-strip additive dosage rate and verify compatibility of mixture materials by the ten minute boil test in accordance with this Subsection. Contractor-furnished design mixes must be submitted to the Department for approval, prior to their use. The Contractor shall be responsible for the process control of all materials during handling, blending, mixing, and placing operations.

(c) Quality Control System:

1. General Requirements. The Contractor shall furnish and maintain a quality control system that will provide reasonable assurance that all materials and products submitted to the Department for acceptance, conform to the specification requirements.

The Contractor shall have a Quality Control Technician, who is currently certified by the Department as a Certified Asphalt Plant Technician, available at the asphalt plant at all times the Contractor is producing asphalt mix for the Department. When it becomes evident to the Department that the Quality Control Technician cannot perform as required by the position,

the Department will revoke the certification and require replacement with a certified technician. The Contractor's quality control procedures, inspection, and tests shall be documented and that information shall be available for review by the Department throughout the life of the contract.

2. Documentation. The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of tests made, the number and type of deficiencies found, and the nature of corrective action taken as appropriate. The Contractor's documentation procedures will be subject to the review and approval of the Department prior to the start of the work and to compliance checks during the progress of the work. Copies of all charts and records documenting the Contractor's quality control tests and inspections shall be furnished to the Engineer daily.
3. Charts and Forms. All conforming and nonconforming inspections and test results shall be recorded on approved forms and charts which shall be kept up to date and complete. These test results shall be maintained at the Contractor's plant site laboratory and shall be available at all times to the Engineer during the performance of the work. Test results for the various materials and mixtures shall be charted on forms that are in accordance with the applicable requirements of the Engineer. An example of each chart and form to be used by the Contractor will be furnished by the Engineer. The Contractor will furnish his own supply of the charts and forms.
4. Corrective Actions. The Contractor shall take prompt action to correct any errors, equipment malfunctions, process changes, or other assignable causes which have resulted or could result in the submission of materials, products, and completed construction which does not conform to the requirements of the specifications. When it becomes evident to the Engineer that the Contractor is not controlling his process and is making no effort to take corrective actions, the Engineer will require that plant operations be ceased until such time as the Contractor can demonstrate that he can and will control the process.
5. Laboratories With Measuring and Testing Equipment. The Contractor shall furnish a fully equipped laboratory at the production site in accordance with the provision of **Subsection 106.06**. This facility may be permanent or portable. The laboratory shall be furnished with the necessary testing equipment and supplies for performing Contractor Quality Control sampling and testing as well as Department Acceptance sampling and testing. To assure accuracy, the testing equipment will be checked

- periodically in accordance with the TDOT Procedure for Qualified Laboratories.
6. Sampling and Testing. Sampling and testing methods and procedures used by the Contractor to determine quality conformance of the materials and products shall be in accordance with **Subsection 106.04** Sampling and Testing, or Inspection. The Contractor's Quality Control Plan will include the taking of samples for material characteristics on a random basis and the plotting of the test results on control charts.
 7. Alternative Procedures. The Engineer may approve the use of alternative sampling methods, procedures, and inspection equipment when such procedures and equipment provide, as a minimum, the quality assurance required by the contract documents. Prior to applying such alternative procedures, the Contractor shall describe them in a written proposal and shall demonstrate for the approval of the Engineer that their effectiveness is equal to or better than the contract requirements.
 8. Mix Design/Production Verification. The Contractor will be required to sample and test asphaltic concrete base and surface mixes throughout production to verify that the mix being produced is within the criteria listed below. This information shall also be recorded on control charts. This requirement applies only to mixes designed in keeping with the Marshall Method of Mix Design. The following will be required for all interstate projects, any project with a current Average Daily Traffic (ADT) exceeding 12,000 and any project utilizing modified asphalt cements but in no case shall the following apply to any individual mix with a quantity of 1,000 tons(metric tons) or less:

Maximum Theoretical Gravity:	$\pm .025$ of Mix Design Value
Voids in Total Mix:	3.0% to 5.5%
Voids in Mineral Aggregate:	Minimum as noted in Specifications
Marshall Stability:	Minimum as noted in Specifications
Dust/Asphalt Ratio:	As noted in Specifications

The asphalt pavement mix design/production verification procedure shall consist of the following:

- a. Mix designs shall be submitted to the Engineer for approval prior to mix production. Once approved,

sufficient mix shall be produced to construct a test strip as noted in **Subsection 407.15**.

- b. The Contractor will perform maximum theoretical gravity and gradation tests from material produced for constructing the test strip. These tests will be performed under the Engineer's observation by a Quality Control Technician, who is currently certified by the Department as a Certified Asphalt Mix Design Technician.
- c. The equipment and procedures used for determining the theoretical gravity of the mix shall conform to AASHTO T 209. The equipment for determining bulk specific gravity shall conform to AASHTO T 312 when designing with the gyratory compactor.
- d. No more than 500 tons(500 metric tons) of mix shall be placed until the verification testing, with the exception of TSR, is complete. If the test results for the produced mix are within the previously defined limits required for production and mix density requirements are met, the Contractor will be allowed to proceed. If not, a revised design will be required prior to start up and another evaluation process will be required for the revised design. No more than 100 tons(100 metric tons) of mix shall be placed during this trial. This process shall be repeated until an acceptable mix can be produced. All test strip and mixture design/production verification material will be subject to applicable price adjustments or removal at no cost to the Department. If the TSR results are not in compliance with the specifications, production shall immediately stop until mixture adjusts are made.
- e. During construction, the Contractor will be required to perform verification testing for each 1/2 day's production for mix quality control. A random numbers table shall be used to determine when to collect samples for testing.
 1. When the test results are outside the allowable criteria, a subsequent sample shall be immediately obtained and tested for compliance.
 2. If the subsequent test results are within allowable limits, the Contractor may continue mix production.
 3. If the subsequent test results are outside allowable limits, production of mix shall not continue until the Contractor has demonstrated to the Engineer that adequate corrective action has been taken. The Contractor will then be permitted to produce sufficient mix, not to exceed 100 tons(100 metric

tons), to provide a representative sample for determining stability, voids in the total mix, and the dust/asphalt ratio. Production of mix shall not continue until test results indicates compliance with the previously defined requirements and density meets specifications.

(E) Testing Procedures:

The Loss on Ignition(LOI), Tensile Strength Ratio(TSR), Stripping Test and the Coating Tests shall be determined in accordance with the following:

Tensile Strength Ratio

Testing for stripping and moisture susceptibility of the mixture shall be in accordance with ASTM D 4867, Standard Test Method for Effect of Moisture on Asphalt-Concrete Paving Mixtures(Root-Tunnecliff Procedure).

When a polymer modified asphalt cement is specified, a minimum tensile strength of 100 psi(690 kPa) and a minimum tensile strength ratio(TSR) of 80% for the conditioned specimen shall be required when testing for stripping and moisture susceptibility in accordance with Root-Tunnecliff Procedures as described above. When a non-polymer modified asphalt cement is specified, the above conditions will be required except the minimum tensile strength shall be 80 psi(550 kPa).

Ten Minute Boil Test (Stripping)

Field Test

The completed mix will be tested for stripping at the asphalt plant as follows. From a sample of the completed mix, visually select a minimum of 50 grams of the plus No. 4(4.75 mm) material and place immediately in boiling water. Continue to boil for 10 minutes, pour off water and place coated aggregate on a paper towel. The coated aggregate shall not show any evidence of stripping as determined by a visual inspection.

Laboratory Test

The dosage rate will be determined in the laboratory by the following: Fifty grams of the mineral aggregate passing the 1/2 in. (12.5 mm) sieve and retained on the No. 4(4.75 mm) sieve shall be washed and surface dried. The selected aggregate shall be thoroughly coated with the blend by stirring of the mixture heated to 250° F(120° C). The material shall be placed immediately in boiling water. Continue to boil for 10 minutes, pour off water and place coated aggregate on a paper towel. The coated aggregate shall not show any evidence of stripping as determined by a visual inspection.

Coating Test

At least a 1500 gm aggregate sample of plus No. 4(4.75 mm) material shall be taken from each hot bin, after drying in a batch plant, or at least a 5,000 gm aggregate sample of plus 4 material shall be taken from material dried in a dryer drum plant. The aggregate shall be gently manipulated on the No. 4(4.75 mm) screen to separate it from all free fines. Transfer the aggregate retained on the No. 4(4.75 mm) screen to a tared No. 8(2.36 mm) screen and determine its dry weight. Thoroughly wash the material retained on the No. 8(2.36 millimeters) screen to remove all fines. Dry the aggregate retained on the No. 8(2.36 mm) screen and calculate the percent loss.

Test for Percent loss on ignition of the Mineral Aggregate in a Asphalt Paving Mixture.

Obtain a representative aggregate sample and weigh approximately 600 grams into an assayer's fire clay crucible which has been ignited to constant weight. The crucible must have a cover to prevent pop-out of aggregate while heating. The covered crucible and its contents is then ignited in a muffle furnace at 1742° F(950° C) to constant weight (minimum of 8 hours). The crucible and contents are cooled to room temperature and weighed.

If the aggregate sample has been obtained by extraction with a vacuum extractor, the weights before and after ignition must be corrected for filter aid.

Calculations:

$$\text{Percent Loss on ignition} = \frac{(A-B) \times 100}{A}$$

Where A = weight of sample before ignition (corrected for filter aid)
 B = weight of sample after ignition (corrected for filter aid)

EQUIPMENT

407.04-Bituminous Mixing Plant. Sufficient storage space shall be provided for each size aggregate. The different sizes shall be kept separated until they have been delivered to the cold elevator or belt feeding the dryer. The storage yard shall be maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling.

Plants used for the preparation of bituminous mixture shall conform to all requirements under (a). In addition, batch mixing plants shall conform to the requirements under (b), continuous mixing plants shall conform to the requirements under (c), and dryer-drum mixing plants shall conform to the requirements under (d).

(a) Requirements for All Plants.

Mixing plants shall be of sufficient capacity and so coordinated to adequately handle the proposed bituminous construction.

1. Equipment for preparation of bituminous material.

Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provisions shall be made for measuring and sampling the contents of storage tanks.

2. Feeders for dryer.

Separate feeders shall be provided for each size aggregate, and each size shall be fed onto the belt going to the dryer by mechanical feeders with separate adjustable gates. The feeders shall be capable of delivering the separate aggregates onto the belt in proper proportions.

Adequate means shall be provided to assure a constant and uniform flow of material from each bin. Bins containing fine aggregate shall be equipped with vibrators if necessary.

The Contractor will not be permitted to blend or mix different aggregates or different sizes of the same aggregates with clam shells, bulldozers, high lifts or similar equipment.

The aggregate shall be fed uniformly into the dryer so that a uniform production and uniform temperature may be obtained.

3. Dryer.

The plant shall include a dryer or dryers that agitate the aggregate continuously during the heating and drying process; it shall be capable of heating and drying all aggregates to the temperature required, and shall be capable of supplying the mixing unit continuously at its operating capacity. Dryers shall be constructed and operated so that aggregates will not be contaminated with unburned fuel.

4. Screens.

Plant screens, capable of screening all aggregates to the specified sizes and proportions and having normal capacities in excess of full capacity of the mixer, shall be provided.

A consistent carry-over, but not to exceed 20%, will be allowed on any screen. If any bin contains more than 20% of material which is undersized for that bin, the bin shall be

emptied and correction of the cause for such condition shall be made.

Approved scalping screens shall be required on all dryer-drum mixing plants, but additional screens will not be required.

5. Bins.

The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Each bin shall be provided with overflow pipes of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with an outlet gate constructed so that when closed there shall be no leakage. The gates shall be cut off quickly and completely. The bins shall be constructed to provide adequate and convenient approved facilities for obtaining representative samples of aggregate from the full flow of each compartment. These bins shall not be required in an approved Dryer-Drum Mixing Plant. When mineral filler is used, separate dry storage shall be provided and the plant shall be equipped to uniformly and accurately feed the filler into the mixer.

6. Bituminous control unit and Anti-strip additive (ASA) systems.

Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

Where anti-stripping additive, other than hydrated lime, as described in **Subsection 918.09(B)** is required, it shall be added by approved in-line blending equipment. The Contractor shall have a storage tank for the ASA that can maintain a constant temperature without overheating the additive. The additive shall be stored in accordance with the Manufacturers recommendations and in no case shall it be stored above 150 °F. The in-line blending equipment on drum plants shall have a totalizing "flow meter" capable of measuring the actual flow rate within the production range of 0.00 to 1.00 gallons per minute at increments of 0.05 gallons. Batch plants must have a totalizing flow meter. The totalizer shall display the total gallons of material dispensed. The dispenser and/or pumps shall be capable of adding the heat stable anti-stripping additive within a tolerance of 10 % of the specified rate.

7. Thermometric equipment.

An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feedline at a suitable location near the charging valve at the mixer unit. The plant shall also be equipped with an approved thermometric instrument so placed at the discharge chute of the dryer as to register automatically or indicate the temperature of the heated aggregates. With the approval of the Engineer, the thermometric instrument may be placed within the fines bin.

The plant shall be equipped with an approved automatic recording and regulating apparatus for control of the temperature of the aggregates.

8. Dust Collector.

The plant shall be equipped with a dust collector constructed to uniformly waste or return to the dried aggregate all or any part of the material collected. Collected baghouse fines intended for recirculation into the mix shall be handled as if it were mineral filler or fed by another suitable method approved by the Engineer. Means shall be provided to calibrate and adjust the dust fed from a baghouse.

9. Safety Requirements.

Adequate and safe stairways to the mixer platform and sampling points shall be provided. Guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Engineer to obtain samples and mixture temperature data. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment and other similar equipment from the ground to the mixer platform and return. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free of drippings from the mixing platform.

10. Field Laboratory.

The Contractor shall furnish a Type B field laboratory in accordance with the requirements of **Subsection 106.06**.

11. Surge and Storage Systems.

Surge or Storage systems may be used at the option of the Contractor provided each system is approved by the Department prior to use.

The surge and storage system shall be of such design that there is no appreciable difference between material being discharged from the bin or silo and material being discharged directly from the pugmill.

The surge bins and storage silos must be equipped with low and high mix level indicators. The low level indicator shall be placed at a location on the bin or silo that has been predetermined to prevent segregation of the mix.

The conveyor system used with the surge bins or storage silos shall be arranged in such a manner that samples of the mix or dry material may be conveniently taken from the pugmill.

Storage silos shall be closed, insulated, and heated in such a manner that localized heating does not occur. The storage silo shall be capable of being sealed to prevent oxidation of the mixture. Surge bins shall be equipped with a rain cover capable of preventing water from entering the mix in the bin.

Approval of a surge or storage system will be dependent upon inspection and tests that indicate that the system is capable of conveying, retaining, and delivering the bituminous mixture:

1. within the tolerance ranges as set forth on the Job Mix Formula;
2. without segregation;
3. without balling or hardening.

Approval of a surge or storage system may be withdrawn if tests and/or inspections indicate that the system is having a detrimental effect on the bituminous mixture.

Any bituminous mix which, in the judgment of the Engineer, is damaged in any way by the use of a surge or storage system will be rejected.

Platform truck scales meeting the requirements of **Section 109** shall be mounted under the loading hopper and shall be capable of recording tare and gross weights.

(b) Requirements for Batching Plants.

1. Plant Scales.

Dial scales shall be provided for weighing of all aggregates and mineral filler, in the suspended weigh box. Dial scales shall be of a standard make and of sufficient size that the numerals on the dial can be read at a distance of 25 ft. (8 m). The dials shall be of the compounding type having a full complement of index pointers. The value of the graduation of scales used in weighing amounts of aggregates less than 5,000 lbs. (2,500 kgs) shall not be greater than 5 lbs. (3 kgs); amounts of aggregates from 5,000 to 10,000 lbs. (2,500 to 5,000 kgs) shall not be greater than 10 lbs. (5 kgs);

amounts of aggregates in excess of 10,000 lbs. (5,000 kgs) shall not be greater than 0.1% of the capacity of the scales. Pointers which give excessive parallax errors shall not be used. All dial scales shall be so located that they will be in plain view of the operator at all times. When bituminous material is measured by weight, the asphalt weigh bucket shall be equipped with a separate dial scale with a minimum graduation not greater than 2 lbs. (0.9 kgs). All dial scales shall be accurate within a tolerance of 0.5%. Vibration shall be eliminated by setting the scales on a separate foundation, if required. Each installation of scales shall be provided with 10 standard 50 lb(25 kg) weights meeting the requirements of the U. S. Bureau of Standards) for calibrating and testing weighing equipment. Scales shall be inspected as often as the Engineer may deem necessary to assure their continued accuracy.

The Contractor shall provide an approved automatic printer system which will print the weights of the material delivered, when the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weigh ticket for each load.

2. Weigh box or hopper.

The equipment shall include a means for accurately weighing each size of aggregate and mineral filler in a weigh box or hopper suspended on scales. The weigh box or hopper shall be of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.

3. Bituminous control.

The bituminous material bucket shall be a non-tilting type. The length of the discharge opening or spray bar shall be not less than 3/4 the length of the mixer and it shall discharge directly into the mixer; the bituminous material bucket, its discharge valve or valves, and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drainable and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least 15% in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket. When the bituminous material is metered, the indicator dial shall have a capacity of at least 15% in excess of the quantity of bituminous material used in a batch. The meter indicator

dial shall have a scale with divisions measuring in gallons equivalent to a weight sensitivity of 0.04% of the total batch weight. The meter shall be accurate within a tolerance of 0.5%. The controls shall be so constructed that they may be locked at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry-mixing period is over. All of the bituminous material required for 1 batch shall be discharged in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve, and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

4. Mixer.

The batch mixer shall be an approved twin pugmill type, steam or hot oil jacketed, and shall be capable of producing a uniform mixture within the job mix tolerances. The mixer shall be so constructed as to prevent leakage of its contents. It shall be equipped with a sufficient number of paddles or blades set in the "run around" order and operated at such speed as to produce a properly and uniformly mixed batch. The depth of the material in the pugmill shall not be above the tips of the paddles. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

The clearance of blades from all fixed and moving parts shall not exceed 1 in. (25 mm) unless the maximum diameter of the aggregate in the mix exceeds 1 1/4 in. (30 mm), in which case the clearance shall not exceed 1 1/2 in. (40 mm).

5. Control of mixing time.

The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate, at the completion of the cycle. It shall lock the bituminous material bucket throughout the dry-mixing period and shall lock the mixer gate throughout the dry and wet-mixing periods. The dry-mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of bituminous material. The wet-mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixer gate. The control of the timing shall be flexible and capable of being set at intervals of 5 seconds or less

throughout a total cycle of up to 3 minutes. A mechanical batch counter shall be installed as a part of the timing device and shall be so designed as to register only batches that have been mixed for the full time interval. The setting of time intervals shall be performed in the presence of and at the direction of the Engineer, who shall then lock the case covering the timing device until such time as a change is to be made in the timing periods.

6. Operator's Platform Observation House.

The plant shall be equipped with a scale observer's house. The house shall be mounted on or near the weigh platform and shall be so situated that the aggregate and asphalt scales, asphalt thermometer, and pyrometer are plainly visible from within the house.

The house shall be soundly constructed of approved materials with at least 45 s.f. (4 m²) of floor space and air conditioned by a unit of at least 12,000 B.T.U. (12,700 kilojoules). If the Contractor so desires, he may install all batch controls in the house. However, it shall not be used for storage or purposes other than to house the batch controls, plant operator and Department Inspector. If the Contractor elects not to move the plant controls into the house, it shall be so situated as to give the scale inspector full view of the control panel.

When the scale-watcher's house is located on the asphalt plant it shall be equipped with an adequate secondary means of escape in the event of fire or explosion.

The house will be considered as part of the plant and no direct payment will be made for its construction and maintenance.

(c) Requirements for Continuous Mixing Plants.

1. Aggregate proportioning.

The plant shall include means for accurately proportioning each size of aggregate. The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate to form an orifice for measuring volumetrically the material drawn from each compartment. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points.

The feeding orifice shall be rectangular with 1 dimension adjustable by positive mechanical means provided with a lock. Indicators shall be provided for each gate to show the respective gate opening in inches (millimeters).

Mineral filler shall be fed into the mixer continuously and uniformly in the proportion set out in the formula for the job mix, and in a manner satisfactory to the Engineer.

2. Weight calibration of aggregate feed.

The plant shall be equipped with an approved revolution counter in satisfactory working condition. The plant shall include a means for calibration of gate openings by weighing test samples. Provision shall be made so that materials fed out of individual orifices may be bypassed to individual test boxes. The plants shall be equipped to handle conveniently individual test samples weighing not less than 200 lbs. (100 kgs). Accurate scales shall be provided by the Contractor to weigh such test samples.

3. Synchronization of aggregate feed and bituminous material feed.

Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of bituminous material from the meter or other proportioning device. This control shall be accomplished by mechanical means or by any other positive method satisfactory to the Engineer.

4. Mixer.

The plant shall include a continuous mixer of an approved twin pugmill type, adequately heated and capable of producing a uniform mixture within the job mix tolerances. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge. Charts shall be provided showing the rate of feed of aggregate per minute for the aggregate being used. Determination of the mixing time shall be by weight method, using the following formula (the weights shall be determined for the job by tests made by the Engineer) where:

Mixing time in seconds =

$$\frac{\text{Pugmill dead capacity in lbs(kgs)}}{\text{Pugmill output in lbs(kgs) per second}}$$

5. Surge hopper.

The mixer shall be equipped with a discharge hopper with dump gates which will permit rapid and complete discharge of the mixture and of such size and design that no segregation of the mixture occurs.

6. Platform Truck Scales.

Platform truck scales shall meet the requirements of **Section 109**.

(d) Requirements for Dryer-Drum Mixing Plants.

1. Control of Aggregate.

The aggregates shall be stockpiled and handled so as to prevent any significant amount of segregation, contamination or degradation. Stockpiles shall be constructed in accordance with **Subsection 903.20**.

Each aggregate shall have a separate feeder that has a positive feed that can be easily and accurately calibrated. The plant shall have a flow indicator and an audible warning device on each separate feeder to assure a constant and uniform flow of aggregate from each bin onto the belt.

Mineral filler, if required, shall be fed into the mixer continuously and uniformly in the proportion set out in the formula for the job mix, and in a manner approved by the Engineer.

2. Synchronization of Aggregate Feed and Bituminous Material Feed.

Satisfactory means shall be provided to afford a positive interlocking control between cold aggregate feed and asphalt. The control setting for the asphalt flow will be based on the dry weight of the aggregate. There must be an acceptable method provided for proportioning asphalt flow as variations in aggregate flow take place. A metering system will be provided to measure the flow of asphalt into the drum and an approved method of checking and calibrating the metering system shall be located in the control house. An automatic interlock system will be provided that will shut off the asphalt flow and the burner when the aggregate flow ceases.

3. Temperature Control.

Dryer-Drum Mixing Plants shall be equipped with a recording pyrometer or other approved thermometric instrument sensitive to a rate of temperature change of not less than 10° F(6° C) per minute. The system shall be equipped with automatic burner controls and shall provide for temperature sensing of the bituminous mixture at discharge from the drum.

4. Scales and Metering Systems.

The Contractor shall be required to furnish weights and charts for checking the accuracy of the belt scales and the bituminous metering system. The scales and meters shall have an accuracy within a tolerance of 0.5%.

The belt scale which weighs the combined aggregate shall be in accordance with the **National Institute of Standards and Technology Handbook 44**.

5. Sampling Devices.

There shall be an approved method provided for sampling individual cold feeds and sequential sampling of aggregate and asphalt under full scale production. The sampling device and procedures used shall be approved by the Engineer and shall be such that the normal operation will not be interrupted.

6. Platform Scales.

The Contractor shall make certified platform scales available for checking the asphalt metering system and for weighing or checking loads of asphalt mix in accordance with Department policy.

7. Silos or Surge Bins.

Surge or storage silos shall meet the requirements of **Subsection 407.04(a)11** or if a silo is not provided, an approved surge bin capable of holding sufficient mix to allow the plant to operate at an efficient rate of production shall be provided, and the system shall be capable of conveying, retaining and delivering the bituminous mixture so that it is within the job mix formula and without segregation. Any mix that is damaged in any way will be rejected.

The surge bin may include a weighing system. If a weighing system is included in the surge system, it shall be subject to approval of the Engineer and the Contractor shall provide approved weights for checking the weighing system. The system shall be checked in maximum increments of 5,000 lbs. (2,500 kgs) and checked in a minimum of 3 increments. The system shall be checked through its entire weighing range to or above the maximum weight which is expected to be applied and shall be accurate within a tolerance of 0.5%.

Surge bins that do not include a weighing system shall have platform truck scales meeting the requirements of **Section 109** mounted under the loading hopper.

8. Aggregate Feed.

Aggregate shall be proportioned by feeding each size aggregate from a separate cold bin. The belt that delivers the aggregate shall have a load cell capable of registering the amount of flow from each individual bin on a readout in the control office; or the aggregate shall be proportioned by a linear system based on measured RPM of each feeder belt at a constant gate opening to feed aggregate at a predetermined rate that is set in the control office and which has a readout in the control office. The rate of feed as determined from the bin settings shall agree with the load cell on the collection belt

feeding the dryer within a tolerance of $\pm 10\%$. In the event that the predetermined tolerance is exceeded, an alarm shall sound, and if corrections are not made within 60 seconds, the plant shall automatically shut down. The aggregate feed system shall employ computer controlled adjustments to automatically produce mix of the correct proportions over the entire range of production rates of the plant.

If the Engineer has previously calibrated and approved the plant for temporary manual operation, the plant may run for a period not to exceed 2 working days, or portions thereof, on manual in the event of a computer breakdown.

9. Electronic Data Retention.

The computer system and automatic weighing system shall include means to retain all electronic data during electrical power failures.

10. Dryer-Drum Plants Prior to January 1983.

Dryer-drum plants approved by the Department prior to January, 1983 which do not employ computer controlled adjustments may continue to be used.

407.05-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, hydrated-lime solution or other approved material from the Department's QPL to prevent the mixture from adhering to the beds. Each truck shall be covered immediately after loading at the plant with a cover of canvas or other suitable material. The covers shall be of sufficient size to protect the mixture from the weather. The cover shall lap down along the sides and rear of the truck bed a minimum of 6 inches (150 millimeters) and be secured by tie downs at a maximum of 5 ft. (1.5 m) spacing along the sides and rear of the truck bed. When necessary, so that the mixture will be delivered on the road at the specified temperature, truck beds shall be insulated and covers shall be securely fastened. Each truck shall have a $\frac{1}{4}$ inch (6.4 mm) hole in the side of the bed for the purpose of inserting a thermometer.

407.06-Bituminous Pavers. Bituminous pavers shall be self-contained, power-propelled units provided with an activated screed, equipped to be heated, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the plans. All paver extensions shall be full assembly extensions, including activated and heated screeds, auger extensions and auger guards. When augers are extended, the maximum distance from the augers to the end plate shall be 18 in. (457 mm). Augers shall be within 4 ft. (1.2 m) of the end plate on trailing edge extendible screeds, however if bolt-on extensions are used the augers shall be extended a distance equal to the length of the bolt-on extensions. Strike off boxes shall not be permitted except on continuously varying width sections. Materials for shoulders less

than 8 ft. (2.4 m) in width and similar construction may be placed by means of approved mechanical spreading equipment.

The paver shall be equipped with a receiving hopper having a sufficient capacity for 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 or strike-off assembly shall produce effectively a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

All asphalt paving machines shall be equipped with automatic grade and slope controls. Both the grade and slope controls shall be in working order at all times, except that, in the event of mechanical failure of the automatic controls, the Contractor will be permitted to finish the day's work using manual controls but will not be allowed to resume work the following day until both the grade and slope controls are in first class working order.

The Engineer may allow the Contractor to pave the inside shoulder concurrently with the inside traffic lane, subject to the approval of the price adjustment for the mix used on the shoulder and approval of the paving and rolling equipment by the Engineer. In addition to the preceding requirements, the paver must have an articulated screed that can be adjusted to fit the pavement cross section and a power unit capable of handling the increased loading without undue stress.

407.07-Rollers. Rollers shall be self-propelled and of steel-wheel, pneumatic tire, and/or vibratory type. Rollers shall be in good condition, capable of reversing without backlash and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. Rollers shall be equipped with a device for moistening and cleaning the wheels as required.

Additional requirements are:

1. The steel-wheel roller shall weigh a minimum of 8 tons (7.25 metric tons) and may be either a 3 wheel or tandem type.
2. The pneumatic tire rollers shall have a minimum contact pressure of 85 psi (585 kPa). The roller shall contain 2 axles upon which are mounted not less than 7 pneumatic-tire wheels in a manner so that the rear set of tires will not track the front set. The axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. The tires shall be uniformly inflated. The Contractor shall furnish to the Engineer charts or tabulations of the contact area and contact pressures for the full range of tire inflation pressures and loadings for each size of roller tire furnished. A combination roller (pneumatic and steel wheel combination), of the make and model approved by the Department, may be substituted for a pneumatic tire roller.
3. The use of vibratory rollers will be permitted when the particular roller proposed for use is approved by the Engineer.

The required rollers shall be on the job, inspected, and approved before paving operations are begun.

When the Contractor is paving the inside shoulder concurrently with the inside traffic lane, an additional roller a minimum of 4 ft. (1.2 m) wide to a maximum width of 1 ft. (300 mm) wider than the inside shoulder being paved, shall be required to compact the shoulder. Neither the roller(s) on the inside traffic lane nor the roller on the shoulder shall be allowed to traverse between the inside shoulder and the inside traffic lane.

407.08-Small Tools. The Contractor shall provide all necessary small tools and suitable means for keeping them clean and free from accumulations of bituminous materials.

CONSTRUCTION REQUIREMENTS

407.09-Weather Limitations. Bituminous plant mix may be placed on properly constructed and accepted subgrade or previously applied layers provided the following conditions are met:

1. The subgrade and the surface upon which the bituminous plant mix is placed shall be free of excessive moisture.
2. The bituminous plant mix shall be placed in accordance with the temperature limitations of the following table and only when weather conditions otherwise permit the pavement to be properly placed, compacted and finished.

TEMPERATURE LIMITATIONS

Compacted Thickness	Minimum Placement Temperature Air or Surface (Whichever is less) Degrees F(Degrees C)	
	Unmodified mixes	Modified Mixes
	1.5 in. or less (40 mm)	45° F(7° C)
> 1.5 in. (40 mm)	40° F(4° C)	50° F(10° C)

3. Unless otherwise permitted in writing, no bituminous plant mix, with a compacted thickness of 1.5 in. (40 mm) or less, shall be placed between November 30 and April 1; and further, no bituminous plant mix, with a compacted thickness greater than 1.5 in. (40 mm), shall be placed between December 15 and March 16. Where permission is granted to place mix during the above prohibited periods, the temperature requirements in paragraph 2 above shall be increased 10° F(6° C).

407.10-Conditioning of Existing Surface. When bituminous mixes are to be placed upon an existing concrete pavement, with or without a bituminous overlay, all excess bituminous material shall be removed from joints and cracks. Sections of existing pavement that are broken and pumping under traffic shall be removed. Pavement where blowups have occurred at joints or cracks shall be removed to provide a minimum opening of 1 ft. (300 mm) for the full width of the pavement.

When the bituminous mixture is to be placed upon an existing bituminous pavement, any areas containing excess bitumen and any failures in the existing surface and base shall be removed as directed by the Engineer.

The Contractor shall properly adjust all manholes and catch basin frames, associated with the storm sewer system, to the finished grades of the pavement. Unless otherwise specified, such adjustments shall be made without additional compensation. The respective Utility Owner(s) shall properly adjust all utility manholes, utility valve covers and like structures, to the finished grades of the pavement, unless otherwise stipulated by the Plans.

Unsatisfactory subgrade material encountered when existing pavement is removed shall be removed and replaced with approved material. Openings left by the pavement and base removal shall be filled to the full depth of the existing pavement, with the overlay mixture or other approved material, as directed by the Engineer; and compacted in layers not to exceed 3 in. (75 mm) in thickness.

Contact surface of curbing, gutters, manholes, and other structures shall be painted with a thin, uniform coating of bituminous material prior to the mixture being placed against them.

Existing surfaces that are warped and irregular shall be brought to uniform grade and cross section by the use of the leveling mixture specified under **Section 307**, when indicated on the Plans.

407.11-Preparation of Bituminous Material. The bituminous materials for hot mixes shall be heated to the required mixing temperature in accordance with the following **Table B**:

Table B

PG Binder Grade	Minimum Temp.	Maximum Temp.
PG 64-22, PG 67-22	290° F(143° C)	350° F(177° C)
PG 70-22	320° F(160° C)	350° F(177° C)
PG 76-22	320° F(160° C)	350° F(177° C)
PG82-22	325° F(163° C)	350° F(177° C)

The temperature for Grading AS and Grading ACRL mixtures shall be between 225 and 275° F(110 and 135° C), except when modified binders are used, and then the temperatures shall be in accordance with **Subsection 407.11**, Table B, above.

407.12-Preparation of Aggregates. Unless otherwise specified, the aggregate for hot mixes shall be dried and heated so as to produce a completed mix of a uniform temperature in accordance with **Subsection 407.11, Table B**. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate.

On all plants requiring screens, the hot dried aggregate shall be screened into 2 or more fractions as specified. The separated fractions shall then be conveyed into separate compartments ready for batching and mixing with bituminous material.

407.13-Mixing. The dried aggregates shall be combined within the mixer in the amount of each fraction of aggregates required to meet the job mix formula. The bituminous material shall be measured and introduced into the mixer in the amount specified by the job mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, 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. Wet-mixing time shall be determined by the Engineer for each plant and for each type of aggregate used, but in no case shall the wet-mixing time be less than 25 seconds for batch type plants and 40 seconds for continuous mix plants.

The temperature of the completed mixture, (determined at the time it is dumped from the mixer) made with aggregates containing absorbed moisture which causes foaming or boiling in the completed mix shall be not less than 225° F(110° C). The temperature of the mix when it is discharged from the mixer shall not deviate from that shown in **Subsection 407.11, table B.**

The temperature for Grading AS and Grading ACRL mixture shall be between 225 and 275° F(110 and 135° C).

Unless otherwise specified the temperature of all other bituminous pavement mixture shall be as designated in **Subsection 407.11, table B.**

Hot-mixed bituminous mixtures may be placed in surge or storage silos provided that the mixture as used from the silos meets all the specification requirements for the particular mix involved.

When the use of surge or storage silos is permitted, the following additional requirements shall apply:

1. The surge bin or storage silo system shall conform to the requirements of **Subsection 407.04(a) 11.**
2. The storage silos or surge bins shall be emptied when directed by the Engineer in order to check material quantities.
3. Hours of plant operation, whether for storage or direct shipment to the road, shall be limited to reasonable working hours in order that normal inspection of plant operations may be performed.
4. Bituminous mixtures placed in a surge bin must be removed on the same day in which it is stored.
5. Bituminous mixtures Gradings A, AS, ACRL and B may be stored for up to 48 hours and Gradings BM, BM2, C, CS, CW, D, E and F for up to 96 hours in a storage silo provided the following requirements are met:
 - (a) An approved silicone additive shall be added to the asphalt cement for mixes to be stored beyond the day of mixing.
 - (b) The stored bituminous mixture shall be kept sealed at all times during storage.
 - (c) The storage silo shall be filled to at least 90% of capacity.
6. Samples of the stored material will be taken following the period of storage.

7. Material stored will be subject to the temperature, segregation, and laying requirements as required for unstored plant production.
8. Excessive segregation, lumpiness, or stiffness of the mix shall be sufficient cause for rejection by the Engineer.
9. The Surge bins and Storage silos shall be located in a position that enables the top of the truckload to be visible to the load operator during the loading operation.

407.14-Spreading and Finishing. Unless otherwise specified or permitted, bituminous mixtures shall be delivered and spread on the roadway in ample time to secure thorough compaction during daylight hours unless otherwise directed by the Engineer. The temperature of the mixture at the time of depositing in the paver hopper shall be in accordance with **Subsection 407.11, Table B.**

The mixture shall be placed upon an approved surface, spread and struck off to the established line, grade and elevation by means of approved asphalt paving machine(s). Echelon or full-width paving may be permitted where plant production is capable of supplying the paver so that a constant forward speed can be maintained. Alignment of the outside edge of the pavement shall be controlled by preset control string lines. Where multi-course pavements are placed, the longitudinal joint in 1 layer shall offset that in the layer immediately before by approximately 1 ft. (300 mm); however, the joint in the top layer shall be at the center-line of the pavement if the roadway comprises 2 lanes of width, or at lane lines if the roadway is more than 2 lanes in width. The Contractor shall be required to pave in the direction of traffic.

A paving machine shall not be fed from more than 1 asphalt plant. Plant production and paving operations shall be so coordinated that there is constant forward movement of the pavers. Repetitive interruptions or stopping of the paver shall be cause for the Engineer to stop the work until the cause of the stoppage is corrected. If the paver must be stopped for a significant period of time, a joint shall be constructed and the paver moved from the roadway before the bituminous mixture has cooled sufficiently to prevent proper compaction. If the bituminous mixture is permitted to cool to the extent that the required density cannot be obtained, the mixture shall be removed and replaced at the Contractor's expense.

Unevenness of texture, segregation(including end-of-load segregation), as measured by a properly calibrated nuclear gauge, tearing or shoving of bituminous mixture that occurs during the paving operation, shall be reason to stop the paving until the condition is corrected. Unacceptable mix shall be immediately removed and replaced at the Contractor's expense. Excessive throwing back of the bituminous mixture will not be permitted.

Automatic screed controls utilizing either the string line, ski type grade reference system or a non-contact averaging system will be required on all work regardless of the paver width. The string line reference system may be required on new construction. In the event the base has been finished with equipment having automatic grade control or the Contractor demonstrates that an alternate method of spreading and finishing will result in a satisfactory riding surface the Engineer may conditionally waive the

string line requirement and authorize use of the ski type reference system. In any event the Engineer may at any time require the use of a string line reference system, even though it may have previously been waived, if in his opinion, the use of the string line will result in a superior riding surface. When the string line system is required on a multi-course pavement, it shall be used on at least 2 courses exclusive of the surface course. Where the ski type system is used, the ski shall have the maximum practical length and in no case shall it be less than 40 ft. (12 m) in length. Pavement lanes previously placed with automatic controls or to form grade may serve as longitudinal control reference for placing adjacent lanes by utilizing a ski or joint matching shoe.

The string line reference system shall consist of suitable wire or twine supported by approved devices that will be compatible with the type of automatic paver control system used. The string line and supports shall be capable of maintaining the line and grade designated by the Plans at the point of support while withstanding the tensioning necessary to prevent sag in excess of 1/4 in. (6 mm) between supports spaced 50 ft. (15 m) apart. Additional supports shall then be installed to provide a minimum spacing of 25 ft. (8 m), or less as directed by the Engineer, to remove the apparent deviation of the string line from theoretical grade.

The Contractor shall furnish all materials, equipment, labor, and incidentals required to construct the string line reference system as described herein and shall maintain same until its use is no longer required. The cost of erecting and maintaining the string line reference system shall be included in the unit price bid for other items of construction. The string line reference system shall be complete in place at least 300 ft.(100 m) in advance of the point where the pavement is being placed. Automatic screed controls will not be required on sections of projects where service connections and other conditions interfere with their efficient operation.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be taken from the hopper of the spreading machine and shall be distributed immediately into place by means of suitable shovels and other tools and spread with rakes and lutes in a uniformly loose layer of such depth as will result in a completed course having the required thickness.

The Contractor and the Department will each be required to have an individual that is certified by the Department through the HMA Roadway Certification Course.

407.15-Compaction. After the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly compacted. The method employed must be approved by the Engineer and be capable of compacting the mixture to the specified density while it is in a workable condition. When no density requirements are specified, a system of compaction for roadway pavements shall be employed which has previously produced required bituminous pavement densities. A control strip and random density samples may be employed to aid the Engineer in evaluating the system.

In general, compaction shall be accomplished by the use of a combination of the equipment designated in **Subsection 407.07**. The

following are minimum roller requirements; however, the number of rollers shall be increased if the required results are not being obtained.

Except as noted below, each paving train shall consist of a minimum of 3 rollers as specified in **Section 407.07**. The intermediate roller in each train shall be a pneumatic type. If the surface course contains a latex or polymer additive, a steel wheel type roller for intermediate rolling may be used instead of a pneumatic type provided the surface course meets density requirements.

A minimum of 2 rollers will be required when placing 307 CS mix. Breakdown rolling shall be performed, as soon as possible and while the mixture is sufficiently hot, by a pneumatic tire roller having a minimum contact pressure of 85 psi (585 kPa). A combination roller may not be substituted for a pneumatic roller when placing CS mix. The paver speed shall be regulated so rollers can maintain proper compaction of the mixture as determined by the Engineer.

The minimum number of rollers listed above may, with the approval of the Engineer, be reduced to 1 roller of either the steel-wheel or vibratory type on the following types of construction; (a) On shoulder construction, (b) On incidental construction such as bridge approaches, driveways, etc., and (c) on projects containing less than 10,000 s.y. (9,000 m²) of bituminous pavement.

Unless otherwise directed, rolling shall begin at the low side and proceed longitudinally parallel to the road centerline. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. When paving in echelon, rollers shall not compact within 6 in. (150 mm) of an edge where an adjacent lane is to be placed. Rollers shall move in a slow uniform speed with the drive wheels nearer the paver and shall be kept as nearly as possible in continuous operation. Rolling shall continue until all roller marks are eliminated. Rollers shall not park on the bituminous pavement.

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. An excess of liquid shall not be used.

Rollers shall not be refueled on the bituminous pavements.

Density Requirements.

ADT 1,000 or less

MIX TYPE	% OF MAXIMUM THEORETICAL DENSITY (AVERAGE)	NUMBER SINGLE TESTS LESS THAN, %
A	90	87
B, BM & BM2	90	87
C & CW	90	87

D	90	87
E	90	87

ADT 1,000 to 3,000

A	91	89
B, BM & BM2	91	89
C & CW	91	89
D	91	89
E	91	89

ADT 3,000 or greater

A	92	90
B, BM & BM2	92	90
C & CW	92	90
D	92	90
E	92	90

Any ADT

Shoulder Mix (D or E)	88	85
A S and A-CRL	None*	None
CS	None*	None

* Density requirements shall be waived on Bituminous Plant Mix Base Grading ACRL, Grading AS and Bituminous Plant Mix Leveling Course, Grading CS; however, a system of compaction for roadway pavements shall be employed which has been approved by the Engineer. When placing Bituminous Plant Mix Base Grading ACRL and Grading AS, the intermediate roller (pneumatic tire) specified previously may be replaced by a steel wheel type if irreparable damage to the pavement is occurring.

The density(bulk specific gravity) determination for a compacted asphalt mixture shall be performed in accordance with AASHTO T-166, Method A or C.

Any base or surface course that tests below the minimum density shall be corrected until the density of the area is equal to or above minimum before it can be used to determine the average density of the lot. No successive layer, where applicable, shall be placed until the area has been corrected. When it is necessary to determine the classification of open graded or dense graded mixes and to measure segregation, ASSHTO T-269 or ASTM D-3203 shall be used.

For density testing purposes, the pavement shall be divided into lots of 10,000 s.y.(9,000 m²), except for 307 Gradings A, B and BM which shall

be divided into lots of approximately 5,000 s.y.(4,500 m²). Five density tests shall be performed in each lot and the average results compared with the requirements listed above. At the beginning of the project or at any time it is deemed advisable, smaller lots may be considered in order to evaluate compaction methods or for other reasons which are approved and/or directed by the Engineer.

It is intended that acceptance density testing will be accomplished as soon as is practicable. If the average density of the lot does not conform to the requirements stated herein above, or if an individual test value does not meet the requirements stated herein above, the Contractor shall continue his compactive effort until the required density is obtained.

Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be compacted thoroughly with hot hand tampers, smoothing irons, or with mechanical tampers. On depressed areas, a trench roller may be used to compact the mix.

Any defective mixture shall be repaired or replaced to the satisfaction of the Engineer.

Test Strips.

Test Strips shall be required for all A, B, BM, C, CW, D, E and F mixes to establish rolling patterns, to calibrate nuclear gauges, to verify that the base course or surface course meets the density requirements of the specifications, and for mix design/ production verification as required.

Construction of the test strip shall be as follows:

1. The base course or other pavement course upon which a test strip is constructed shall have been approved by the Engineer prior to the construction of the test strip.
2. Equipment proposed for use in the compaction of test strips, shall meet the requirements set forth in this subsection and **Subsection 407.07**.

The test strip shall be constructed at the beginning of work on the pavement course. New test strips shall be required when:

1. a change in the job mix formula is necessary
2. a change in the source of materials occurs
3. a change in the material from the same source is observed
4. There is reason to believe that the test strip density is not representative of the bituminous mixture being placed.

With the approval of the Engineer, the Contractor may be permitted to construct additional test strips.

Each test strip shall be constructed with approved bituminous mixture and shall remain in place as a section of the completed work. Each test strip shall be 1 paver width wide and have an area of at least 400 s.y. (350 m²) and shall be of the depth specified for the pavement course concerned.

Compaction of the test strip shall commence immediately after placement of the bituminous mixture and be continuous and uniform over the entire test strip.

The compaction of the test strip shall be continued until no appreciable increase in density (1 lb/c.f. (15 kgs/m³)) as measured with the nuclear gauge can be obtained by additional roller coverage. The roller coverage necessary to obtain this maximum density shall be used as the rolling pattern for the remainder of the project. Cores shall be taken by the Contractor on the test strip at 10 randomly selected locations. Cores shall not be taken within 2 feet of the longitudinal edges for calibration or determining average densities. These cores shall be given to the State for use in calibrating the nuclear gauge and to verify that the average density of the test strip meets the density requirements of the specifications. All densities will be reported using the corrected nuclear gauge readings.

In the event the density of the asphaltic concrete in the test strip does not meet specification requirements, the Contractor shall make whatever changes are necessary to obtain the specified density. Other sources and combinations of aggregates shall be used as required, subject to approval of the Engineer, to produce a mix meeting the required density.

407.16-Joints. Placing of the bituminous paving 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. A brush coat of bituminous material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

407.17-Pavement Samples. When directed, the Contractor shall cut samples from the compacted pavement for testing by the Engineer. Samples of the mixture shall be taken for the full depth of the course at locations selected by the Engineer. The samples shall be cut with a power saw or core drill and shall have a top surface area of at least 10 in²(65 cm²).

Holes formed by taking samples shall be filled with the same type mixture that was used to construct the course sampled, and compacted to conform to the surrounding pavement. Cutting samples and repairing sample holes shall be at the Contractor's expense.

407.18-Surface Requirements. The surface shall be tested with a 12 ft. (3.6 m) straightedge applied parallel to the centerline of the pavement. The deviation of the surface from the testing edge of the straightedge shall not exceed that specified for the respective types of bituminous construction under the applicable Subsections of these Specifications.

The transverse slopes of tilted pavements shall be tested with a string-line and string-level applied at right angles to the centerline of the pavement, and the per cent of slope, when computed for the full width of the pavement, shall not deviate more than 0.5 percentage points from that specified on the Plans.

The crown in crowned pavements shall be tested with a string-line applied at right angles to the centerline of the pavement and the crown shall not deviate more than 1/2 in. (13 mm) from that specified on the Plans.

Deviations greater than the specified tolerances shall be corrected by methods best suited for the purpose. Pavement that cannot be corrected to comply with the specified tolerances shall be removed and replaced at the Contractor's expense.

COMPENSATION

407.19-Method of Measurement. Chemical additives or modifiers, when required, will not be measured for payment, but will be considered as part of the asphalt cement.

Mineral filler will not be measured separately for payment, but will be included in mineral aggregates.

Asphalt cement and mineral aggregate, including mineral filler when required, will be measured by the ton(metric ton).

Where the mix is loaded from a storage or surge bin, the quantities will be determined by weighing the completed mix on truck scales meeting the requirements of **Section 109** and calculating the weight of asphalt cement and mineral aggregate based on the percentages measured into the mix by the appropriate scales or meters described in **Subsection 407.04**.

Where the mix is loaded directly into the hauling equipment from a batch plant, asphalt cement and mineral aggregate will be measured in batch quantities by scales or scales and meters as described in **Subsection 407.04(b)**.

Where a continuous mix plant is used, Bituminous Material for Bituminous Plant Mix Pavement will be measured by the ton(metric ton) in accordance with the provisions of **Section 109**, Measurement and Payment. The Mineral Aggregate, including Mineral Filler when required will be determined by weighing the bituminous pavement mixture on truck scales meeting the requirements of **Section 109**, and deducting the weight of the bituminous material from the weight of total mixture accepted.

When the work described under **Subsection 407.10** is required, the removal and disposal of existing surface(concrete) will be measured by the yards.y. (m^2) in accordance with the provisions of **Section 109**, Measurement and Payment. Such measurement shall include the removal of bituminous overlay.

The Removal and Disposal of Existing Surface (Bituminous) will be measured by the s.y. (m^3) in accordance with the provisions of **Section 109**, Measurement and Payment. Such measurement shall include the removal of base material, except concrete, as directed by the Engineer.

Removal of unsatisfactory subgrade material where existing pavement has been removed will be measured by the c.y.(m^3) in accordance with the provisions of **Subsection 203.09**. Material used to replace such undercutting will be measured and paid for in accordance with the specification for the type of material used.

Bituminous mixtures used to fill openings left by pavement removal will be measured for payment in accordance with the provisions of this **Subsection 407.19**. Base materials used to fill openings left by base

removal will be measured as provided for in the respective Sections for each type specified.

Adjustment of catch basin grates and frames, water valve boxes, gas valve boxes and manhole covers and frames shall be measured per each when required.

407.20-Basis of Payment.

A. General:

All work performed and measured as prescribed above will be paid for as provided in the respective sections for each type specified.

B. Acceptance of the Mixture:

1. General:

The bituminous mixture will be accepted at the plant with respect to gradation and asphalt content, on a LOT basis. The material will be tested for acceptance in accordance with the provisions of **Subsection 407.03(D)** and the following requirements. However, any load or loads of mixture which, in the opinion of the Engineer, are unacceptable for reason of being excessively segregated, aggregates improperly coated, or of excessively high or low temperature shall be rejected for use in the work.

A standard size LOT at the asphalt plant shall consist of a day's production. The number of sublots in a LOT will vary from n=1 to n=4 according to the following:

Quantity	Number of Sublots
3,001-4,000 tons(metric tons)	4
2,001-3,000 tons(metric tons)	3
1,001-2,000 tons(metric tons)	2
less than 1,001 ton(metric tons)	1

When the total plan quantity of any mix is less than 1,000 tons(metric tons), the Department will accept the mix on the basis of visual inspection and Contractor Quality Control certification. The Department may run extraction, gradation analysis, or other tests deemed necessary for acceptance purposes.

2. Defective Materials:

- (a) Acceptance or Rejection. Following the application of the appropriate acceptance plan, the decision of the Engineer shall be final as to the acceptance, rejection, or acceptance at an adjusted payment of the LOTs.
- (b) Disposition of LOTs. Nonconforming LOTs of materials, products, or complete construction that are not adaptable to correction by reworking shall be removed and replaced at the Contractor's expense or accepted at an adjusted payment as

stated in these Specifications, or if not stated, as directed by the Engineer.

When a deficiency is determined, the applicable payment as shown in these Specifications will be applied to the entire LOT. When multiple deficiencies occur, the applicable partial payments will be applied to the LOT of material that is identified by each deficiency. The payment adjustment for each deficiency will be applied separately and will not be affected by any other payment adjustment occurring for the same LOT except that when there are 2 or more deficiencies in the gradation acceptance tests, only the greater payment adjustment will be applied. When an area or linear measurement is used to specify lot size, the equivalent tons(metric tons) of mix placed in each lot shall be determined by using the average calculated spread from the plant inspector's daily report for that days production.

3. Acceptance of the mixture shall be on the basis of test results on consecutive random samples from each LOT. One random sample shall be taken from each subplot. The bituminous mixture will be sampled at the plant in accordance with AASHTO T-168. The percent bitumen content of the mixture will be determined in accordance with AASHTO T-164 or by AASHTO T-308 except as herein revised.

The Contractor may, at his option, use an approved ignition furnace in lieu of a vacuum extractor for the use in determining asphalt content and gradation. The method of calibration and test procedures shall be in compliance with AASHTO T-308 with the following provisions:

- (a.) Only AASHTO T-308 Method A shall be used.
 (b.) When calculating the washed gradation of the aggregate by AASHTO T-30, the total aggregate mass used shall be the total of the recovered aggregate after ignition and the amount of aggregate lost in the furnace. Use the following formula:

$\text{Total Aggr. Mass} = \frac{\text{Recovered Original Mass}}{\text{Mass}} + \frac{\text{Mix Sample Mass} \times \text{Calib. Factor}}{100}$

- (c.) When using a mixture containing RAP, assume a zero correction factor for the RAP. Burn off a minimum of 3 samples of RAP to determine the binder content of the RAP. Blend the virgin aggregate with the RAP, and then add the virgin AC to the prescribed mass for the required AC Content. Calculate the calibration factor by subtracting the known AC

Content of the mixture from the measured AC Content on the furnace ticket.

At least once per week, per mixture, during production, the correction factor shall be checked with a sample of the aggregate mixture proportions, blended at the optimum asphalt content. The correction factor shall be adjusted accordingly. The contractor shall keep records of all correction factors for all mixtures. Adjusted payment for asphalt content and gradation will be based on the ignition furnace results in accordance with **Subsection 407.20(Table 407-2)**. It is understood that use of this alternative equipment will be at no additional cost to the Department.

The percents passing the sieves will be determined in accordance with AASHTO T-30.

TABLE 407-2

ACCEPTANCE SCHEDULE OF PAYMENT
(Asphalt Plant Mix Characteristics)

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the Job Mix Formula	
		1 Test	2 Tests or more
Asphalt Cement	1.00	0.00-0.40	0.00-0.35
Content ***	0.95	0.41-0.46	0.36-0.40
(Extraction or	0.90	0.47-0.52	0.41-0.45
ignition oven)	0.80*	over 0.52	over 0.45
Gradation			
3/8 In.	1.00	0.00-6.50	0.00-5.70
(9.5 mm),	0.95	6.51-7.08	5.71-6.20
Sieve and	0.90	7.09-7.66	6.21-6.69
Larger	0.80*	over 7.66	over 6.69
Gradation			
No. 4 Sieve**	1.00	0.00-4.62	0.00-4.00
(4.75 mm)	0.95	4.63-5.20	4.01-4.50
	0.90	5.21-5.77	4.51-5.00
	0.80*	over 5.77	over 5.00
Gradation			
No. 8 16, 30 & 50	1.00	0.00-3.80	0.00-3.30
(2.36 mm, 600 µm	0.95	3.81-4.46	3.31-3.91
& 300 µm ,) Svs**	0.90	4.47-5.12	3.92-4.52
	0.80*	over 5.12	over 4.52

Gradation			
No. 100 & 200	1.00	0.00-1.80	0.00-1.60
(150 µm & 75 µm)	0.90	2.01-2.20	1.76-1.90
Sieves**	0.95	1.81-2.00	1.61-1.75
	0.80*	over 2.20	over 1.90

*If approved by the Engineer, the Contractor may accept the indicated partial pay. The Department may require removal and replacement at no cost. The Contractor has the option to remove and replace at no cost to the Department at any time.

**When there is more than 1 reduced payment relating to gradation in 1 LOT of material, only the greatest reduction in payment will be applied. Reductions applicable for any other reason will be cumulative.

***Does not apply to 307 Grading A, AS, or ACRL mixes.

Deduction for both asphalt content and gradation deficiencies shall be cumulative. The deduction shall be applied to the total price of the mix (asphalt cement and aggregate combined) and shall be made under the item for Asphalt Cement Content and Gradation Deduction.

4. Additional Tests:

The Engineer may perform any test at any time to determine the effectiveness of the Contractor's quality control.

5. Acceptance for Mix Density on the Roadway:

A deduction in payment, not as a penalty but as liquidated damages, shall be made for failure to meet the density requirements as outlined in **Subsection 407.15**. As soon as practical after the final rolling is completed on each lot, 5 density tests shall be performed by the Department at locations determined by the Engineer, and an average of all such tests shall be computed. Any deduction for failure to meet density requirements shall be computed to the nearest 0.1% as a percentage of the total payment otherwise due for each lot. The percent of total payment to be deducted shall be 5 times the percent the average in-place density for each lot that fails to meet the requirements of **Subsection 407.15**. Any deduction in monies due the Contractor for failure to meet the Density Requirements shall be made under the item for Density Deduction.

410

**SECTION 410-BITUMINOUS PLANT MIX
SURFACE COURSE (COLD MIX)**

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**SECTION 410-BITUMINOUS PLANT MIX
SURFACE COURSE (COLD MIX)**

410.01-Description. This work shall consist of a Bituminous Plant-Mix Surface Course (Cold Mix) composed of aggregate and bituminous material. It shall be constructed on a designated base in 1 or more layers, in accordance with these Specifications and in reasonably close conformity with the lines, grades, typical cross section and rate of application shown on the Plans, or established by the Engineer.

MATERIALS

410.02-Materials. Materials used in this construction shall meet the requirements of the following Subsections of these Specifications:

<u>Materials</u>	<u>Subsection</u>
Mineral Aggregate	903.10
Emulsified Asphalt, Grade AE-3	904.03

The mineral aggregate will be accepted for gradation in the stockpile at the paving plant site. The bituminous material may be conditionally accepted at the source. The plant mixed material will be accepted after being spread on the road.

410.03-Composition of Mixtures. The specified material aggregate and bituminous material shall be combined in such proportions as to produce mixtures within the following master composition limits:

Proportions of Total Mixture, Per Cent by Weight

Mineral Aggregate	93.0-95.0%
Emulsified Asphalt	5.0-7.0%

EQUIPMENT

410.04-Equipment. All equipment necessary for the satisfactory performance of this construction shall be on hand and approved before work will be permitted to begin.

The equipment shall meet the applicable requirements of **Subsection 407.04** with the following modifications:

Automatic screed control devices will not be required on the bituminous pavers.

Plant equipment required for heating or drying materials and for blending different size aggregates will not be required.

CONSTRUCTION REQUIREMENTS

410.05-Limitations. Limitations shall be in accordance with the provisions of **Subsection 407.09**.

410.06-Preparing Designated Surface. Preparation of the designated surface upon which the material is to be placed shall be performed in accordance with the applicable provisions of **Subsection 404.05**.

410.07-Mixing. Mixing shall be performed in accordance with the provisions of **Subsection 407.13**. The mix may be stockpiled for a period of time or may be hauled directly from the mixer to the road. If stockpiled, the material shall show no damage from weather, nor any sign of stripping during handling.

410.08-Spreading and Finishing. Spreading and finishing and spreading choker aggregate shall be performed in accordance with the provisions of **Subsection 308.10**.

410.09-Compaction. The requirements of **Subsection 407.15** shall apply to this construction.

410.10-Surface Requirements. The surface shall meet the requirements specified under **Subsection 407.18**, and when tested in accordance with the provisions of that Subsection, the deviation of the surface from the testing edge of the straightedge shall not exceed 1/4 in. (6 mm).

410.11-Maintenance. Maintenance shall be performed as prescribed in **Subsection 404.09**.

COMPENSATION

410.12-Method of Measurement. Mineral Aggregate and Emulsified Asphalt for Bituminous Plant Mix Surface Course(Cold Mix) will be measured as prescribed in **Subsection 407.19**.

410.13-Basis of Payment. The accepted quantities of Bituminous Plant Mix Surface Course(Cold Mix) will be paid for at the respective contract unit prices per ton(metric ton) for Mineral Aggregate (Including Choker) and Emulsified Asphalt. The work required for preparing the designated surface as provided for under **Subsection 410.06** will be measured and paid for in accordance with the provisions of the applicable Section or Subsection under which the work is performed.

**SECTION 411-ASPHALTIC CONCRETE SURFACE
(HOT MIX)**

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SECTION 411-ASPHALTIC CONCRETE SURFACE (HOT MIX)

411.01-Description. This work shall consist of an asphaltic concrete pavement composed of a mixture of coarse aggregate, fine aggregate, mineral filler if specified or required, and asphalt cement, constructed on a prepared roadbed in accordance with these Specifications and in reasonably close conformity with the lines, grades, typical cross section and rate of application shown on the Plans, or established by the Engineer.

The provisions of **Section 407** of these Specifications shall apply to this construction unless otherwise stipulated.

MATERIALS

411.02-Materials. Materials used in this construction shall meet the requirements of the following Subsections of these Specifications:

<u>Material</u>	<u>Subsection</u>
Mineral Aggregate	903.11
Asphalt Cement, PG 64-22, 70-22, 76-22 or 82-22	904.01
Mineral Filler	903.16
Chemical Additive	918.09(B)

The mineral aggregate, bituminous material and plant mix will be accepted as provided for in **Subsection 407.02**.

411.03-Composition of Mixtures.

- (a) General Composition of mixtures used in this construction shall meet all applicable requirements of **Subsection 407.03**.
- (b) The specified mineral aggregate and asphalt cement shall be combined in such proportions as to produce mixtures within the following master composition limits.

Proportions of Total Mixture, Per Cent by Weight

Surface Courses	Effective Combined Mineral Aggregate	Asphalt Cement
Grading D	93.0-94.7	5.3-7.0*
Grading E	93.0-94.7	5.3-7.0*
Grading E (shoulders)	92.0-94.7	5.3-8.0*

*If the effective combined specific gravity of the aggregate exceeds 2.80, the above proportions may be adjusted as directed by the Engineer. The upper limit for Flow values shall not apply to mixes with modified asphalt liquids.

Grading D

In addition to the other requirements of these specifications the composition of the mineral aggregate shall be such that when combined with the required amount of bitumen the resultant mixture shall have:

All Roads

Mix	Stabil. Min. lbft* (kN)	Flow 0.01 in. (mm) ***	Design Void content %*	Productio n Void Content %*	Min. VMA %*	Dust- Asphalt Ratio**
411D	2,000 (9.0)	8-16 (2-4)	4.0±0.2	3-5.5	14	0.6-1.2

*Tested in accordance with AASHTO T 245 with 75 blows of the hammer on each side of the test specimen, using a Marshall Mechanical Compactor.

**The dust to asphalt ratio is the percent of the total aggregate sample that passes the 200 mesh(75 µm) sieve as determined by AASHTO T 11 divided by the percent asphalt in the total mix

***Flow will only be required when using a non-modified binder (PG 64-22 or 67-22)

****In order to identify critical mixes and make appropriate adjustments, the mix design shall have these required design properties for the bitumen content range of Optimum Asphalt Cement ±0.25%.

The addition of limestone screenings or agricultural limestone in a maximum amount of 25% by weight of the mineral aggregate may be required to comply with this section. When crushed stone screenings meeting the requirements of **Subsection 903.11 (c)** are used, all additional fines shall be natural or manufactured sand. When natural sand is used as fine aggregate, it shall be limited to a maximum amount of 25% by weight of the mineral aggregate. A maximum of 5% mineral filler meeting the requirements of **Subsection 903.16** may be substituted for an equal quantity of the limestone fines. If the mixture does not comply with the design criteria, another source of aggregate shall be required.

When gravel is used as the coarse aggregate for a 411 Grading D mix, a minimum of 20% by weight limestone screenings, agricultural limestone and/or mineral filler shall be required.

Grading E

In addition to the other requirements of these specifications where Grading E is used for the riding surface the composition of the mineral aggregate shall be such that when combined with the required amount of bitumen the resultant mixture shall have:

High Volume Roads (ADT over 1,000)

Mix	Stability Min. lbft* (kN)	Flow 0.01in. (mm) **	Design Void content %*	Production Void Content %*	Min. % VMA*
411E	2,000 (9.0)	8-16 (2-4)	4.0±0.2	3-5.5	14

Low Volume Roads (ADT 1,000 and below) and shoulders

Mix	Stability Min. lbft* (kN)	Flow 0.01in. (mm)**	Design Void content%*	Production Void Content %*
411E	1,500 (6.75)	8-16 (2-4)	3.5±0.5	2-5

*Tested in accordance with AASHTO T 245 with 75 blows of the hammer on each side of the test specimen, using a Marshall Mechanical Compactor.

**Flow will only be required when using a non-modified binder (PG 64-22 or 67-22)

If the design criteria above cannot be obtained with the aggregate, submitted to the laboratory for design, another source of aggregate will be necessary.

(c) Recycled Asphalt Pavement

The Contractor may utilize asphalt pavement that has been removed from a Department project or other State Highway Agency project by cold planing or other approved means in combination with appropriate aggregate, asphalt cement and anti-stripping additive if required, to produce a mixture which will otherwise meet all the requirements of **Subsection 903.11** and the requirements herein **Section 411**. RAP shall be allowed in each mix listed in the following table:

Mix Type**	%RAP (Non-processed)**	%RAP (Processed)*	Maximum Particle size
411D(PG64-22, PG67-22)	0	15	½ in. (12.5 mm)
411D(PG70-22)	0	10	½ in. (12.5 mm)
411D(PG76-22, PG82-22)	0	10	½ in. (12.5 mm)
411E(Roadway)	0	25	½ in. (12.5 mm)
411E(Shoulder)	15	25	½ in. (12.5 mm)

*RAP that has been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that listed in the table above prior to entering the dryer drum, shall qualify as "Processed". "Non processed" RAP shall be similar material that has not been crushed and screened or otherwise sized previous to its use.

**All mixes shall contain at least 80% virgin asphalt except for 411E Shoulder Mix which shall have at least 65% virgin asphalt.

The grade of asphalt cement shall be as shown on the plans. The mixture will be accepted for aggregate gradation and asphalt content based on extractions or AASHTO T 308.

The Contractor will be responsible for his own sampling and testing of the RAP as well as new materials for bid purposes, and for the submission of the job mix formula in accordance with **Subsection 407.03**. After mixing, the moisture content of the total mix shall be no more than 0.1% as determined by oven drying, and the provisions for lowering the temperature because of boiling or foaming shall not apply.

The stockpile gradation tolerance for all recycled material on each sieve is listed below.

3/8in. (9.50 mm) sieve and larger± 10%
 No. 4(4.75 mm) sieve.....± 8%
 No. 8(2.36 mm) sieve.....± 6%
 No. 30(600 µm) sieve.....± 5%
 No. 200(75 µm) sieve.....± 4%

The mixture will be accepted for aggregate gradation and asphalt content based on extractions or in accordance with AASHTO T 308

- (d) Anti-Strip Additive - Asphaltic concrete surface mixtures (Grading D & E) shall be checked for stripping by the Ten Minute Boil test for dosage rate and ASTM D 4867 (Root-Tunnecliff procedure) for moisture susceptibility.

If moisture susceptibility is indicated, then an approved anti-strip agent shall be mixed with the asphalt cement at the dosage recommended by the respective test and as specified in **Subsection 918.09(B)**.

EQUIPMENT

411.04-Equipment. The equipment used in this construction shall meet the requirements of **Subsection 407.04** through **407.08**. All equipment necessary for the satisfactory performance of this construction shall be on the project, and approved, before work will be permitted to begin.

The equipment for the construction of shoulder mixes with recycled material shall comply with **Section 407**, except that the asphalt plant shall be modified as approved by the Engineer to accommodate the asphalt plantings which are to be added. If a batch plant is used to produce recycled mix, the aggregate shall be heated to a temperature that will transfer sufficient heat to the cold plantings to produce a mix of uniform temperature within the specified range.

CONSTRUCTION REQUIREMENTS

411.05-General Requirements. The construction requirements for this work shall be as prescribed in **Subsections 407.09, 407.11, 407.12, and 407.14** through **407.17** and the following Subsections.

411.06-Preparing the Designated Surface. Preparation of the designated surface upon which the material is to be placed shall be performed in accordance with the applicable provisions of **Subsection 404.05** of these Specifications.

Loops used for traffic signals shall be installed before the final surface is applied.

411.07-Mixing. Requirements for mixing shall be as prescribed in **Subsection 407.13**. In addition, the mixing cycle for surface course mixtures may require a dry-mixing period.

411.08-Surface Requirements. The surface shall meet the requirements specified under **Subsection 407.18**, and when tested in accordance with the provisions of that Subsection, the deviation of the surface from the testing edge of the straightedge shall not exceed 1/4 in. (6 mm).

COMPENSATION

411.09-Method of Measurement. Mineral Aggregate including Mineral Filler when required, and Asphalt Cement for Asphaltic Concrete Surface (Hot Mix) will be measured as prescribed in **Subsection 407.19**. Mineral Filler when required will not be measured for payment separately, but will be included as mineral aggregate.

If recycled mix is permitted, the completed mix, including new mineral aggregate, planings, asphalt cement and additive, shall be measured by the ton (tonne) in accordance with **Section 109**. For bidding purposes, the asphalt cement content of the specified mix shall be used in the chart below:

Mix Type	Asphalt Content
411-D	5.9%
411-E Roadway	6.3%
411-E Shoulder	6.3%

In the event that the Engineer sets an asphalt content other than that stated above, a price adjustment will be made based on the asphalt content set by the Engineer and the invoice price of the asphalt cement F.O.B. the asphalt plant. The price adjustment will be calculated according to the following formula:

$$PA = [IP \times (DA - BA) \times T] / 100$$

Where:

PA = Price Adjustment

IP = Invoice price of asphalt cement

DA = Percent asphalt set on the mix design

BA = Percent asphalt specified above to be used for bidding

T = Total tons(metric tons) asphalt mix for price adjustment

The liquid anti-strip additive will be measured by the gallon(liter) and paid as outlined in **Subsection 411.10**. Hydrated Lime will be measured by the ton(metric ton) and paid as outlined in **Subsection 411.10**.

No direct payment will be made for polymer or latex additives and cost thereof shall be included in the price bid for the modified asphalt cement or modified mixture.

411.10-Basis of Payment. The accepted quantities of Asphaltic Concrete Surface (Hot Mix) or asphaltic Concrete Surface(Hot Mix) (Shoulders) with or without recycled material, complete in place, will be paid for at the contract unit price per ton(metric ton) of the total mix, which will include mineral aggregate, planings, asphalt cement and additives except anti-striping agent. Payment will be made to the Contractor for additional asphalt cement as provided for above at the purchase price F.O.B. the asphalt mixing plant, as verified by invoice, and no

compensation will be allowed for further handling or processing. The Department will be reimbursed from monies due the Contractor for a decrease in asphalt cement content in the amount equal to the purchase price F.O.B. the asphalt plant.

The liquid anti-strip additive will be paid for based on certified invoices of material cost not to exceed \$15 per gallon(\$4 per liter). Hydrated Lime anti-strip additive will be paid for based on certified invoices of material cost not to exceed \$90 per ton(\$100 per metric ton). This payment shall be full compensation for all labor, materials, equipment and other incidentals incurred in utilizing the anti-strip additive.

In cases where the effective combined specific gravity of the mineral aggregate exceeds 2.80, the tonnage of mineral aggregate, or plant produced mixture, will be adjusted for payment by multiplying the tonnage of mineral aggregate, or plant produced mixture, used by a specific gravity of 2.80 and dividing by the higher specific gravity.

The work required to prepare the designated surface as provided for under **Subsection 411.06** will be measured and paid for in accordance with the provisions of the applicable Sections or Subsections under which the work is performed.

When the approved job mix formula includes a mixture of limestone with gravel, granite, slag, quartzite or gneiss, tests for the percent loss on ignition of the limestone aggregate in the asphalt paving mix shall be performed according to the provisions of **Subsection 407.03**.

In the event the percent of loss on ignition in the aggregate differs by more than $\pm 2\%$ from the loss on ignition indicated in the job mix formula, a deduction in payment in the price bid for the mix shall be made, not as a penalty but as liquidated damages. The percent of total payment to be deducted shall be 5 times the percent that the loss on ignition exceeds the job mix formula tolerance of $\pm 2\%$.

All mix produced with aggregate tested and found to have a loss on ignition that differs more than $\pm 6\%$ from the loss on ignition indicated in the job mix formula shall be replaced or overlaid at the expense of the Contractor.

For the purpose of determining the deduction, lots of approximately 5,000s.y.(4,500 m²) will be used. The sampling and testing to establish the loss on ignition will be performed in accordance with the Department's sampling and testing procedures. In event the initial tests indicates a variation in the loss on ignition of greater than $\pm 2\%$ than the value shown on the mix design, the additional sampling necessary to establish the loss on ignition of the aggregate in each lot shall be performed by the Contractor with the cost of the sampling being included in the contract unit prices bid for the paving items.

Any deduction for excess variation in loss on ignition shall be made under the item for material variation(deduction).

**SECTION 414-EMULSIFIED ASPHALT
SLURRY SEAL AND MICRO-SURFACING**

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SECTION 414-EMULSIFIED ASPHALT SLURRY SEAL AND MICRO-SURFACING

414.01-Description. The work covered by this specification includes the design, testing, construction, and quality control required for the proper application of an emulsified asphalt slurry seal surface(slurry seal) or micro-surface.

The slurry seal or micro-surface shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, water and specified additives or modifiers, properly proportioned, mixed and uniformly spread over a properly prepared surface as specified herein and as directed, and in accordance with these specifications. The cured slurry or micro-surface shall have a homogeneous appearance, and adhere firmly to the surface.

MATERIALS

414.02-Materials. Materials in this construction shall meet the requirements of the following Subsections of these Specifications:

<u>Material</u>	<u>Subsection</u>
Mineral Aggregate (Slurry Seal)	903.12(a)
Mineral Aggregate (Micro-Surface)	903.12(b)
Mineral Filler (Portland Cement)	901.01
Water	918.01
Emulsified Asphalt	904.03

The emulsified asphalt for a Slurry Seal shall be Type CQS-1h and the emulsified asphalt for micro-surfacing shall be CQS-1h-p.

414.03-Composition of Mixture. At least 2 weeks prior to beginning work the Contractor shall submit a signed original of a mix design covering the specific materials to be used on the project to the Materials and Tests Division for acceptance together with representative samples of each ingredient to be used in the mixture. The samples should contain information relative to sources, type of materials and project number.

This design must have been performed by a qualified laboratory. Once the materials are approved, no substitution will be permitted unless first tested and approved by the laboratory preparing the mix design. No work shall begin nor will any mixture be accepted until the Materials and Tests Division has evaluated and accepted the mix design.

The laboratory report will show the results of tests performed on individual materials, comparing their values to those required by this specification. Job aggregates will be used in all laboratory design tests. Mixing tests must pass at the maximum expected air temperature in ISSA T115, compatibility.

Slurry Seal. The laboratory report will provide the following information on the slurry seal mixture.

Quick-Set Emulsified Asphalt Slurry Seal

Mixing Time Test, seconds @ 77° F(25° C) (TB #102),	120 minimum
Mix Time @ (50° and 100° F) (10° and 37.7° C)	(informational)
Set Time Tests	
30-Minutes-Blotter Test (TB #102) Displacement Test	no brown stain no displacement
Water Resistance Test @ 30 minutes (TB #102)	no discoloration
Wet Stripping Test, % coating (TB #114)	90% minimum
System Compatibility (TB #115)	Pass
Set Time Tests: 30 minutes (TB #139)	12 kg-cm minimum
Early Rolling Traffic Time: 2 hours (TB #139)	20 kg-cm minimum
Wet Track Abrasion Test, loss in grams psf(m ²) (TB #100)	800(75) maximum

In addition to the tests specified above, the following test will be required on roadways having greater than 1500 ADT.

ISSA T #109	Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester and Sand Adhesion
1,500-3,000 ADT	Maximum 55grams/psf (590g/m ²) sand adhesion, 1,000 cycles @ 125 lbs. (57 kgs).
3,000+ ADT	Maximum 50grams/psf (540g/m ²) sand adhesion, 1,000 cycles @ 125 lbs.(57 kgs).

Slurry Seal Composition. Emulsified asphalt slurry seal shall be a uniform mixture of aggregate, emulsified asphalt, latex solids when specified on the Plans, mineral filler and water. Compatibility of all ingredients (including the mix set additive) of the mix shall be certified by the emulsified asphalt manufacturer.

The percent of residual asphalt based on the weight of the dry aggregate shall be between 7.5 and 13.5 with a mixture control tolerance of ±0.50%.

The aggregate gradation and percent residual asphalt, as provided in the slurry seal design accepted by the Engineer, shall be maintained within the mixture control tolerances stated herein.

Portland cement may be added to obtain the desired dispersion and working characteristics of the slurry. Such addition shall be stated on the slurry seal design, shall not exceed 3% of the weight of the aggregate, and shall have a mixture control tolerance of $\pm 0.25\%$.

Portland cement added for dispersion of the slurry seal shall be a commercial quality, non-air entraining cement and shall not be considered as mineral filler for the purpose of satisfying the gradation requirements of the aggregate.

The aggregate shall be prewetted with a minimum amount of water prior to blending with the emulsified asphalt to obtain a fluid, homogeneous slurry mixture of the proper consistency. No additional water above that quantity required by the slurry seal mix design shall be added to the slurry mix in order to obtain a more workable mixture.

Micro Surfacing. The laboratory report will provide the following information on the micro-surface mixture.

Mixing Time Test, secs @ 77° F (25° C), (T-102)	60 minimum*
Mix Time @ 50 and 100° F (10° C and 37.7° C)	(informational)
Set Time Tests: 30 minutes (T-139)	12 kg-cm minimum
Early Rolling Traffic Time: 60 minutes (T-139)	20 kg-cm minimum
Wet Stripping Test, % coating (T-114)	90% minimum
Wet Track Abrasion Test, loss in grams psf(m ²) (T-100)	75 (800) max 6 days 50 (538) max. 1 hour
Measurement of Excess Asphalt (T-109)	Max. 50 grams/ft ² (540 grams/m ²) Sand Adhesion, 1,000 Cycles @ 125 lbs. (57 kgs).
Classification Compatibility (T-144)	max. 3 gram loss

*For double shafted, multi-bladed mixers and fully agitated spreaders. Conventional mixing and spreading equipment requires 90 to 120 seconds.

Micro-Surface Composition. For the paving mixture, the design shall verify the functioning of the set regulating additives and shall present certified test results for the Engineer's approval. Aggregate in the mixture shall represent material to be used on the project.

The Engineer shall approve the design prior to use. Proportions for the design shall be within the following limits:

Modified Emulsified Asphalt Residue by Dry Wt. of Aggregates	5.0-9.0%
Mineral Additive by Dry Weight of Aggregate	0.5%-3.0%
Latex or Polymer Based Modifier	3% minimum and as required to provide the specified properties
Mix Set Additive	As required to provide the specified properties
Water	As required to produce consistency

The mixture shall also be proportioned such that the test strip requirements in **Subsection 414.06** are achieved.

Applicable Specifications. The following specifications and test methods form a part of this specification.

Title	Source
Mixing, Setting and Water Resistance Test to Identify "Quick-Set" Emulsified Asphalts	ISSA T-102
Wet Track Abrasion of Micro Seals	ISSA T-100
Guide for Sampling Micro Mix for Extraction Test	ISSA T-101
Measurement of Micro-Seal Consistency	ISSA T-106
Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester	ISSA T-109
Outline Guide Design Procedure for Micro-Seal	ISSA T-111
Method to Estimate Micro-Seal Spread Rates and to Measure Pavement Macrotecture	ISSA T-112
Trial Mix Procedure for Micro-Seal Design	ISSA T-113
Wet Stripping Test for Cured Micro-Seal Mixes	ISSA T-114
Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by	

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Modified Cohesion Tester. Measurement of Set and Cure Characteristics	ISSA T-139
Classification Compatibility	ISSA T-144
Design, Testing and Construction of Micro-Seal	ASTM D 3910
Quantitative Extraction of Bitumen for Bituminous Paving Mixtures	ASTM D 2172

EQUIPMENT

414.04-Equipment. All equipment necessary for the satisfactory performance of this work shall be on hand and approved before the work is permitted to begin. All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working condition. The Contractor shall have available at all times a device capable of determining aggregate moisture within 3 minutes.

All trucks shall be covered immediately after loading with a cover of canvas or other suitable material. The cover shall lap down along the sides and rear of the truck bed a minimum of 6 in. (150 mm) and be secured by tie downs at a maximum of 5 ft. (1.5 m) spacing along the sides and rear of the truck bed. All trucks must be equipped to meet the above requirements prior to commencing hauling operations.

Power brooms, power blowers, air compressors, water flushing equipment and hand brooms shall be capable of thoroughly cleaning all cracks and the old surface. Hand squeegees, hand brooms, shovels and other incidental equipment shall be provided as necessary to perform work.

Mixing Equipment. The mixing equipment shall be re-supplied with all materials while depositing the mixture on the roadway in order provide a continuous, non-stop surfacing operation. The paving mixture shall be produced in a self-propelled, front feed, continuous loading, mixing machine equipped with a positive, non-slipping aggregate delivery system and an interconnected, positive displacement water-jacketed gear pump to accurately proportion ingredients.

The mixing machine shall be equipped with an approved fines feeder that has an accurate metering device or method to introduce a predetermined amount of mineral filler into the mixer at the same time and location as the mineral aggregate. A spray bar shall be provided to completely wet the aggregate dropping down to the pug mill with additive and water. The twin-shafted multi-blade pug mill shall be a continuous flow type and a minimum of 50 in. (1.25 m) long. The emulsion shall be introduced above the third point of the mixer to ensure proper premixing of the aggregate, cement, additive and water when the modified emulsified asphalt is added. Blade size and side clearances shall meet the equipment manufacturer's recommendations.

Mixing shall be done in a manner that does not cause premature breaking of the emulsified asphalt. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients.

The mixer shall be equipped with a remote forward speed control at the back mixing platform so the back operator can control forward speed and level of mixture in paving or rut box. Effective April 1, 2006, the Contractor shall provide a computerized material monitoring system with integrated material control devices that are readily accessible and positioned so the amount of each material used can be determined at any time. The mixer shall be equipped with a back-up electronic materials counter that is capable of recording running count totals for each material being monitored. The mixer shall be equipped with a radar ground measuring device. Each material control device shall be calibrated prior to each mix application and as often thereafter as deemed necessary by the Engineer. The computer system shall have the capability to record, display and print the following information:

- Individual sensor counts for emulsion, aggregate, cement, water and additive
- Aggregate, emulsion, and cement output in lbs.(kgs) per minute
- Ground travel distance. The mixer shall be equipped with a Radar Ground metering device
- Spread rate in lbs./s.y.(kgs/m²)
- Percentages of emulsion, cement, water and additive
- Cumulative totals of aggregate, emulsion, cement, water and additive
- Scale factor for all materials

The mixing machine shall be equipped with a water pressure system and fog type spray bar, adequate for complete fogging of the surface preceding spreading equipment of the mixture.

The mixing machine shall include controls for proportioning and calibrating the aggregate feed. The aggregate feed device shall be equipped with a revolution counter so that the amount of aggregate used may be determined at any time and shall have a positive locking feed gate.

The emulsion pump shall be of the positive displacement type and shall be equipped with a device so that the amount of emulsion used may be determined at any time. The emulsion pump, meter and piping shall be arranged to afford a means to calibrate the meter by weighing a metered volume. The pump shall deliver the emulsion to the mixer box at a uniform rate which shall not vary more than 2% from the required quantity.

The water pump shall be equipped with a minimum of 2 valves. One valve shall establish the required water flow. The other valve shall be a quick acting valve to start and stop the water flow.

The mixing machine shall have sight gauges located at the material storage tanks for the asphalt emulsion and water.

The mixing machine shall be equipped with approved metering devices so that it can be accurately calibrated and the quantities of materials used during any 1 period can be closely estimated. In the event that the metering devices stop working properly, the mixing machine shall no longer be used until necessary repairs have been made.

Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of emulsion from the pump. Each mixing unit to be used in the performance of the work shall be calibrated in the presence of the Engineer prior to construction. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering devices. When calibrating the emulsion system, a minimum of 3 tests shall be run, with each test run being a minimum of 40 gal. (150 liters). Calibration of the aggregate delivery system shall require tests at 3 different gate settings with 2 test runs at each gate setting and a minimum of 425 lbs. (193 kgs) per test run. Calibration of the filler(cement) delivery system shall require 3 tests at a minimum of 25 lbs. (11 kgs) per test. The scales used shall be certified. No machine will be allowed to work on the project until the calibration has been completed and accepted. Additional calibrations may be required during the process of the work as directed by the Engineer.

Spreading Equipment. Attached to the machine shall be hydraulically adjustable(adjustable while applying mixture) type spreader box with a positive screed adjustment for yield control and a positive adjustment for the joint matcher. The box shall be attached to the mixer, equipped with ribbon flights mounted on an adjustable shaft to continually agitate and distribute the materials throughout the box. The box shall be equipped with curb bumpers and replaceable runners with a minimum of 5 ft. (1.5 m) long end runners. The box shall be equipped with a sufficient walkway to provide access to either side of the spreader box without walking through the freshly laid material. The spreader box shall be heavy duty with crossbracing for rigidity and a manufacturer's weight not less than 1,400 lbs. (635 kgs) at a width of 12 ft. (3.6 m). The box must be capable of laying mix to a width of 14 ft. (4.3 m). The equipment shall provide sufficient turbulence to prevent the mix from setting in the box or causing excessive side build-up or lumps. To prevent the loss of the mixture from the box, the Contractor shall attach flexible seals, front and rear, in contact with the road. The full width application box shall be equipped with a secondary strike-off located approximately 2 to 3 ft. (0.5 to 1.0 m) behind the primary strike-off to minimize transverse corrugations. The secondary strike-off shall have elevation and width adjustments similar to the primary strike-off. It shall have a pivot point where it can be tilted for texturing or raised completely off the surface. Rut filling shall require a steel strike-off on the spreading equipment or the use of a rut box. A rut box shall be used for filling ruts in excess of 3/8 in. (10 mm) unless otherwise specified on the plans. The Contractor shall operate the spreading equipment in such a manner to prevent the loss of the mixture on super-elevated curves. Mixture shall be spread to fill cracks and minor surface irregularities and achieve a uniform skid-resistant surface without causing skips, lumps or tears in the finished mat.

For slurry seals, the use of burlap drags or other drags necessary to obtain the desired finish, shall require approval by the Engineer. Drags having excessive build-up shall be replaced. Drags shall be kept in a

completely flexible condition at all times. No drags shall be used on Micro-surfacing.

CONSTRUCTION REQUIREMENTS

414.05-Preparation of Existing Surface. Immediately prior to applying the tack coat and mixture, all dust, dirt, vegetation and other deleterious material shall be removed from the existing surface by brooming, washing with water under high pressure, blowing with compressed air or other approved methods. The cleaned surface shall be approved prior to application of the tack coat and mixture. All thermoplastic pavement markings shall be removed flush with the existing surface by the contractor prior to tacking.

The Contractor shall establish stations at 1,000 ft. (300 m) intervals on the entire project prior to placing materials. The stations shall be clearly identified and maintained until project completion.

414.06-Application. Prior to the placement of the mixture, a tack coat of CQS-1h emulsion shall be applied with an asphalt distributor. The tack coat shall consist of 1 part emulsion and 2 parts water. The application rate shall be 0.05 to 0.10 gal./s.y.(0.2 to 0.5 liters/m²) of the diluted emulsion. The actual application rate shall be determined by the Engineer. The method of application of the tack coat shall be in accordance with **Section 403**.

The emulsified asphalt slurry seal shall be applied at a rate of 16 ±2 lbs./s.y.(of 8.75 ±1 kgs/m²) based on dry aggregate weight unless otherwise specified on the Plans. The rate of application shall be varied within the range specified above as required by the condition of the pavement to obtain a minimum thickness of 1/8 in. (3 mm) above the high points of the milled areas and 1/4 in. (6 mm) thickness on unmilled areas.

Micro-surface shall be applied as follows:

- **Rutfill Course.** If a rut fill course is specified, apply enough material to fill the wheel paths without excess crowning (overfilling). An excess crown is defined as 1/8 in. (3 mm) after 24 hours of traffic compaction. Apply rut fill courses in widths from 5 to 6 ft. (1.5 to 1.8 m) for each wheel path. Provide a smooth, neat seam where 2 rut fill passes meet. Take care to restore the designed profile of the pavement cross-section. Feather the edges of the rut fill course to minimize the use of excess material.
- **Leveling Course.** If a leveling course is specified, apply the dry aggregate at 14 ±2 lbs /s.y. (7.6 ±1.1 kgs/m²).
- **Surface Course.** If a surface course is specified and it is placed on another micro-surfacing course, apply the dry aggregate at 18 ±1 lbs/s.y. (8.7 ±0.6 kgs/m²). If a surface course is specified and it is not placed upon another micro-surfacing course, apply the paving mixture at a minimum of 22 lbs/s.y. (11.9 kgs/m²).

Micro-surface shall be applied at the rates as specified on the plans for leveling and surface courses.

The mixture shall be applied based on dry aggregate weight as specified on the plans.

The maximum allowable speed of the machine shall be 130 ft. (40 m) per minute. When rut filling, the maximum allowable speed shall be determined by the Engineer. The final surface seal shall be placed uniformly across the width of the traffic lane unless otherwise specified or directed. The action of the squeegee shall permit the mix to flow freely leaving a smooth, uniformly textured surface.

Unless otherwise directed by the Engineer, the surface shall be pre-wetted with water by fogging ahead of the spreader box. Pre-wetting shall be closely controlled to prevent accumulation of water to the point of running off or puddling.

As the aggregate and emulsion is being loaded into the aggregate/emulsion support trucks or mixing machine, the aggregate shall be given a final screening by sieving it through screening equipment capable of removing any random oversize material.

The mixture shall be of the desired consistency when deposited on the surface after which no additional elements shall be added. A sufficient amount of mixture will be carried in all parts of the spreader at all times so the complete coverage is obtained. No lumping, balling or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the mix will be removed from the pavement. The mixture shall have proper consistency so that excessive splattering and excessive free water is avoided. The spraying of water into the spreader box during lay down operations will not be permitted. Hand tools, lutes and squeegees shall be used to spread mix on areas not accessible to the machine spreading equipment. Rolling with a pneumatic-tired roller shall be required after proper curing for sections of pavement not to be exposed to traffic. The roller shall be equipped with tires with a pressure of 40-60 psi(275 to 425 kPa).

Quality Control: The Contractor shall produce a mixture that will be in compliance with the mix design and the quality control tolerances. The Slurry Seal or Micro-Surface shall be applied at the rates as specified on the plans. The methods described in this section shall be used by the Contractor to measure compliance. Contractor shall maintain all quality control documentation and make available to the Engineer or Project Inspector upon request or at completion of work.

- a. Asphalt Content – The Contractor shall calculate the % asphalt content of the mixture from the equipment computer display readings randomly, a minimum of 3 times a day. The quality control tolerances from the mix design is $\pm 0.5\%$.
- b. Application Rate – The Contractor shall calculate the yield of the course being placed from the equipment computer display readings randomly, a minimum of 3 times a day. The quality control tolerance from the specified application rate is ± 2 lbs/s.y. (± 1 kg/m²).

- c. Documentation – The Contractor shall maintain a daily report and a lot sheet as follows:
1. Daily Report – The daily report shall include the following information:
 - Aggregate used, ton(metric ton) (dry)
 - Slurry or Micro-Surfacing emulsion used, ton(metric ton)
 - Bituminous Materials for Tack Coat and for Fog Seal, ton (metric ton)
 - Cement used, ton(metric ton)
 - Water used in mixture, gallons(liters)
 - Additive used in mixture, gallons(liters)
- d. Test Strip Construction - Prior to production application, the Contractor shall place a 1,000 ±50 ft. (300 ±15 m) test section to verify a quick breaking emulsion is being used. The test strip shall be placed at the same time as paving is to take place, night or day, and under the same ambient conditions. The test strip shall be able to carry normal traffic within 60 minutes. If normal traffic cannot be carried, the emulsion or mixture must be adjusted and another test strip will be required.

Lot Sheet - The project shall be segmented into lots with any 1 lot not to exceed 20,000 s.y.(16,700 m²). For each lot the Contractor shall maintain a lot sheet, providing the following information:

- Control Section, Job Number, Route, Engineer (Project Inspector)
- Date, Air Temperature
- Control Settings, Calibration Values, Unit Weight of Emulsion (lbs per gallon) (kgs per liter), Percent residue in Emulsion.
- Beginning and Ending Intervals
- Computer display readings for material usage (Beginning, and Ending, and Total)
- Length, Width, Total Area (s.y.) (m²), (lbs.) (kg) of Aggregate, lbs. (kg) of Emulsion, lbs. (kg) of Cement.
- Percent of each Material, Percent of Asphalt Cement, Application Rate, Combined Application Rate (lbs./yd²) (kgs/m²)
- Mix Design (Percent Portland Cement, Percent Emulsion, Percent Asphalt Cement)
- Contractors Authorized Signature
- Calibration Forms

414.07-Joints. No excessive build-up, uncovered areas or unsightly appearance shall be permitted on longitudinal or transverse joints. An excessive overlap will not be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. When placing micro-surfacing, the final center joint of the micro-surfacing must

terminate at a point that will fall directly under the final permanent center line. Before opening to traffic, pavement markings meeting the requirements of **Subsection 716.06** shall be in place. A maximum of 3 in. (75 mm) shall be allowed for overlap of the longitudinal lane line joints. Also the joint shall have no more than ¼ in. (6 mm) difference in elevation when measured with a 10 ft. (3 m) straightedge over the joint. Final edge lines must extend a minimum 4 in. (100 mm) over the old longitudinal edge joint. Care shall be taken to insure straight lines along curbs and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide a neat appearance.

414.08-Fog Seal Application. When fog sealing of shoulders is included in the contract it shall be accomplished with emulsified asphalt, Grade SS-1, CSS1h-p or CQS-1h-p. The rate of application shall be 0.2 gal./s.y.(0.9 liter/m²) based on a dilution rate of 1 part emulsified asphalt to 1 part water. This application may require 2 equal increments if run-off occurs.

414.09-Weather Limitations.

Micro-Surface. The micro-surface shall be placed only when the pavement surface temperature and the ambient air temperature are a minimum 50° F(10° C) and rising. Micro-surface will not be placed during foggy or rainy conditions. The placement of micro-surfacing shall be limited to the period from April 1 to October 31.

Slurry Seal. The placement of slurry seal shall be limited to the period from April 1 to October 31. Slurry seal shall not be applied if either the pavement or ambient temperature is 50° F(13° C) or less.

414.10-Opening to Traffic. Micro-surface material shall cure sufficiently within 1 hour after application and slurry seal material shall cure sufficiently within 2 hours after application, so that traffic can be allowed on the pavement without damaging the surface. Traffic shall not be allowed on the mixture until it has cured sufficiently to prevent pickup by vehicle tires. The Contractor shall maintain traffic control as necessary to prevent damage to the mixture. Any damage caused by traffic to the mixture shall be repaired by the Contractor at no expense to the Department.

COMPENSATION

414.11-Method of Measurement. Emulsified Asphalt Slurry Seal will be measured by the square yards(meters) in place as completed and accepted. The quantity of aggregate for Micro Surfacing, including mineral filler, shall be measured by the ton(metric ton) (dry), based on the calibrated metering devices affixed to the micro-surface mixing machine. The quantity of latex or polymer modified emulsion used in the accepted portion of the Micro- surfacing shall be measured by ton(metric ton) of material based on the calibrated metering device affixed to the micro-surface mixing machine. Bituminous Materials for Tack Coat and for Fog Seal, will be

measured and paid for by the ton(metric ton) in its undiluted state. No direct payment will be made for the latex or polymer additives when used and the cost thereof shall be included in the price bid for the respective items.

For bidding purposes, the emulsified asphalt content on the slurry mix design shall be 15% and for micro-surfacing design the asphalt content shall be 12%. In the event that the Engineer sets an emulsified asphalt content other than that stated above, a price adjustment will be made based on the emulsified asphalt content set by the Engineer and the invoice price of the emulsified asphalt F.O.B. the project delivery point. The price adjustment will be calculated according to the following formula:

$$PA = [IP \times (DA-BA) \times T] / 100$$

Where:

PA = Price Adjustment

IP = Invoice price of emulsified asphalt cement

DA = Percent emulsified asphalt set
on the mix design

BA = Percent emulsified asphalt specified
above to be used for bidding

T = Total tons(metric tons) of aggregate for price
adjustment as determined by the metering
system on the mixing machine

Payment will be made to the Contractor for additional emulsified asphalt as provided for above at the purchase price F.O.B. the project delivery point, as verified by invoice, and no compensation will be allowed for further handling or processing. The Department will be reimbursed from monies due the Contractor for a decrease in emulsified asphalt content in the amount equal to the purchase price F.O.B. the project delivery point.

414.12-Basis of Payment. The accepted quantities, determined as provided above, will be paid for at the contract unit prices, which payment shall be full compensation for all equipment, materials, labor and incidentals necessary to complete the work.

**SECTION 415-COLD PLANING OF BITUMINOUS
PLANT MIX PAVEMENTS**

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SECTION 415-COLD PLANING OF BITUMINOUS PLANT MIX PAVEMENTS

415.01-Description. This work shall consist of cold planing an existing bituminous plant mix pavement in accordance with the requirements of these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

EQUIPMENT

415.02-Equipment. All equipment necessary for the satisfactory performance of this work shall be on hand and approved before work will be permitted to begin. The required equipment shall include a power broom, a water truck, and a planing machine. Equipment shall be furnished to remove the material planed from the pavement.

The planing machine shall be a power operated, self-propelled milling machine or grinder capable of removing bituminous concrete to the required width, depth, profile, cross-slope and surface texture. The machine shall be capable of accurately establishing profile by referencing from either the existing pavement or from an independent grade control and shall have positive means for controlling cross-slope. The machine shall have a floating moldboard with sufficient down pressure to plane the milled surface. The machine shall have an effective means of removing cuttings from the pavement and for preventing dust from escaping into the air.

When milling the Interstate or controlled access freeways, the planing machine shall be equipped with a cutter drum at least 12 ft. (3.65 m) wide and be capable of restoring pavement profile with either a contact or non-contact leveling system. A contact leveling system shall be a minimum of 40 ft. (12 m) in length and the non-contact leveling system shall have a minimum of 3 sensors dispersed the length of the machine.

The maximum spacing between teeth on the cutter drum shall not exceed 5/8 in. (15 mm). Supplemental equipment shall be provided as necessary to remove material in areas that cannot be reached by the planing machine.

CONSTRUCTION REQUIREMENTS

415.03-General Requirements. The operations shall be so arranged that no vertical longitudinal faces exceed 1-1/4 in. (32 mm) in height in areas to be used by public traffic. Transverse faces shall be tapered in a manner approved by the Engineer to avoid creating a hazard for traffic. The Contractor shall be required to cold plane in the direction of traffic.

When milling roadways for hot mix overlays, the planing machine shall operate at a consistent forward speed to provide an acceptable surface texture. The maximum allowable forward speed shall be 60 ft. (18 m)/min when the teeth spacing is between 1/2 and 5/8 in. (13 and 15 mm), and the maximum allowable forward speed shall be 80 feet(24 m)/min when the teeth spacing is less than 1/2 in. (13 mm).

After planing, the finished surface shall provide a smooth riding surface free from scallops, scabs, gouges, ridges, oil film, and other imperfections of workmanship, having a uniform texture, and true to the

required grade and cross section. The elevation of the longitudinal edges of adjacent cuts shall not differ more than 1/8 in. (3 mm).

Milling shall not commence unless the subsequent layer of pavement can be placed within limitation specified in **Subsection 407.09**.

The planed pavement shall be thoroughly swept immediately behind the machine and all materials swept up shall be loaded and hauled away. A water truck shall be furnished and used to control dust from the work, when deemed necessary by the Engineer.

Where sound pavement has been gouged, torn, or otherwise damaged during the milling operations, or damage is done to any other property of any kind including utility frames, grates, and covers, repairs shall be made by the Contractor at no cost to the Department. The Contractor shall take appropriate measures so that the cold planing operation does not trap water.

415.04-Surface Requirements. Where the planed pavement is not to be resurfaced, the texture shall be uniform throughout the project and shall provide a satisfactory riding surface. The average texture depth shall be no less than 0.20 in. (5 mm).

The finished surface on the Interstate and controlled access freeways shall be of uniform profile throughout, without any scabbing, scallops, gouges, ridges, or other imperfections resulting from worn cutter teeth, improper operating speeds, poor equipment maintenance, or other instances of poor workmanship. The cross-slope shall be as specified on the plans in the tangent, transition, and super-elevated curve sections.

The finished surface after the final cut shall not show a deviation greater than 1/8 in. (3 mm) from a 10 ft. (3 m) straightedge, and the cross-slope shall not deviate more than 3/8 in. (10 mm) in 10 ft. (3 m). All irregularities exceeding these limits shall be corrected.

Approaches and tapers shall be acceptably textured when required by the Engineer. Length, width, and depth of cut on approaches and tapers will be as determined by the Engineer. The approaches and tapers shall match the finished cut on the main line and shall be transitioned to the existing surface to within $\pm 1/8$ in. (3 mm).

When deemed necessary by the Engineer, private entrances shall be transitioned to provide a smooth approach to the roadway.

Unless otherwise specified on the plans, the cuttings shall become the property of the Contractor and be removed from the project.

COMPENSATION

415.05-Method of Measurement. Cold Planing of Bituminous Pavement will be measured by the ton(metric ton) of material removed, by the cubic yard(meter) of material removed, or by the square yard(meter) of planed pavement. The method of measurement will depend upon the pay item designated in the proposal.

Where payment is by the square yard(meter) the pavement acceptably planed will be measured by the square yard(meter) in accordance with **Section 109**.

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Unless otherwise specified, water used to control dust will not be measured for separate payment but will be considered incidental to the planing operation.

415.06-Basis of Payment. The accepted quantity of Cold Planed Bituminous Pavement will be paid for at the contract unit price, which payment shall be full compensation for all labor, materials, equipment, hauling, and incidentals necessary to plane the pavement, control dust, and dispose of the cuttings.