DIVISION 400
ASPHALT PAVEMENTS

SECTION 401
PRIME AND TACK COATS AND EMULSIFIED ASPHALT IN BASE COURSE

401.01 Description. This item shall consist of a single application of asphalt material and blotter material, if required, applied to the completed and approved subgrade, to the base course, or on the existing asphalt or concrete surface according to these specifications and in reasonably close conformity with the lines shown on the plans or as directed.

401.02 Materials. Materials shall conform with the requirements provided under Section 403. A medium curing cut-back asphalt will be used for prime coat and a rapid curing cut-back or an emulsified asphalt will be used for tack coat. Emulsified asphalt conforming to grades SS-1, SS-1h, CSS-1, or CSS-1h shall be used for emulsified asphalt in base course. Dependent upon the texture of the base and the season of the year that work is being performed, the Engineer will select the particular grade of the type of asphalt material that will be used.

401.03 Construction Requirements. The methods employed in performing the work, and all equipment, tools, and machinery used in handling materials and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory, shall be changed and improved as required. All equipment, tools, and machinery used shall be maintained in a satisfactory working condition and shall meet the requirements of Section 403.

The surfaces of all structures shall be protected by some satisfactory method to prevent their being disfigured by the application of asphalt material. Objectionable asphalt discoloration, caused by the Contractor's operations, shall be removed from all roadway and bridge structures at no cost to the Department.

(a) Cleaning. If needed, the surface to be treated with prime or tack coat shall be cleaned of dust, dirt, and loose or foreign material by sweeping with mechanical brooms immediately preceding the application of the prime or tack coat. Care shall be taken to clean

but not loosen or dislodge the embedded aggregate in base courses. Patches of asphalt, dirt, or other material that do not form an integral part of the surface to be treated shall be removed. When directed, the surface shall be sprinkled with water and given an additional sweeping.

The cleaning operations shall be carried only far enough in advance of the application of the asphalt material to ensure the surface being properly prepared at the time of application. When the existing surface is an old concrete pavement, excess joint and crack filler shall be removed from the surface.

(b) Application of Prime Coat. After the surface to be treated has been prepared as outlined above, the asphalt material for the prime coat shall be sprayed uniformly over the surface by means of an approved mechanical pressure distributor at the rate of application indicated on the plans, or as directed.

Surplus asphalt material collected in surface depressions shall be removed.

Following the application of the prime coat, the road will be closed to traffic, if practicable, for a period of time sufficient to allow the proper curing of asphalt coating. Prime coat shall be allowed to cure a minimum of 3 days before any successive application of asphalt material. However, the minimum three day curing time may be waived when, in the opinion of the Engineer, the prime has sufficiently cured to allow placement of successive courses . No material for a succeeding course shall be placed on a primed base course until the prime coat has cured sufficiently to prevent damage by hauling operations. When shown on the plans or directed by the Engineer, the prime coat shall be applied in half widths in order to allow free passage of public traffic at all times.

Prime coat shall not be applied when the air temperature is below 45° F (7° C), nor shall it be applied to a surface having excess moisture, nor when general weather conditions, in the opinion of the Engineer, are not suitable. Special precautions shall be observed to ensure a uniform distribution of the asphalt material. The distributor shall be so adjusted and operated as to distribute evenly the material being applied. Deposits of asphalt material upon the road surface in excess of the quantity specified, caused by stopping or starting the distributor, by overflow, leakage, or otherwise, shall be removed.

The asphalt material shall be applied at the temperature specified in Section 403. The distributor shall be operated at a pressure of not less than 30 psi (200 kPa) nor more than 70 psi (500 kPa). The Contractor shall provide the necessary facilities for determining the temperature of the asphalt material in the heating equipment and in the distributor, for determining the rate of application, and for securing uniformity of distribution at longitudinal and transverse joints.

If the primed surface becomes damaged, such areas shall be cleaned or patched and re-treated at no cost to the Department.

At the Contractor's option, Emulsified Asphalt in Base Course, constructed according to the provisions of Subsections 401.02 and 401.03(d), may be substituted in lieu of Prime Coat. Payment for this substitution will be made as Prime Coat.

(c) Application of Tack Coat. When an asphalt course is to be laid on an asphalt or concrete surface, a tack coat shall be applied prior to placing the course. The tack coat shall be applied by means of a pressure distributor in the same manner as outlined above for the application of prime coat. When emulsified asphalt is used it shall be diluted with water as directed. The asphalt material shall be applied at the temperature specified in Section 403. The rate of application shall be from 0.03 gallon to 0.10 gallon per square yard (0.1 L/sq m to 0.5 L/sq m) as designated by the Engineer. The tack coat shall be applied sufficiently in advance of the asphalt course to allow the proper curing of the asphalt material but shall not be applied so far in advance as to lose its adhesiveness as a result of being covered with dust or foreign material. If the tack coat becomes damaged or covered with foreign material, such areas shall be cleaned as necessary and re-treated at no cost to the Department.

(d) Application of Emulsified Asphalt in Base Course. Construction of the base course shall be according to the provisions of Division 300 for the applicable type of base course.

Emulsified asphalt shall be incorporated into the top 2" (50 mm) of the base course in a manner that will produce a uniform distribution of the asphalt at the plan designated rate. To facilitate uniform application and distribution, the emulsified asphalt may be added to water at a rate dictated by job conditions.

When an existing base course is to be treated, the top 2" (50 mm) of the existing material shall be scarified, treated as described above, and spread and compacted.

At the Contractor's option, prime coat, constructed according to the provisions of Subsections 401.02 and 401.03(b), may be substituted in lieu of Emulsified Asphalt in Base Course on shoulders, driveways, turnouts, islands, detours, temporary roadways, and parking or small, irregular areas. Payment for this substitution will be made as Emulsified Asphalt in Base Course.

401.04 Blotter Course. (a) General. When directed, the fresh prime coat shall be covered by a blotter course in order to permit immediate use of the road by traffic without undue damage to the work or inconvenience to the traveling public.

(b) Material. The material for the blotter course may be an approved, clean, sandy material from a local source or may be a commercially processed sand. Material used shall be free from lumps, roots, sticks, or other foreign matter.

(c) Construction Requirements. Before the primed surface is opened to traffic, the blotter course shall be distributed evenly over the primed surface in such quantity as may be necessary to blot the surplus asphalt and prevent it from picking up under traffic. The surface shall then be dragged with an approved type of drag broom, supplemented as necessary by hand brooming, so as to distribute the material evenly.

401.05 Method of Measurement. Asphalt material will be measured by the gallon (liter).

Blotter course material, applied at the direction of the Engineer, will be measured either by the cubic yard (cubic meter) in vehicles or by the ton (metric ton).

401.06 Basis of Payment. Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per gallon (liter) for Prime Coat, Tack Coat, or Emulsified Asphalt in Base Course and per cubic yard (cubic meter) or ton (metric ton) for Blotter Course Material, which price shall be full compensation for furnishing, preparing, hauling, diluting, and applying asphalt material and blotter course material, when required; for cleaning or scarifying and compacting the surface; and for all

labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Prime Coat	Gallon (Liter)
Tack Coat	Gallon (Liter)
Emulsified Asphalt in Base Course	Gallon (Liter)
Blotter Course Material	Cubic Yard (Cubic Meter) or Ton (Metric Ton)

SECTION 402
ASPHALT SURFACE TREATMENT

402.01 Description. This item shall consist of the application of one or more seal coats, as specified, according to these specifications and in reasonably close conformity with the lines shown on the plans or as directed.

When requested by the Contractor and approved by the Engineer, Asphalt Concrete Hot Mix Surface Course (1/2" [12.5 mm]) or (3/8" [9.5 mm]), conforming to Section 407, may be used in lieu of an asphalt surface treatment and will be considered to be equivalent construction when furnished according to the following minimum substitution rate:

	Shoulders		Roadways
Material	**Single AST**	**Double AST**	**Double AST**
ACHM Surface Course (1/2" [12.5 mm]) or (3/8" [9.5 mm])	100 lbs./S.Y. (60 kg/sq m)	165 lbs./S.Y. (90 kg/sq m)	165 lbs./S.Y. (90 kg/sq m)

402.02 Materials. All materials for asphalt surface treatment shall conform to the applicable requirements of Section 403. All materials for equivalent construction shall conform to the applicable requirements of Sections 407, 409, and 410.

The asphalt material shall be either a medium or rapid curing cut-back asphalt, an emulsified asphalt, or asphalt binder. If the type and grade are not specified in the Contract, the Contractor may choose the type and the Engineer will specify the grade.

402.03 Construction Requirements. (a) General. The methods employed in performing the work, and all equipment, tools, and machinery used in handling material and executing any part of the work shall be subject to the approval of the Engineer before the work is started and whenever found unsatisfactory shall be changed and improved as required. Equipment, tools, and machinery used must be maintained in a satisfactory condition, and must conform to the requirements provided in Section 403, or in Sections 409, and 410, for equivalent construction.

The surfaces of all structures shall be protected by some satisfactory method to prevent their being disfigured by the application of asphalt material. Objectionable asphalt discoloration, caused by the Contractor's operations, shall be removed from all roadway and bridge structures at no cost to the Department.

Asphalt material shall not be applied on a surface having excess moisture or when weather conditions are unsuitable. The Contractor shall monitor local weather conditions to avoid placing material on the road ahead of adverse weather that could subsequently damage the material. In the event materials are damaged by adverse weather, they shall be replaced or repaired at no additional cost to the Department.

Special precautions shall be taken to ensure that the equipment is operated in a manner that distributes the asphalt and aggregate evenly and uniformly. Deposits of asphalt and aggregate material upon the road surface in excess of the quantity specified, caused by stopping or starting the distributing machine, overflow, leakage, or other mechanical or human errors, shall be removed.

Prior to performing the actual work, all equipment shall be adjusted and calibrated according to Section 403 and applicable manufacturer's requirements.

The surface section shall be constructed in half widths for each application when public traffic is to be maintained. When traffic is not being maintained over the roadway, full width applications may be made when sufficient aggregate spreading and rolling equipment is provided for complete simultaneous coverage.

(b) Sweeping and Cleaning. Before the asphalt material is applied, the surface shall be thoroughly cleaned and swept with a rotary power broom to remove all dust, dirt, mud, and loose or foreign material. A blower may be used to assist in the cleaning operation. The sweeping and cleaning operations shall be carried only far enough in advance of the application of the asphalt material to ensure that the surface is maintained in the proper condition at the time of application.

(c) Application of Asphalt Material. After the surface to be treated has been prepared as specified above, the asphalt material for the surface treatment shall be sprayed uniformly over the surface by means of an approved mechanical pressure distributor, meeting the requirements of Section 403, to the lines and at the rate of application designated by the Engineer. The asphalt material shall be applied at the temperature specified in Section 403. The Contractor shall ensure uniformity of distribution at junctions of distributor loads by use of building paper or other approved methods.

After asphalt material is applied, no equipment or traffic will be permitted on the surface until the aggregate is applied and rolled.

(d) Application of Mineral Aggregate. The mineral aggregate shall not contain excessive free moisture and shall be spread immediately following the application of the asphalt material. Operations shall not proceed or continue when the asphalt material is allowed to chill, set up, dry, or otherwise impair retention of the mineral aggregate. The mineral aggregate shall be spread with a mechanical spreader meeting the requirements of Section 403. The mineral aggregate shall be distributed over the asphalt material to the lines and at the rate of application as directed by the Engineer. The use of an approved chip box to distribute the mineral aggregate will be permitted on detour construction and other areas approved by the Engineer where the use of a mechanical spreader is impractical. Spreading shall be accomplished in such manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and freshly applied asphalt material. Portions of the surface not covered by mechanical spreaders shall be hand spotted so that the entire surface will be uniformly covered. Light hand brooming may be necessary to distribute excess aggregate.

(e) Rolling and Brooming. A minimum of two rollers, one pneumatic and one steel wheel, along with one rotary power broom

shall be used with each aggregate spreader being used. A combination steel wheel/pneumatic roller will be allowed as a substitute for the steel wheel roller.

Rolling shall begin immediately behind the spreader. Each surface treatment shall be completely rolled a minimum of three times.

After the final set of asphalt has occurred and no more than 48 hours after application, the surface shall be lightly broomed to remove excess aggregate. Generally, the brooming shall be confined to the cooler hours of the day and shall be conducted so as not to displace embedded material.

(f) Second and Successive Applications. If the work involves two or more applications of asphalt material and mineral aggregate, the rates of application for this material will be those specified on the plans or as designated by the Engineer and the method of construction will be the same as for the first application. Each application shall be placed only after the preceding application has been satisfactorily completed and cured.

A minimum of 48 hours for emulsions and asphalt binders and 72 hours for cut-backs shall elapse between the first and any succeeding application, however, a minimum of 24 hours is required before applying the succeeding application on detours or other temporary work. Further, the asphalt shall be firmly set and the aggregate firmly embedded so as not to be displaced by brooming. Before application, the surface shall be thoroughly swept with a rotary power broom so that no dust or loose aggregate is left that might cause a plane of cleavage.

402.04 Traffic Control. During the application of the asphalt material and aggregate, and during the rolling operation, traffic will not be allowed on the new surface. When traffic must use the lane adjacent to the lane under construction, the Contractor shall regulate the flow of vehicles past the surfacing operation at a speed not to exceed 25 miles per hour (40 km/h). The Engineer may require the use of a pilot vehicle.

Until the asphalt has set and the cover aggregate is firmly embedded, traffic shall not exceed 25 miles per hour (40 km/h). The vehicle speeds shall be controlled by the use of one or a combination of barricades, flaggers, signs, or pilot vehicles that will minimize the loss of cover aggregate. The method used for speed control shall be

approved by the Engineer and will be subject to change or modification should the selected method of control prove unsatisfactory.

The Contractor shall route the aggregate haul trucks to and from the work area so that they will not have to turn on the freshly placed surface treatment.

402.05 Temperature and Seasonal Limitations. Asphalt material shall not be applied when the surface temperature is below 60° F (15° C). In addition, asphalt surface treatments shall not be applied outside the following seasonal limitations:

Traveled Lanes	April 15 to September 30
Shoulders	April 1 to October 31

No deviation from the above limitations will be allowed except by written permission from the Engineer.

402.06 Method of Measurement. (a) Mineral aggregate in surface treatments will be measured either by the cubic yard (cubic meter) or by the ton (metric ton).

(b) Asphalt in surface treatments will be measured by the gallon (liter).

(c) When the actual rate of application of ACHM Surface Course (1/2" [12.5 mm]) or (3/8" [9.5 mm]) is placed within the limits shown on the plans or as directed by the Engineer at the rate shown in Subsection 402.01, or greater, it will be considered as the equivalent plan rate of Mineral Aggregate and Asphalt Material contained in each square yard (square meter) of Asphalt Surface Treatment.

Should the Contractor inadvertently apply a lesser rate of application, the quantities placed at the lesser rate will be adjusted by the following factors:

Rate of Application				
lbs./S.Y.		**kg/sq m**		
165	**110**	**90**	**60**	**Adjustment Factor**
165	110	90	60	1.00
158-164	106-109	86-89	57-59	0.96
152-157	101-105	82-85	54-56	0.92
145-151	96-100	79-81	51-53	0.88
Less than 145	Less than 96	Less than 79	Less than 51	No pay or overlay at no cost to Dept.

402.07 Basis of Payment. Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) or per cubic yard (cubic meter) for Mineral Aggregate in Asphalt Surface Treatment.

In cases where the combined specific gravity of the material used for Mineral Aggregate in Asphalt Surface Treatment exceeds 2.80 and the method of measurement is by the ton (metric ton), the quantity of material will be adjusted for payment by multiplying the quantity of the material used by the specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt material will be paid for at the contract unit price bid per gallon (liter) for Asphalt in Surface Treatment, Polymer Modified Cationic Emulsified Asphalt (CRS-2P), or Latex Modified Cationic Emulsified Asphalt (CRS-2L).

The above contract unit price shall be full compensation for furnishing, loading, heating, hauling, placing, and applying materials; for cleaning, sweeping, brooming, and rolling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Mineral Aggregate in Asphalt Surface Treatment (Class___)	Cubic Yard (Cubic Meter) or Ton (Metric Ton)
Asphalt in Surface Treatment	Gallon (Liter)
Polymer Modified Cationic Emulsified Asphalt (CRS-2P)	Gallon (Liter)
Latex Modified Cationic Emulsified Asphalt (CRS-2L)	Gallon (Liter)

SECTION 403
MATERIALS AND EQUIPMENT FOR PRIME, TACK, AND ASPHALT SURFACE TREATMENTS

403.01 Mineral Aggregate. The various classes of Mineral Aggregate shall conform to the grading requirements of Subsection 403.02. Composition shall be as follows:

Class 1, Class 2, and **Class 4** shall be crushed stone, crushed gravel, or crushed steel slag in which at least 90% by weight of the coarse particles have been produced from larger particles by crushing operations and shall contain no more than 5% novaculite.

Class 3 shall be crushed or uncrushed gravel, crushed steel slag, or crushed stone.

Class 5 shall be composed of material meeting the requirements of either Class 1, Class 2, or Class 3 at the option of the Contractor.

Crushed stone shall consist of tough durable fragments of rock of uniform quality, and shall not contain more than 5% soft particles (AHTD Test Method 302). When subjected to 5 cycles of the Sodium Sulfate Soundness Test (AASHTO T 104), it shall have a loss not to exceed 12% and shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 35.

Gravel shall consist of hard, durable aggregate and shall not contain more than 5% soft particles (AHTD Test Method 302) and shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 35.

Steel slag shall consist of hard, durable aggregate and shall not contain more than 5% soft particles (AHTD Test Method 302). When subjected to 5 cycles of the Sodium Sulfate Soundness Test (AASHTO T 104), it shall have a loss not to exceed 12% and shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 35.

Fine aggregate is that portion passing the #10 (2.00 mm) sieve, and shall consist of clean, sound, hard, and durable particles of natural sands, stone sand, and other inert substances of similar characteristics. Coarse aggregate is that portion retained on the #10 (2.00 mm) sieve.

All mineral aggregates shall be uniformly well graded from coarse to fine and free from lumps or foreign material. They shall also be free from adherent films of clay that will prevent thorough coating with asphalt material.

403.02 Aggregate Gradation. Requirements in the following table are given in percent passing by weight.

Class	Sieve, (mm)					
	3/4" (19.0)	**1/2" (12.5)**	**3/8" (9.5)**	**#4 (4.75)**	**#10 (2.00)**	**#16 (1.18)**
1	100	90-100	--	0-15	0-3	--
2	--	100	80-100	--	0-15	0-3
3	--	100	80-100	--	0-15	0-3
4	--	--	100	50-90	0-15	0-8
5	May be either Class 1, 2, or 3.					

Sieve analysis will be determined by AASHTO T 27.

The decantation loss as determined by AASHTO T 11 shall not exceed 1.5% for any class of mineral aggregate.

403.03 Asphalt Materials. Asphalt materials shall include cut-back asphalt, emulsified asphalt, and asphalt binder. Samples of asphalt material will be tested according to applicable AASHTO or ASTM methods.

(a) Rapid Curing Cut-back Asphalt. Rapid Curing Cut-back Asphalt shall conform to the requirements of AASHTO M 81.

(b) Medium Curing Cut-back Asphalts. Medium Curing Cut-back Asphalt of the grade designated shall conform to the requirements of AASHTO M 82.

(c) Anionic Emulsified Asphalt. Anionic Emulsified Asphalt shall conform to the requirements of AASHTO M 140.

(d) Cationic Emulsified Asphalt. Cationic Emulsified Asphalt shall conform to the requirements of AASHTO M 208. In addition, CRS-2 shall have: 1) A minimum Saybolt Furol Viscosity at 122° F (50° C) at the point of manufacture and/or origin of 200 seconds, and a maximum Saybolt Furol Viscosity of 500 seconds. The Saybolt Furol Viscosity at 122° F (50° C) on destination field samples shall be within the limits of 100-500 seconds. If the asphalt fails to comply at 122° F (50° C) test temperature, the test shall be repeated at 160° F (70° C) and shall be within the limits of 90-200 seconds; and 2) the minimum residue from distillation by weight shall be 68%.

(e) Polymer/Latex Modified Cationic Emulsified Asphalt. Polymer Modified (CRS-2P) and Latex Modified (CRS-2L) Cationic Emulsified Asphalt shall conform to the requirements of AASHTO M 316, except for the minimum Ductility at 25° C (77°

F). In addition, CRS-2P and CRS-2L shall have : 1) A minimum Saybolt Furol Viscosity at 122° F (50° C) at the point of manufacture and/or origin of 200 seconds, and a maximum Saybolt Furol Viscosity of 500 seconds. The Saybolt Furol Viscosity at 122° F (50° C) on destination field samples shall be within the limits of 100-500 seconds. If the asphalt fails to comply at 122° F (50° C) test temperature, the test shall be repeated at 160° F (70° C) and shall be within the limits of 90-200 seconds; 2) the minimum residue from evaporation by weight shall be 68%, and 3) the penetration on residue from evaporation test shall be a maximum of 250.

(f) Asphalt Binder. Asphalt binder furnished shall conform to the requirements of AASHTO M 320 Table 1, except the Direct Tension requirement is deleted.

403.04 Application Temperatures. Asphalt material shall be applied at a temperature that provides proper and uniform distribution and within practical limits avoiding higher temperatures than necessary. Satisfactory application usually should be obtained within the recommended ranges shown below. No material shall be heated above the maximum allowable temperatures shown:

Type and Grade	Recommended Range		Maximum Allowable	
	°F	°C	°F	°C
RC-70	80-150	27-66	175	80
RC-250	100-175	38-80	200	93
RC-800	160-225	71-107	250	121
RC-3000	200-275	93-135	290	143
MC-30, MC-70	80-150	27-66	175	80
MC-250	100-200	38-93	230	110
MC-800	185-260	85-127	275	135
MC-3000	225-275	107-135	290	143
RS-1, RS-2	125-185	52-85	185	85

Type and Grade	Recommended Range		Maximum Allowable	
	°F	°C	°F	°C
MS-2	70-160	21-71	160	71
SS-1, SS-1h	70-160	21-71	160	71
CRS-1, CRS-2, CRS-2P, CRS-2L	125-185	52-85	185	85
CMS-2h, CMS-2	70-160	21-71	160	71
CSS-1, CSS-1h	70-160	21-71	160	71
All Asphalt Binders	275-325	135-163	350	177

Note: Heating of asphalt materials (except emulsions) constitutes a fire hazard to various degrees. Proper precautions should be used in all cases and especially with rapid curing cut-backs, as the maximum allowable temperature may exceed the flash point.

403.05 Heating Equipment. Equipment for heating asphalt material in tank cars or storage tanks shall have adequate capacity to heat the material by steam coils, electricity, or other means such that no flame shall come in contact with the heating tank.

The heating equipment shall be provided with an accurate thermometer to indicate the temperature of the asphalt material in the unit to which heat is being applied. Heating equipment that agitates the material will be prohibited if, in the opinion of the Engineer, it injures or in any way changes the characteristics of the material. The introduction of free steam directly into asphalt material will not be permitted.

403.06 Pressure Distributors. Each pressure distributor used for applying asphalt material shall be equipped with the following listed appliances or devices:

1) Tachometer devices registering traveling speed in feet per minute (meters per minute) or feet per second (meters per second).

2) A gauge, indicating pump pressure or output in gallons per minute (liters per minute) or gallons per second (liters per second) passing through the nozzles.

3) Thermometer well and accurate thermometer to indicate the temperature in degrees Fahrenheit (Celsius) of the asphalt material in the distributor.

4) Spray bars shall be of adjustable length and height and the distributor shall produce a 50% lap of the sprays from adjacent nozzles.

5) A power unit and pump system that will supply a uniform pressure through the entire length of the spray bar to provide equal output from all nozzles.

6) Calibrated metal measuring stick, marked in increments of not more than 10 gallons (50 L).

7) Easily removable dome cover.

8) Wind guard on ends of spray bars.

Calibration of the distributor will be checked by the Engineer before being used on the work. Distributors previously calibrated as described above by the Department or by another state Department of Transportation or the manufacturer, and certified in writing, will be accepted. Distributors will be kept free from sludge or other residue and at any time there is evidence of inaccuracy they will be subject to re-calibration. The Contractor shall provide, at no cost to the Department, all necessary equipment, materials, and assistance for any required calibration.

403.07 Aggregate Spreaders. The mechanical spreader for mineral aggregate shall be self-propelled and capable of accurately and uniformly spreading the material.

Calibration of the spreader will be checked by the Engineer prior to the actual work, and as often as necessary, to assure that the openings are properly set to feed the aggregate at the designated application rate.

403.08 Rollers. (a) General. Rollers shall be equipped with approved devices to prevent adhesion of the surfacing material to the wheels. Rollers shall be maintained in good mechanical condition and operated to produce a surface course with satisfactory aggregate orientation and interlock. Rollers shall be equipped with a self-contained power unit adequate to maintain dependable forward and reverse working speeds. Rollers shall have a system for cleaning the tires for the full width of each tire.

(b) Pneumatic Rollers. Pneumatic rollers shall be mounted on 7 or more wheels, a minimum of 3 leading wheels and 4 drive wheels. The wheels shall be mounted at right angles to the axles, shall maintain this position through the full revolution, and shall afford a continuous and complete rolling width of not less than 60 inches (1.5 m). The tires shall have a smooth tread. All tires on an individual roller unit shall be of equal size and diameter and shall be so arranged that the gap between the tires of one axle is covered by the tires of the other axle. Tires shall be uniformly inflated so that the air pressure of the several tires shall not vary more than 5 psi (35 kPa).

Pneumatic rollers shall be capable of exerting a minimum ground contact pressure of 45 psi (310 kPa). The Contractor shall furnish to the Engineer charts or tabulations showing the contact area and contact pressure for the full range of tire inflation pressures and for the full range of tire loadings for each type and size compactor tire furnished. The tires shall be inflated and the roller loaded with ballast, as required, to obtain the average ground contact pressure necessary to obtain proper compaction.

(c) Steel Wheel Rollers. Steel wheel or combination steel wheel/pneumatic rollers may be either three wheel or tandem type, shall weigh not less than 200 pounds per inch (35 kg/10 mm) width of roller, and shall have a complete rolling width of not less than 36" (1 m).

SECTION 404
DESIGN AND QUALITY CONTROL OF ASPHALT MIXTURES

404.01 Design of Asphalt Mixtures. (a) General. The Contractor shall furnish one mix design for each of the particular asphalt mixtures listed on the plans or in the Contract. The mix design shall be performed by a laboratory that is on the Department's QPL of approved asphalt mix design laboratories and shall include the following:

- Type of mix (e.g., ACHM Base, Binder, and Surface Course).
- Design values for asphalt binder content, air voids, voids in mineral aggregate, gradation, and wheel tracking test.

- Source of each material to be used in production of the mix.
- Designation of the asphalt plant to be used for production of the mix.
- Name(s) of individual(s) who performed the sampling, testing, and preparation of the mix design and the name of the laboratory used.
- Optimum laboratory mixing and compacting temperatures.
- Temperature viscosity curves for the asphalt binder to be used in the mix.
- A one gallon sample of performance grade asphalt binder to be used in the mix.
- Copies of all test results and mix design work papers.
- Nine (9) blended aggregate samples.
- A Certification by the Contractor that the mix design was prepared according to the specifications and that the materials to be used are from sources approved by the Engineer.

The mix design shall be submitted to the Engineer of Materials for review. After completion of the review, the Engineer of Materials will accept or reject, in writing, the mix design. A mix design will be accepted only for a specific type of mix, materials sources, and the plant to be used. A change in any materials source will require a different mix design. Mix designs will be approved for a period of five years from the original approval date provided satisfactory results are obtained during production and placement. The Engineer of Materials will accept a maximum of three (3) mix designs for a particular type mix, materials source, and plant combination at any time. Mix designs submitted in excess of three will not be considered until the number of accepted mix designs is reduced by declaring one or more of them invalid. All mix designs accepted by the Engineer of Materials become the property of the Department.

The Contractor shall notify the Resident Engineer in writing of the accepted mix design proposed for use on a specific project and provide copies of the mix design to the Resident Engineer. The Resident Engineer will approve an accepted mix design for use on each project. Only one mix design for each type of mix will be active (approved for use on highway projects) at any one plant at any time. A maximum of two other accepted mix designs for each type of mix will be considered inactive. If a change of mix design is

desired, the Contractor shall notify the Resident Engineer and request permission to change the mix design. Arbitrary changes of the active mix design will not be approved.

The Engineer will not perform any pre-bid testing of materials. It will be the Contractor's responsibility to obtain material sources approved by the Engineer unless sources are designated on the plans or in the Contract. Additives shall be selected from those on the Qualified Products List. If asphalt binder or aggregate sources proposed for use are not on the Qualified Products List, at least 10 business days must be allowed for sampling and testing before beginning the mix review process. At least five (5) business days shall be allowed for the review of the mix design.

(b) Design Requirements. Each mix design shall be prepared by laboratory analysis according to the requirements of the specifications. Each mix design will establish a mix gradation for the aggregates (based on the weight of material passing specified screen sizes), an optimum asphalt binder content (expressed as a percentage of the total mix weight), an optimum laboratory mixing temperature, and an optimum laboratory compaction temperature. Optimum laboratory mixing and compaction temperatures shall be established based on temperature-viscosity curves of the asphalt binder to be used in the mix. The optimum asphalt content is the asphalt binder content at 4% Air Voids (AV) for PG 76-22 mixes and 4.5% Air Voids (AV) for PG 64-22 and PG 70-22 mixes. The mix design will be designed in accordance with the volumetric mix design procedures contained in AASHTO M 323, its referenced standards, and the exceptions below:

- PG 64-22 and PG 70-22 mixes will be designed using 4.5% air voids;
- the fine aggregate angularity will be determined in accordance with AASHTO T 304 using the aggregate blend specific gravity of the minus No. 8 (2.36 mm) sieve through plus No. 100 (0.15 mm) sieve material;
- if any part of an ACHM Binder Course or an ACHM Base Course is within four inches (100 mm) of the pavement surface, the binder or base course lift shall comply with the angularity requirements for the top four inches (100 mm) of pavement;

- the gyratory compactor used in design, quality control, and acceptance testing must be a type evaluated by a Superpave Center and must meet the testing protocols for gyratory compactors. Gyratory compactors shall be calibrated in accordance with AASHTO T 312 and the manufacturer's recommendations. Documentation of calibration shall be made available to the Engineer upon request.
- the Voids in Mineral Aggregate (VMA) ranges will be as shown in Tables 405-1, 406-1, 407-1, or 407-2, as appropriate;
- the minimum requirement for one fractured aggregate face will be 98% and 80% for two fractured faces;
- wheel tracking test results will be determined using AHTD Test Method 480.
- water sensitivity will be determined using AHTD Test Method 455A. Copies of AHTD Test Methods are available from the Department.

The maximum number of gyrations (N_{max}) will be shown on the plans.

Asphalt binder shall comply with the requirements of AASHTO M 320 Table 1, except the Direct Tension requirements are deleted, and shall be from sources that have executed a certification agreement with the Department. PG 70-22 and PG 76-22 asphalt binders shall be production straight run binders that are modified by using either a SB, SBS or SBR to achieve the specified grade. PG 70-22 and PG 76-22 asphalt binders shall meet a minimum elongation recovery of 40% and 50%, respectively, when tested on the original binder at 77º F (± 1º F) [25º C (± 0.5º C)], in accordance with AASHTO T 301. Additives shall be approved by the Engineer. If an anti-strip additive is needed, a heat stable liquid anti-strip additive from the Qualified Products List shall be added at the rate of 0.5% or 0.75% by weight of the asphalt binder as determined by laboratory analysis. The maximum theoretical density computed from the specific gravity as determined by the Rice method (AASHTO T 209) shall be included in the mix designs. The Contractor shall compute the effective specific gravity. A correction factor, accounting for the difference in the VMA(actual) determined by bulk specific gravity and the VMA(effective) determined by the effective specific gravity, shall be shown on the mix design. The mix design for each type of asphalt mix shall meet the design

criteria for asphalt binder content, Air Voids (AV), Voids in Mineral Aggregate (VMA), fines to asphalt ratio, aggregate gradation, water sensitivity, and wheel tracking test.

The Contractor certified mix design shall provide for the design requirements for asphalt binder content, AV, VMA, fines to asphalt ratio, aggregate gradation, and water sensitivity specified for the particular mix.

The mix design gradation must fall within the master gradation limits for the specified type of mix.

If an acceptable pavement is not produced and it is determined that the accepted mix design is at fault, paving operations shall be stopped and the Contractor shall prepare a new mix design. The processing of proposed changes or new designs shall follow the same procedures as the initial mix designs.

404.02 Mixture Requirements. Asphalt mixtures will be designed and tested to meet the requirements specified in Sections 405, 406, and 407.

404.03 Mixture Substitutions. Substitutions of specified courses will be allowed only on shoulders, leveling, and incidental or temporary construction as follows:

1) ACHM Base Course (1-1/2″ [37.5 mm]) may be replaced with:
   ACHM Binder Course (1″ [25 mm])
   ACHM Surface Course (1/2″ [12.5 mm])
   ACHM Surface Course (3/8″ [9.5 mm])
2) ACHM Binder Course (1″ [25 mm]) may be replaced with:
   ACHM Surface Course (1/2″ [12.5 mm])
   ACHM Surface Course (3/8″ [9.5 mm])
3) ACHM Surface Course (1/2″ [12.5 mm]) may be replaced with:
   ACHM Surface Course (3/8″ [9.5 mm])

Mixture substitution will be at the planned rate for the material for which the substitution is being made and shall use the specified asphalt binder grade. Measurement for payment of all components of the mix will be based on the accepted mix design for the type specified on the plans or on the accepted mix design for the type used, whichever results in the lower cost per ton (metric ton) of mix to the Department. If no accepted mix design for the type specified on the plans is available, the mixture composition for payment will be based on the composition shown on the plans as the basis of estimate for the plan type or on the accepted mix design for the mix

actually used, whichever results in the lower cost per ton (metric ton) of mix to the Department.

404.04 Quality Control of Asphalt Mixtures. The Contractor shall perform all applicable quality control sampling and testing of the asphalt mixtures used on the project.

The Contractor is responsible for product quality control during handling, blending, mixing, storing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to produce the accepted mix design within the tolerances specified for the mix. Adjustments to the accepted mix design to conform to actual production values without re-design of the mixture shall be based on production of the mixture at a target value of 4.0% Air Voids (AV) for PG 76-22 mixes and 4.5% Air Voids (AV) for PG 64-22 and PG 70-22 in specimens and an asphalt binder content not less than that specified in the accepted mix design. The VMA shall be within the specified limits for the adjustment to be acceptable.

The accepted mix design shall be field verified by the Contractor at the start of mix production or after an interruption of more than 90 calendar days. The asphalt mixture shall be verified by testing mix that has been produced through the plant using the aggregate proportions shown on the accepted mix design.

The mix will be considered to be verified if test values for air voids, asphalt binder content, and VMA are within the compliance limits shown in Table 410-1, and when the accepted mix design has been produced within the gradation tolerances according to Subsection 404.04.

After verification of the initial design, the Contractor may elect to make adjustments in aggregate proportions to vary the accepted mix design gradations and bring the mix properties near the center of the compliance limits. If these adjustments are made and the plant produced mix has the desired properties, the Contractor may request that a field mix design be accepted by the Engineer. If this is acceptable to the Engineer, the Contractor will be notified in writing.

If other changes to the accepted mix design are desirable, the Contractor must first produce another laboratory mix design, submit it to the Engineer for review and acceptance, and follow the verification procedures that are described above.

The Contractor shall perform all applicable quality control sampling and testing required to ensure that the completed asphalt pavement complies with all requirements of the specifications. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*.

Quality control sampling and testing shall be accomplished in a timely manner. Sampling and testing shall be planned and conducted so that a representative sample is obtained and tested. The Contractor shall determine the specific locations for samples and frequency of sampling for quality control, except the minimum frequency which is listed below for aggregate gradation shall be used. In addition, the Contractor shall be required to perform acceptance sampling and testing at specific times and/or locations specified by the Engineer according to Subsection 410.09. The Contractor may use the results of these required tests in their quality control program.

If the accepted mix design is not being produced as defined by the accepted mix design, and if the mix cannot be adjusted within the tolerances of the accepted mix design to achieve the specified mix properties, production shall be discontinued. A new mix design shall be developed and submitted for review and acceptance. Sieve tolerances shall be as tabulated below.

Mix Design Tolerances

Sieve Size	**(mm)**	**Tolerance (%)**
1"	(25.0)	±7.0
3/4"	(19.0)	±7.0
1/2"	(12.5)	±7.0
#4	(4.75)	±7.0
#8	(2.36)	±7.0
#16	(1.18)	±4.0
#30	(0.60)	±4.0
#50	(0.30)	±4.0
#100	(0.15)	±4.0

Sampling shall be performed according to AASHTO T 168 and AHTD 465, except that the number and locations for sampling shall

be as specified in this Subsection and in Subsection 410.09. Test methods shall be as shown below:

Property	**Test Method(s)** (NOTE 1)
Aggregate Gradation	AASHTO T 30, AHTD 460, or AASHTO T 308 1 per 750 metric tons (750 tons) minimum
Asphalt Binder Content (NOTE 4)	AHTD 449/449A or AASHTO T 308
Stability	AASHTO T 245
Air Voids (AV) (NOTE 2)	AASHTO T 269
Voids in Mineral Aggregate (VMA)	AHTD 464
Density - Maximum Theoretical	AASHTO T 209
Density (Field)	AASHTO T 166 or AHTD 461
Water Sensitivity (NOTE 3)	AHTD 455A
Wheel Tracking Test	AHTD 480

NOTE 1: Where alternate test methods are shown, the method used shall be at the Contractor's option. All testing for quality control and acceptance shall be performed on samples of the plant mixed product. Field densities and samples to investigate segregation shall be taken from the roadway after compaction; all other samples shall be taken from trucks at the plant.

NOTE 2: Test for AV on samples prepared by gyratory compactor according to the volumetric mix design procedures in AASHTO M 323.

NOTE 3: The Water Sensitivity shall be determined at least once during the first three days of production of each type mix; during the first three days of production of any new mix design; and/or during the first three days of production after an interruption of 90 calendar days or more. If the water sensitivity falls more than 10 percentage points below that specified for the type mix, production shall cease and a new mix design will be required.

NOTE 4: Department test results for asphalt binder content will be determined by AHTD 449/449A (nuclear asphalt content gauge) exclusively. In the event of disagreement between the test results from a nuclear gauge and test results from an ignition oven, the

nuclear gauge results shall take precedence over the ignition oven results.

Sampling and testing for acceptance and adjustment of payment will be performed as specified in Subsection 410.09.

The Contractor shall furnish a building for the use of the Department's plant inspector according to Subsection 409.03(h). This building shall be separate and independent of the Contractor's facilities and equipment for performing quality control sampling and testing. The "separate and independent" requirement may be met by space in a building that is also used by the Contractor or supplier, provided that the space otherwise meets all requirements of Subsection 409.03(h); is physically separated from the rest of the building by a solid wall; and has an outside entrance with all keys placed in the custody of the Engineer.

The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures. The Contractor's quality control personnel may observe the AHTD project personnel during acceptance sampling and testing for the purpose of comparing sampling and testing procedures.

The Contractor shall maintain a daily plot of all test results, and make the plots available to the Engineer. Upon completion of work on the item these plots shall be furnished to the Resident Engineer for inclusion in the project files. The Resident Engineer will make acceptance test results available to the Contractor's personnel.

If the test results show that the material is outside the mix design limits, is widely varying, or is consistently marginal, corrective action shall be taken. Corrective actions taken shall be based on the Contractor's quality control test results. The Department's asphalt plant inspector will be notified of all proposed corrective actions before their implementation. Each individual aggregate cold feed may be adjusted no more than an amount that is sufficient to produce the specified AV and VMA and that is within the tolerances for the accepted mix design. If excessive changes are required, production will be suspended and a new mix design shall be developed according to the applicable specifications.

Use of nuclear asphalt content gauges is regulated by the Radiation Control and Emergency Management Programs of the Arkansas State Department of Health. If the Contractor elects to use a nuclear gauge in his quality control program, he shall be

responsible for meeting and following all licensing and use requirements.

404.05 Method of Measurement and Basis of Payment. Design and Quality Control of Asphalt Mixtures will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various types of asphalt concrete hot mix used on the project.

SECTION 405
ASPHALT CONCRETE HOT MIX BASE COURSE

405.01 Description. This item shall consist of a base course constructed on an accepted course according to these specifications and in substantial conformity with the lines, grades, and typical cross section shown on the plans.

405.02 Vacant

405.03 Materials. The materials used shall comply with Section 409 and this subsection. The materials shall be proportioned to meet the design requirements for asphalt concrete base course as shown in Table 405-1.

The design and quality control of ACHM base course mix shall be according to Section 404.

Table 405-1
Design Requirements for Asphalt Concrete Hot Mix Base Course
(1-1/2″ [37.5 mm])

	Control Points
Sieve (mm)	Percent Passing (%)
2″ (50.0)	100
1½″ (37.5)	90 - 100
1″ (25.0)	90 max.
No. 4 (4.75)	-
No. 8 (2.36)	15 - 41
No. 16 (1.18)	-
No. 30 (0.60)	-
No. 50 (0.30)	-
No. 200 (0.075)	0 - 6

Table 405-1 continued

Asphalt Binder Content	Design Value	
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)	
% VMA	11.5 – 13.0	
Minimum Water Sensitivity Ratio	80.0	
% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test (8000 cycles, 100 psi, 64ºC)	Design Gyration	Maximum Rut
	75 & 115	0.315 in. (8.000 mm)
	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

405.04 Equipment. Equipment used in this construction shall comply with Section 409.

405.05 Construction Requirements and Acceptance. Construction requirements and acceptance shall conform to the requirements of Section 410. The required density shall be 92% to 96% of the maximum theoretical density. The required density for ACHM Base Course placed in trench areas less than 6' (1.8 m) in width at levels below the existing pavement surface shall be 90% to 96%.

405.06 Method of Measurement. (a) Mineral aggregate will be measured by the ton (metric ton).

(b) Asphalt binder will be measured by the ton (metric ton).

Quantities of mineral aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weights will be used in lieu of truck scales to determine the total weight of the composite mixture.

405.07 Basis of Payment. Basis of Payment. Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in ACHM Base Course. Mineral filler will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Mineral Aggregate.

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG ____) in ACHM Base Course (1½″ [37.5 mm]). Anti-strip additives will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Asphalt Binder.

The contract unit prices mentioned above shall be full compensation for furnishing materials; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Mineral Aggregate in ACHM Base Course (1-1/2″ [37.5 mm])	Ton (Metric Ton)
Asphalt Binder (PG ____) in ACHM Base Course (1-1/2″ [37.5 mm])	Ton (Metric Ton)

SECTION 406
ASPHALT CONCRETE HOT MIX BINDER COURSE

406.01 Description. This item shall consist of an asphalt concrete binder course constructed on an accepted course according

to these specifications and in reasonably close conformity with the lines, grades, and typical cross sections shown on the plans.

406.02 Materials. The materials used shall comply with Section 409 and this subsection. The materials shall be proportioned to meet the design requirements for asphalt concrete binder course mixtures as shown in Table 406-1.

The design and quality control of ACHM binder course mix shall be according to Section 404.

406.03 Equipment. The equipment used in this construction shall comply with Section 409.

406.04 Construction Requirements and Acceptance. Construction requirements and acceptance shall conform to the provisions of Section 410. When Binder is placed on shoulders constructed under Section 216 or on reconstructed base course under Section 305, the minimum density shall be 90% of the maximum theoretical density. The required density for ACHM Binder Course placed in trench areas less than 6' (1.8 m) in width at levels below the existing pavement surface shall be 90% to 96%.

Table 406-1
Design Requirements for Asphalt Concrete Hot Mix Binder Course (1″ [25 mm])

Sieve (mm)	Control Points Percent Passing (%)
1½″ (37.5)	100
1″ (25.0)	90 - 100
¾″ (19.0)	90 max.
No. 4 (4.75)	-
No. 8 (2.36)	19 - 45
No. 16 (1.18)	-
No. 30 (0.60)	-
No. 50 (0.30)	-
No. 200 (0.075)	1 - 7
Asphalt Binder Content	Design Value
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)
% VMA	12.5 – 14.0
Minimum Water Sensitivity Ratio	80

% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test	Design Gyration	Maximum Rut
(8000 cycles, 100 psi,	75 & 115	0.315 in. (8.000 mm)
64ºC)	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

406.05 Method of Measurement. (a) Mineral aggregate will be measured by the ton (metric ton).

(b) Asphalt binder will be measured by the ton (metric ton).

Quantities of aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weights will be used in lieu of truck scales to determine the total weight of the composite mixture.

406.06 Basis of Payment. Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in ACHM Binder Course (1″ [25 mm]). Mineral filler will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Mineral Aggregate.

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG _____) in ACHM Binder Course (1″ [25 mm]). Anti-strip additives will not be paid

for separately, but full compensation therefor will be considered included in the contract unit price bid for Asphalt Binder.

The contract unit prices mentioned above shall be full compensation for furnishing materials; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Mineral Aggregate in ACHM Binder Course (1″ [25 mm])	Ton (Metric Ton)
Asphalt Binder (PG _____) in ACHM Binder Course (1″ [25 mm])	Ton (Metric Ton)

SECTION 407
ASPHALT CONCRETE HOT MIX SURFACE COURSE

407.01 Description. This item shall consist of an asphalt concrete surface course constructed on an accepted course according to these specifications and in reasonably close conformity with the lines, grades, and typical cross sections shown on the plans.

407.02 Materials. The materials used shall comply with Section 409 and this subsection. The materials shall be proportioned to meet the design requirements for asphalt concrete surface course mixtures as shown in Table 407-1 or Table 407-2, as appropriate.

The design and quality control of ACHM surface course mix shall be according to Section 404.

407.03 Equipment. The equipment used in this construction shall comply with Section 409.

407.04 Construction Requirements and Acceptance. Construction requirements and acceptance shall comply with Section 410. When Surface is placed on shoulders constructed under Section 216 or on reconstructed base course under Section 305, the minimum density shall be 90% of the maximum theoretical density. The required density for ACHM Surface Course

placed in trench areas less than 6' (1.8 m) in width at levels below the existing pavement surface shall be 90% to 96%.

Table 407-1

Design Requirements for Asphalt Concrete Hot Mix Surface Course (1/2″ [12.5 mm])

Sieve (mm)	Control Points Percent Passing (%)
¾″ (19.0)	100
½″ (12.5)	90 - 100
3/8″ (9.5)	90 max.
No. 8 (2.36)	28 - 58
No. 16 (1.18)	-
No. 30 (0.60)	-
No. 50 (0.30)	-
No. 200 (0.075)	2 - 10

Asphalt Binder Content	Design Value	
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)	
% VMA	14.0 – 16.0	
Minimum Water Sensitivity Ratio	80.0	
% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test (8000 cycles, 100 psi, 64ºC)	Design Gyration	Maximum Rut
	75 & 115	0.315 in. (8.000 mm)
	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

Table 407-2

Design Requirements for Asphalt Concrete Hot Mix Surface Course (3/8″ [9.5 mm])

Sieve (mm)	Control Points Percent Passing (%)
½″ (12.5)	100
3/8″ (9.5)	90 - 100
No. 4 (4.75)	90 max.
No. 8 (2.36)	32 - 67
No. 16 (1.18)	-
No. 30 (0.60)	-
No. 50 (0.30)	-
No. 200 (0.075)	2 - 10

Asphalt Binder Content	Design Value	
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)	
% VMA	15.0 – 17.0	
Minimum Water Sensitivity Ratio	80.0	
% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test (8000 cycles, 100 psi, 64ºC)	Design Gyration	Maximum Rut
	75 & 115	0.315 in. (8.000 mm.)
	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

407.05 Method of Measurement. (a) Mineral aggregate will be measured by the ton (metric ton).

(b) Asphalt binder will be measured by the ton (metric ton).

Quantities of aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and

mixing control system, the printed batch weights will be used in lieu of truck scales to determine the total weight of the composite mixture.

407.06 Basis of Payment. Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in ACHM Surface Course (_____). Mineral filler will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Mineral Aggregate.

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG ____) in ACHM Surface Course (_____). Anti-strip additives will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Asphalt Binder.

The contract unit prices mentioned above shall be full compensation for furnishing materials; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Mineral Aggregate in ACHM Surface Course (1/2″ [12.5 mm])	Ton (Metric Ton)
Asphalt Binder (PG _____) in ACHM Surface Course (1/2″ [12.5 mm])	Ton (Metric Ton)
Mineral Aggregate in ACHM Surface Course (3/8″ [9.5 mm])	Ton (Metric Ton)
Asphalt Binder (PG _____) in ACHM Surface Course (3/8″ [9.5 mm])	Ton (Metric Ton)

SECTION 408 VACANT

SECTION 409
MATERIALS AND EQUIPMENT FOR ASPHALT CONCRETE PLANT MIX COURSES

409.01 Mineral Aggregates. Mineral aggregate for Asphalt Concrete Hot Mix Base Course, Asphalt Concrete Hot Mix Binder Course, Asphalt Concrete Hot Mix Surface Course, and Asphalt Concrete Cold Plant Mix shall consist of combinations of coarse aggregate, fine aggregate and mineral filler as provided for in the respective mix designs. Mineral aggregate shall consist of clean, hard, durable fragments of aggregate of uniform quality, free from an excess of soft particles, deleterious material and adherent films of clay. Eighty-five percent of the mineral aggregate shall be produced from larger particles by mechanical crushing operations.

Coarse aggregate shall comply with Table 409-1.

Table 409-1
Coarse Aggregate Properties

Coarse Aggregate Type	Crushed Gravel; Crushed Stone; Steel Slag
Size	Plus No. 8 (2.36 mm)
Fractured Faces	
One Face	98 % min.
Two Faces	80 % min.
LA Abrasion (AASHTO T 96)	40 % max.
Sodium Sulfate Soundness [Note 1] (AASHTO T 104, 5 cycle)	12% max.
Flat, Elongated Particle	10 % max.
Wearing Surface Aggregate	
Limestone	60 % max.
Other [Note 2]	40 % min.
Gravel	60 % max.
Other [Note 3]	40 % min.

NOTE 1: Sodium Sulfate Soundness does not apply to Crushed Gravel.

NOTE 2: Crushed sandstone, crushed siliceous gravel, syenite, novaculite, crushed steel slag, or mineral aggregate which has an insoluble residue not less than 85% when tested in a 1:1 solution of hydrochloric acid and water according to ASTM D3042 shall be used as the remaining coarse mineral aggregate.

NOTE 3: Crushed steel slag, crushed sandstone, syenite, novaculite, or other crushed quarry stone which has an insoluble residue not less than 85% when tested in a 1:1 solution of hydrochloric acid and water according to ASTM D3042 shall be used as the remaining coarse mineral aggregate.

The fine aggregate shall comply with Table 409-2.

Table 409-2
Fine Aggregate Properties

Fine Aggregate	
Type [Note 1]	Manufactured Sand; Natural Sand
Size	Minus No. 8 (2.36 mm)
Fine Aggregate Angularity [Note 2 & 3]	As specified in AASHTO M 323
Sand Equivalent	As specified in AASHTO M 323
Natural Sand Content	15% max.
Coal and/or Lignite [Note 4]	2% max.

NOTE 1: Manufactured sand shall be angular particles that have been produced from larger particles by mechanical crushing operations.

NOTE 2: Test to be performed according to AASHTO T 304 using the aggregate blend specific gravity of the minus No. 8 (2.36 mm) sieve through plus No. 100 (0.15 mm) sieve material.

NOTE 3: If any part of an ACHM Binder Course or an ACHM Base Course is used within 4 inches (100 mm) of the pavement surface, the binder or base course lift shall comply with the angularity requirements for the top 4 inches (100 mm) of pavement.

NOTE 4: The amount of coal and lignite shall be determined according to AASHTO T 113.

409.02 Asphalt Binder. Asphalt binder shall be according to AASHTO M 320 Table 1, except the Direct Tension requirement is deleted.

If required, the asphalt binder shall contain a heat-stable anti-stripping additive. The additive shall be approved by the Engineer. It shall be added at the rate of 0.5% to 0.75% by weight of asphalt binder as determined by laboratory analysis and laboratory mix design procedures. The anti-stripping additive shall be added by an in-line blending process just before introduction of the asphalt binder to the mixer.

409.03 Mixing Plants. (a) General. The plant used in the production of the mixture shall be of the separate weigh batch type, the continuous mixing type, or the drum mixing type. The separate weigh batch type and the continuous mixing type may be operated without screens.

(b) Requirements of All Plants.

(1) Uniformity. The plant shall be so designed, coordinated, and operated as to produce mixtures within the job mix tolerances fixed by these specifications.

(2) Storage Tanks for Asphalt Binder. Storage tanks shall be equipped to heat the asphalt binder, under effective and positive control at all times, to the temperature requirements set forth in the specifications. Heating shall be accomplished by steam or oil coils, electricity, or other means such that no flame comes into contact with the heating tank.

A circulating system for the asphalt binder shall be provided of adequate size to ensure proper and continuous circulation during the entire operating period.

Pipe lines and fittings shall be steam or oil jacketed or otherwise properly insulated to prevent heat loss.

Provisions shall be made for sampling storage tanks.

The asphalt storage system shall be provided with signal devices and controls that will warn of low levels if the asphalt storage level is lowered to the point of exposing the feed end of the asphalt suction line.

(3) Mineral Filler and Dust Return. Dry storage shall be provided for mineral filler, when required, and provision shall be made for accurate proportioning.

If the asphalt plant is equipped with a baghouse dust collector, the fines, if elected to be reintroduced to the mixture, shall be added to the mixture at the approximate rate at which collected. In addition baghouse fines may be stored in a silo for use in mixes. If baghouse fines from a silo are incorporated into a mix, the baghouse fines shall be added at the rate that is shown on the mix design. Direct return from the baghouse to the hot elevator will be permitted only when it can be demonstrated that the flow can be controlled at a uniform rate. Intermittent feeding of baghouse fines into the mixture will not be permitted.

(4) Cold Feed Bins and Cold Feeder for Dryer. A minimum of 3 cold feed bins shall be used with weigh batch and continuous mixing type plants, and a minimum of 4 cold feed bins shall be used with drum mixing type plants, weigh batch type plants without screens, and continuous mixing type plants without screens. The bins shall be of sufficient size to store the amount of aggregate that is required for continuous plant operations. The unit shall have a mechanical feeder control mounted under the cold feed bins capable of controlling cold aggregate feeds at the rates shown on the job mix design.

A scalper screen of the dimensions necessary to remove oversize aggregates shall be provided.

(5) Dryer. The plant shall include a dryer or dryers that will continuously agitate the aggregate during the heating and drying process. The dryer shall be capable of heating and drying the aggregate to the moisture and temperature requirements without leaving any visible unburned fuel or carbon residue on the aggregate when discharged from the dryer.

(6) Asphalt Control Unit. Satisfactory means, either by weighing, metering, or the taking of volumetric measurements, shall be provided to obtain the proper amount of asphalt binder in the mixture within the tolerance specified for the job mix.

Suitable means shall be provided, either by steam jacketing or other insulation, for maintaining the specified temperature of asphalt binder in the system.

(7) Thermometric Equipment. An armored automatic recording thermometer covering a range from 200° F to 400° F (90° C to 205° C) shall be fixed in the asphalt binder feed line at a suitable location near the discharge valve at the mixer unit.

An armored recording thermometer shall be placed as to register and record automatically the temperature of the heated aggregates.

(8) Pollution Control Equipment. Asphalt mixing plants shall be so designed, equipped, and operated that the quality and quantity of pollutants emitted will conform to the requirements of applicable Federal, State, and local laws, ordinances, and regulations.

(9) Storage Silos and Surge Bins. Storage silos or surge bins may be used to store production mixture provided that it is not detrimental to the quality of the mixture placed on the roadway.

Open Graded Asphalt Base Course mixtures shall not be stored.

Mixtures that are determined by visual observation to be segregated will be rejected.

The system shall be capable of conveying the hot mix from the plant to the silo by means of a drag-slat conveyor system or other approved system. The conveyor may be enclosed and heated to prevent a drop in the mixture temperature; however, hot air shall not be blown on the mixture.

The atmosphere within the silo may be air or inert gas. The storage silo heating system shall be capable of maintaining the mixture temperature without localizing heating (hot spots). If inert gas is used, the inert gas system must be capable of purging the silo with an oxygen-free (inert) atmosphere and then sealing the silo to prevent loss of the inert gas.

Permissible storage times shall be as follows:

	Storage Time (Hours)* Maximum Aggregate Size	
	¾" (19.0 mm)	1½" (37.5 mm)
Air in bin	36	18
Inert gas in bin	144	72

*Note: Asphalt binder shall be treated with a silicone that is on the Department's QPL at the rate of 1 ounce/5000 gallons (1 g/668 L).

Longer storage times than those permitted above may be allowed based upon the results of tests on the mixture. All sampling and testing of the mixture shall be performed by an approved independent laboratory and certified correct. To qualify the silo or storage bin for longer storage times, the mixture must be sampled immediately after it is mixed and again after it has been stored at the requested longer time.

Penetration loss in storage shall not exceed 20 percent. Comparative tests shall be performed according to AASHTO T 49.

The minimum limits for Rolling Thin Film Oven (RTFO) residue when tested with a Dynamic Shear Rheometer (DSR) in accordance with AASHTO T 315, from samples of discharge from the surge or storage bin, shall be as follows:

GRADES	MINIMUM
PG 64-22	0.3 psi @ 147°F (2.2 kPa @ 64°C)
PG 70-22	0.3 psi @ 158°F (2.2 kPa @ 70°C)
PG 76-22	0.3 psi @ 169°F (2.2 kPa @ 76°C)

Once a silo or storage bin has qualified for longer storage times for particular types of mixes, the requested longer storage times may be used on other jobs without additional testing. Testing of mixture for permitting longer storage time will be at no cost to the Department.

If changes or alterations to a qualified surge or storage system are made, the Engineer shall be notified of the modifications. Any departure or alteration will require reevaluation.

The storage silo or surge bin unloading gates shall not cause segregation or be detrimental to the mixture in any way.

(10) Safety Requirements. Adequate and safe access to all parts of the plant shall be provided for plant inspection. Moving parts shall be shielded. A clean, free from drippings, and unobstructed passage shall be maintained at all times in and around the truck loading space

(11) Anti-strip Additive Measuring System. An anti-strip additive measuring system shall be placed in the anti-strip additive line prior to introduction into the asphalt binder loading line. The meter shall be capable of handling the anti-strip additive at temperatures up to 162° F (72° C) and shall be capable of withstanding the corrosiveness of the anti-strip additive. Meters having working internal components exposed to the additive shall not be composed of aluminum, brass, bronze, or copper. Permanent provisions shall be made for checking the accuracy of the meter. The meter shall be designed so that the cumulative amount of anti-strip additive can be accurately determined.

The anti-strip additive pipe line shall be insulated.

(12) Scales. All approved plant and truck scales shall be furnished by the Contractor according to Subsection 109.01(f).

(c) Additional Requirements for Batch Plants.

(1) Hot Bins. The plants shall include hot bins of sufficient capacity to supply the mixer when it is operating at full capacity. Hot Bins shall be divided into at least three compartments unless otherwise specified.

Each compartment shall be provided with an overflow pipe that shall be of such size and at such location as to prevent any backing up of material into other bins.

(2) Proportioning Equipment. Mineral aggregate shall be proportioned by weight.

The weighing unit shall consist of one hopper or weigh box large enough to hold one batch without running over or without requiring manual placement.

The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they will not be easily thrown out of alignment or adjustment.

The gate shall close tightly when the hopper is empty so that no material will be allowed to leak into a batch in the mixer during the process of weighing the next batch.

(3) Scales. Scales for weigh box or hopper shall be of the digital or springless dial type and shall be of standard make and design.

The capacity of the dial shall not exceed twice the full capacity of the mixer. The dials shall be of compounding type having full complements of index pointers. Scales shall be equipped with a tare beam.

Weight indicators shall be plainly visible and easily read by the operator.

Pointers so placed as to give excessive parallax errors shall not be used.

Scale indicators placed at locations other than the mixer platform shall be operated by a satisfactory electronic system. A mechanical arrangement such as cables and pulleys for operating the scale indicators will not be permitted.

Asphalt shall be measured by weight in a heated bucket suspended from a springless dial scale. Scales for weighing asphalt shall conform to the specifications for the scales for aggregate, and shall read to the nearest pound (kilogram).

In lieu of plant and truck scales, the Contractor may provide an approved automatic printer system that will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weight ticket for each load.

(4) Mixer Unit. The plant shall include a batch mixer of an approved twin pugmill type and capable of producing a uniform mixture within the job mix tolerances.

The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate. It shall lock the asphalt 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 asphalt material. The wet mixing period is the interval of time between the start of introduction of asphalt material and the opening of the mixer gate.

The time control shall be capable of being set at intervals of not more than 5 seconds.

(d) Additional Requirements for Continuous Mixing Plants.

(1) Hot Bins. If hot bins are included as part of the design of the plant, they shall be of sufficient capacity to supply the mixer when it is operating at full capacity. Hot Bins shall be divided into at least three compartments unless otherwise specified.

Each compartment shall be provided with an overflow pipe that shall be of such size and at such location as to prevent any backing up of material into other bins.

(2) Mixer Unit. The plant shall include a continuous mixer of an approved twin pugmill type or rotary drum mixer and capable of producing a uniform mixture within the job mix tolerances

Unless otherwise required, determination of mixing time shall be by weight method under the following formula:

$$Mixing\ Time, seconds = \frac{Pugmill\ dead\ capacity, lb\ (kg)}{Pugmill\ output, lb\ (kg)\ per\ second}$$

The weights shall be determined for the job by tests made by the Engineer.

(e) Additional Requirements for Drum Mixer Plants. The system shall provide a positive weight measurement of the cold aggregate feed by use of belt scales or other devices that will allow regulation of feed gates and permit correction for variations in load.

The asphalt feed control shall be interlocked with the total aggregate weight measuring device in such manner as to automatically vary the asphalt feed rate as required to maintain proper asphalt content in the mixture.

(f) Additional Requirements for All Plants Without Screens. Cold Feed Control. The cold feed control shall be considered acceptable when the results of tests conducted on these cold feed samples indicate that the individual aggregates have been combined within the allowable tolerances for the job mixture limits.

(g) Additional Requirements for Batch Plants Without Screens. The discharge into the weigh hopper shall be made from 1 bin only, which shall discharge into the center of the weigh hopper. The amount of material stored in the bin at any one time shall be such that sloughing or segregation is minimized.

(h) Plant Inspection. The Engineer shall have access to all parts of the plant.

The Contractor shall provide and maintain a laboratory facility for the exclusive use of the Engineer. This facility shall be located at the plant site. The dimensions and other requirements specified herein are minimums. The facility may be built by the Contractor for the specific purposes stated. It is not intended, however, to preclude the use of commercially built trailers or prefabricated buildings that may deviate in minor dimension or detail from the requirements listed but may in some features exceed these requirements and in all major respects be entirely suitable for the purpose intended. The Contractor may furnish, in lieu of a separate building, a facility having sufficient space in a building, parts of which are used for other purposes, provided that the facility furnished meets all other requirements of this subsection; is physically separated from the remainder of the building; and has an outside entrance with unrestricted access allowed and reserved for the exclusive use of the Engineer. Adequate space shall be provided for parking of at least three Department vehicles in the vicinity of the facility. The Engineer will determine the suitability of any facility furnished.

General requirements for the laboratory facility are:

- 208 square feet (20 sq m) floor space, with a width of 8' (2.5 m) or greater and a ceiling height of 7' (2 m).
- Floored, weatherproof, and reasonably dustproof.
- At least two glazed windows capable of being opened and locked only from the inside.
- At least one door with a substantial lock and all keys placed in the possession of the Engineer.
- Windows and doors shall be screened.
- Adequate electric lights and power outlets suitable for the purposes intended. At least one power outlet shall provide 220 VAC.
- Adequate heating in cold weather and air conditioning in hot weather. Heating, cooling, and utility service shall be provided at no cost to the Department.
- Suitable toilet facilities in reasonably close proximity to the facility.

Detailed requirements:

- A work counter approximately 30″ (750 mm) high built-in along one wall and across one end. Total length of the work counter shall be approximately 20' (6 m).
- A single sink, approximately 20″ (500 mm) square, with outside drain, suitable for washing samples, installed in the end section of the work counter.
- A water supply providing a minimum of 50 gallons (200 liters) storage capacity (or connected to a public or private water system), discharging through a faucet above the sink.
- Adequate shelves and/or cabinets for storage of testing equipment.
- A storage area for storing nuclear equipment, complete with a substantial lock and all keys to this area placed in the possession of the Engineer.
- A desk or table approximately 24" x 36" (600 mm x 900 mm), with at least two drawers, each approximately 13" x 13" x 18" (330 mm x 330 mm x 450 mm) for storing records.
- At least three chairs.
- At least one Type C fire extinguisher (10-pound size minimum).
- An exhaust fan shall be installed over the equipment clean up area. The exhaust fan shall be rheostatically controlled and capable of exhausting in one minute a volume of air equal to the volume of the entire laboratory. The exhaust fan shall be maintained operational.
- A local access touchtone telephone line (with access to toll free telephone numbers but otherwise blocked for out-going long distance calls), with a landline modular jack and touchtone telephone, shall be provided in the laboratory facility for use by Department personnel. The local landline telephone service will be furnished at no cost to the Department.

The field laboratory for asphalt mixing plants will not be paid for directly, but will be considered a part of the asphalt mixing plant.

409.04 Equipment. (a) Mechanical Spreading and Finishing Equipment. Mechanical spreading and finishing equipment shall consist of a self-powered paver, capable of spreading and finishing the mixture true to line, grade, and cross section. The paver shall be capable of laying a uniform mixture to the full width being laid.

The paver shall be equipped with mechanical devices such as equalizing runners, straightedge runners, evener arms, or other compensating devices to adjust the grade and confine the edges of the mixture to true lines. The paver shall be equipped with hoppers and distributing screws adequate to place the mixture evenly ahead of the screed for the full width being laid.

Pavers used for shoulders and similar construction shall be capable of uniformly spreading and finishing courses of asphalt material to the full width being laid. The paver shall be equipped with a receiving hopper and distribution system to place the mixture uniformly across the entire width of the screed.

The term "screed" shall include any strike-off device, operated by cutting, crowding, or other practical action that effectively places and spreads the mixture without tearing, shoving, gouging, or segregating. Screeds shall be adjustable to crown and grade and shall have an indicating level attached.

The paver shall be equipped with an automatic screed control system for the control of grade and slope. The sensor for grade control may be operated from a reference stringline, from a ski-type grade reference system, or by any other appropriate method that will produce the desired results.

Final approval of spreading and finishing equipment will be based upon satisfactory performance during actual construction. If equipment becomes unsatisfactory, it shall be replaced before proceeding with the work.

(b) Materials Transfer Device (MTD) / Materials Transfer Vehicle (MTV). A Materials Transfer Device or Materials Transfer Vehicle (MTD/MTV) shall be used on all State, US, and Interstate highways for the placement of all ACHM courses. ACHM quantities exempt from this requirement are projects or phases of work with less than 1000 tons of hot mix, leveling, parking lots, driveways and turnouts, temporary pavements (such as detours and crossovers), and ACHM placement in trench widening areas less than 11′ (3.3 m) in width. At the Engineer’s discretion, isolated

portions of a project may be exempted from use of the MTD/MTV if the weight or operation of the MTD/MTV is detrimental to the roadway. Exemptions will not be made prior to the beginning of paving operations and initial use of the MTD/MTV. The MTD/MTV may not be removed from the project during the paving operations over the exempted location; rather it must be on-site and available to resume work once the paving operation moves out of the isolated area.

The ACHM mixture shall be transferred mechanically to the paver by means of a MTD/MTV. The material shall be continuously remixed or reblended either internally in the transfer vehicle, in a paver hopper insert, or in the paver's hopper. Remixing/reblending shall be accomplished by the use of remixing augers, paddles or screens capable of continuously blending the hot mix asphalt.

The MTD/MTV, haul units, and paver shall work together to provide a continuous, uniform, segregation free flow of material. The number of haul units, speed of the paver, plant production rate, and speed of the MTD/MTV shall be coordinated to avoid stop and go operations. The wings of the paver receiving hopper shall not be raised (dumped) at any time during the paving operation.

If a MTD/MTV or remixing/reblending unit malfunctions during lay-down operations, the Contractor may continue hot mix lay-down operations until any hot mix asphalt in transit or stored in a silo (up to a maximum of 500 tons [500 metric tons]) has been laid and until such time as there is sufficient hot mix placed to maintain traffic in a safe manner. Lay-down operations shall cease thereafter, until such time as the equipment is operational.

The Engineer will evaluate the performance of the MTD/MTV and remixing/reblending equipment by measuring the temperature profile of the mat immediately behind the screed of the paver during placement of the rolling pattern test strip. The ACHM to be placed for the temperature profile test shall be held in the haul truck(s) for at least 45 minutes, measured from the time of loading to the time of discharging into the MTD/MTV. If the bed of the haul truck is covered, the cover will be removed once arriving at the test strip location. The temperature profile measurements shall be taken of the surface of the mat at six 50 ft. (13 m) intervals during test strip construction using a non-contact thermometer. Each temperature profile shall consist of three surface temperature measurements

taken transversely across the mat in a straight line at a distance of 1 foot to 3 feet (0.3 m to 1 m) from the screed while the paver is operating. The three temperature measurements in each profile shall be taken approximately one foot (0.3 m) from each edge and one in the middle of the mat. The difference between the maximum and minimum temperature of each individual profile shall not be more than 10°F (6° C).

If any two temperature measurement profiles within the test strip do not comply with the 10°F (6° C) temperature differential requirement, the paving operation shall be halted and adjustments made to the MTD/MTV or remixing/reblending equipment to ensure that the hot-mix placed by the paver is within the above temperature requirements. Once adjustments are made, the Engineer will repeat this procedure to verify that the mix placed by the paver is within specifications.

Additional surface temperature profile measurements may be taken transversely across the mat at any time during the project to determine if the MTD/MTV and remixing/reblending equipment are working properly. During this verification testing, if two consecutive temperature measurement profiles do not comply with the 10°F (6° C) temperature differential requirement, the paving operation shall be halted and adjustments made to the MTD/MTV or remixing/reblending equipment to ensure that the hot-mix placed by the paver is within the above temperature requirements.

(c) Rollers. Rollers shall be of the size and type to produce the density required and a surface that is smooth and free from check cracking. Rollers shall have a system for moistening the full width of each tire or drum and devices for cleaning the tires or drums. Petroleum products shall not be used on the surfaces of the roller that will be in contact with the pavement.

SECTION 410
CONSTRUCTION REQUIREMENTS AND ACCEPTANCE OF ASPHALT CONCRETE PLANT MIX COURSES

410.01 Description. The methods employed in performing the work shall be at the Contractor's option. The plant and equipment shall comply with the requirements of Section 409. When the

production and/or placement of the material does not comply with the specifications, the Contractor shall make the changes necessary to bring the work into compliance.

410.02 Pre-Placement Conference. Unless waived by the Engineer, prior to the start of paving operations the Contractor shall conduct a Pre-Placement Conference involving the Contractor's personnel and the Department's personnel. The Contractor's proposed plant, delivery, laydown, compaction, and equipment shall be discussed and, if deemed necessary by the Department, all the equipment inspected. The accepted mix designs and materials to be used shall be discussed. The proposed mixing and compaction temperatures, sampling and testing plan, haul route, rolling pattern, and other pertinent information shall be discussed. The Pre-Placement Conference and all items discussed shall be documented by the Contractor and furnished to the Resident Engineer within ten calendar days after the Pre-Placement Conference.

410.03 Preparation of Mixture. The aggregates, mineral filler, and asphalt binder shall be measured separately and accurately mixed in the proper proportions according to the mix design. The aggregates shall be thoroughly coated and the mixture shall not show an excess or deficiency of asphalt binder, injury or damage due to burning or overheating, or an improper combination of aggregates. The continuous production of ACHM shall be within plus or minus 25° F (14° C) of the mixing temperature shown on the approved mix design. Momentary temperature spikes shall be kept to a minimum.

410.04 Preparation of Subgrade. Unless the course is to be placed on an existing base or pavement, the subgrade shall be prepared in conformity with the provisions of Section 212, and shall conform to the typical cross section as shown on the plans, and primed if specified. Additional material obtained from preparing the subgrade shall be bladed to the shoulders and evenly spread, with excess material being distributed evenly on the slopes.

410.05 Preparation of Existing Base or Surface. Newly constructed base or surface courses shall be prepared as set forth in the specification item covering such courses.

Before placing asphalt base, binder, or surface courses, all required corrections of the existing pavement or old base, such as filling pot holes, sags, ruts, and depressions, or alterations of the

existing pavement crown, shall be made. Such corrections shall be accomplished by placing asphalt binder or surface course mixtures at the location and in a manner as directed by the Engineer. Asphalt material used for wedging or leveling courses, or for filling holes, may be placed by hand, blade grader, or mechanical spreader methods. The mixture shall be featheredged to a smooth and even surface around the edges of these areas. Before placing asphalt material, the base or existing surface shall be primed or tacked as applicable.

Unless otherwise specified, no direct payment will be made for cleaning the surface of existing pavement.

Before arrival of the mixture on the work, the prepared surface, primed or tack coated as specified, shall be cleaned of all loose and foreign materials. The mixture shall not be placed on a surface that shows evidence of free moisture.

Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin coating of rapid curing cutback asphalt or emulsified asphalt. No direct compensation will be made for this work.

For foreign material, or when the time lapse between courses is more than 72 hours, the earlier course shall be cleaned and given a tack coat before placing the succeeding course. When directed, the tack coat shall be applied and paid for under Section 401. If directed by the Engineer, a tack coat shall be used even though the elapsed time has been less than 72 hours.

410.06 Transporting. The mixture shall be transported from the mixing plant to the work in vehicles with clean tight beds.

No loads shall be sent so late in the day as to interfere with spreading and compacting the mixture during daylight hours unless adequate artificial lighting is provided.

Sufficient haul vehicles and plant production rate shall be maintained for the project to provide a continuous operation on the roadway.

Only non-petroleum release agents listed on the QPL shall be used in haul trucks.

410.07 Spreading and Finishing. The mixture from all types of plants shall be delivered to the paver at no more than 25° F (14° C)

above the mixing temperature shown on the approved mix design. In no case shall binder or surface course be placed at a temperature less than 250° F (125° C).

The mixture shall be placed on an approved surface, spread, and struck off to the line, grade, and elevation established. The mixture shall be placed only on a base that shows no evidence of free moisture, and only when weather conditions are suitable. The Engineer may, however, permit work of this character to continue when overtaken by sudden rains to utilize materials that may be in transit from the plant at the time, provided the mixture is within the temperature limits specified and provided the finished pavement otherwise meets specification requirements. Water shall not be applied to the ACHM courses to speed cooling of the mat.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6″ (150 mm), however, in general, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two lanes in width, or at lane lines if the roadway is more than two lanes in width. On roadways with a center turn lane, the Contractor may, at his option, elect to place a joint at the crown (i.e., middle of the center turn lane) of the roadway and eliminate the joints on the lane lines of that lane. The slight excess of asphalt at a longitudinal joint, generated by overlapping during placement of an adjacent mat to a previous mat, shall not be scattered across the mat. This material shall be stacked over the joint. The first pass of the steel wheel roller shall be entirely on the new mat, with the edge of the drum 6″ (150 mm) away from the longitudinal joint. The second pass of the steel wheel roller shall be made with 6″ to 8″ (150 mm to 200 mm) of the drum overhanging onto the older mat.

General casting back of material or hand raking material onto the surface will not be permitted. Hand spreading will be permitted only in areas inaccessible to the paver.

On roads under traffic, the mixture shall be spread and finished in full lane widths where practicable. The paver shall alternate between the lanes with such frequency that the adjacent lane shall be laid no later than the next working day after the first lane is laid. A transition area from the new pavement down to the existing pavement will be constructed at the beginning and ending of each day's paving operation. The length of the transition will be based on the thickness of the ACHM course being placed:

Roadway Type	Short Term Temporary (In-place for less than 7 calendar days)	Temporary (In place for over 7 days)	Permanent
Interstates & divided highways with speed limits > 55 mph	4 ft. (1.2 m) length for each 1″ (25 mm) of thickness	10 ft. (3.0 m) length for each 1″ (25 mm) of thickness	100 ft. (30.5 m) length for each 1″ (25 mm) of thickness
Other highways with speed limits ≤ 55 mph	3 ft. (0.9 m) length for each 1″ (25 mm) of thickness	5 ft. (1.5 m) length for each 1″ (25 mm) of thickness	50 ft. (15.2 m) length for each 1″ (25 mm) of thickness

The paver shall uniformly distribute and compact the mixture in front of the screed for the full width being paved. The finished surface shall be smooth and of uniform texture.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

When laying mixtures, the paver shall be operated at forward speeds consistent with satisfactory laying of the mixture. The speed of the paver shall be matched with the plant production rate and number of hauling units. Stop and go operation of the paver shall be held to a minimum.

The edge of the Binder or Surface Course shall be established by a string or chalk line for a distance of not less than 500′ (150 m) ahead of the spreading operation.

410.08 Rolling and Density Requirements and Joints. At the beginning of placement of each mix design, the Contractor shall establish an optimum rolling pattern for the mix being placed. A strip of approximately 500′ (150 m) of the mat being placed shall be used to establish the rolling pattern. A sufficient number of coverages of the entire mat by the rollers proposed to be used by the

Contractor during production paving operations shall be made to achieve the maximum density possible. The Engineer will observe the Contractor's use of a nuclear density gauge to verify that the maximum densities possible are obtained.

The established rolling pattern shall be used for compacting all mix placed. If a change in the accepted mix design occurs, or if the compaction method or equipment is changed, or if unacceptable results are obtained, a new optimum rolling pattern shall be established.

If for any reason a rolling pattern cannot be established to produce the specified density, a new mix design will be required. The Contractor shall establish an optimum rolling pattern that will produce the maximum density using the new mix design. Continuous production of the mix shall not begin until an optimum rolling pattern that produces the specified density within the allowable range has been established.

Rolling shall start longitudinally at the low edge and proceed toward the higher portion of the mat. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Alternate passes of the roller shall be terminated at least 3′ (1 m) from any preceding stop. Rolling on superelevated curves shall progress from the low side. Rollers shall not be stopped perpendicular to the centerline of the traveled way.

The speed of the roller shall be slow enough to avoid displacement of the hot mixture, and shall in no case be more than 3 mph (5 km/h). The roller shall be operated in such a manner that no displacement of the mat will occur. Rolling shall proceed continuously until all roller marks are eliminated and the required density attained. To prevent adhesion of the asphalt mixture to the rollers, the rollers shall be kept moist for the full width of the rollers, but an excess of water will not be permitted.

Upon completion of the rolling operations, the surface shall be smooth and of uniform texture.

If the asphalt binder content varies from the value used to calculate the specific gravity, the maximum theoretical density will be adjusted accordingly. If the Contractor elects to verify the specific gravity or to establish a different specific gravity, he shall perform the test under AASHTO T 209 on production mix and

furnish the results to the Engineer. The Contractor and the Engineer will use the specific gravity that best represents the material that is being sampled for acceptance of the pavement. If either quality control or acceptance density tests indicate that the established maximum theoretical density may be in error, the Engineer may require that the specific gravity be redetermined from production mix. If production has been interrupted for 90 calendar days or the mix design has changed a new maximum theoretical density shall be established.

Rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. A brush coat of asphalt material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously placed material.

410.09 Acceptance of the Pavement and Adjustments in Payment. (a) General. The accepted mix design shall be verified by the Contractor at the start of mix production for that design or after an interruption of more than 90 calendar days. A maximum of 200 tons (200 metric tons) of material may be placed on the roadway during the verification process. If the mix produced does not verify the mix design, the material placed on the roadway shall be declared a partial lot and a new mix design submitted. Verification shall consist of test results showing that the values for air voids, VMA, and asphalt binder content are within the compliance limits. If necessary, adjustments will be made to the plant to produce mix within the specified property limits. All mixes produced shall be within the gradation tolerances of the accepted mix design according to Section 404.04. The adjusted mix shall become the new accepted mix design.

Acceptance and adjustment in payment will be by lot. The standard lot size for acceptance and adjustment in payment will be 3000 tons (3000 metric tons), with each standard lot divided into four sublots of 750 tons (750 metric tons) each. The Engineer may establish a partial lot at any time. The Engineer will determine the size of any partial lots established and the number and size(s) of the sublots, if any. Although there are no specified limits for the size of such partial lots, they normally will be not less than 300 tons (300 metric tons) nor more than 3300 tons (3300 metric tons). Field density tests shall be performed on the compacted mat on the

roadway as soon as possible, preferably not later than the day after placement.

The Contractor shall obtain and test one sample taken at random from each sublot. The Department will determine the location for each sample in the sublot by AHTD Test Method 465. The Department's inspector shall be provided an opportunity to witness all Contractor sampling and testing. The test reports of all Contractor acceptance tests shall be provided to the Engineer by the end of the first working day following production of the material.

The Department will obtain and test a minimum of one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. Verification testing will be conducted in accordance with Subsection 106.11 and the Department's *Manual of Field Sampling and Testing Procedures.* The location of the lot sample will be determined by the Department using AHTD Test Method 465. If core samples are used for field density testing, they shall be obtained by the Contractor at locations selected by the Engineer and at no cost to the Department. The samples shall be obtained using a diamond blade pavement saw or a diamond bit core drill to remove a sample of compacted pavement for the full depth of the course(s). The holes made in taking the sample shall be repaired by the Contractor at no cost to the Department.

The following procedures shall apply for field density testing when ACHM mixes are used as a leveling course or as a bond breaker between a base material and Portland Cement Concrete Pavement:

- If the entire sublot quantity is placed for leveling or as a bond breaker and the thickness of all of the leveling/bond breaker in that sublot is less than three times the nominal maximum aggregate size, no field density sample or test will be required. The sublot will be excluded from the calculation of the average field density for the acceptance of the lot in Subsection 410.09(a).

- If the entire sublot quantity is placed for leveling or as a bond breaker and portions of the leveling/bond breaker have a thickness greater than three times the nominal maximum aggregate size, a field density sample shall be obtained by the Contractor at a location determined by the Department using AHTD Test Method 465; however the sampling area will be

restricted to the area in which the thickness of the leveling course/bond breaker is greater than three times the nominal maximum aggregate size.

- If only a portion of the sublot quantity is placed for leveling or as a bond breaker, the Contractor shall obtain a field density sample at a location determined by the Department using AHTD Test Method 465; however the sampling area will be restricted to the portion of the sublot where the material used as leveling or as a bond breaker has a thickness greater than three times the nominal aggregate size and to the area where the material was not used for leveling or as a bond breaker.

When field density testing for a sublot is waived by one of the above conditions, the ACHM mix used as a leveling course or as a bond breaker shall be compacted utilizing the optimum rolling pattern to achieve the maximum density required, as required by Subsection 410.08.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

The Department will perform all tests for acceptance and adjustment in payment on material used to replace unacceptable material removed by the Contractor. The number of tests and the location(s) for sampling will be determined by the Engineer using the same procedures used for the original material. The results of these tests will be used for acceptance and adjustment in payment for the lot or sublot, as applicable.

Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures.* All sampling and testing for acceptance and adjustment in payment shall be performed using the test methods specified in Subsection 404.04 for quality control

sampling and testing. This includes performing a maximum theoretical specific gravity test (AASHTO T 209) for each acceptance and adjustment in payment test. The VMA (effective) as determined by the effective specific gravity shall be calculated. The VMA (actual) shall be determined by reducing the VMA (effective) by the correction factor shown on the mix design. Samples for all properties except density and the investigation of segregation shall be obtained from trucks at the plant. Samples shall be maintained at or near the optimum mixing temperature until the testing procedure begins. Specimens for air voids shall be compacted at or near the optimum compaction temperature. In no case shall the sample be allowed to cool below the compaction range specified by the accepted mix design.

(b) Acceptance of the Pavement. Acceptance of ACHM courses will be based on the following criteria:

- The results of tests for the properties listed in Table 410-1,
- Pavement smoothness, and
- Segregation.

(1) Properties in Table 410-1. Acceptance with respect to the properties listed in Table 410-1 will be by lot. Acceptance of a standard lot will be based on the average of the five (5) tests performed on the lot. Acceptance of a partial lot will be based on the average of the actual number of tests made on that partial lot. Acceptance of a sublot will be based on the results of the test(s) performed on samples from that sublot.

The term "mix design value" refers to the value shown in the accepted mix design.

When the average of the test results for a lot fall within the range shown in Table 410-1 as "Compliance Limits", the lot will be accepted with no price reduction for those properties. If the average of the test results for a lot for any single property listed in the table falls within the limits shown as "Price Reduction Limits", the material may be left in place at a reduced price as specified in Subsection 410.09(d). If the average of the test results for a lot for any single property listed in the table falls outside the limits shown as "Lot Rejection Limits", the entire lot shall be removed and replaced at no cost to the Department. Sampling and testing of the replacement material will be according to Subsection 410.09(a).

For any single property except density, if the result of the single test in a sublot falls outside the limits shown as "Sublot Rejection Limits", that sublot shall be removed and replaced at no cost to the Department. In the sublot containing the Department's lot test, if the result of either the Contractor's sublot test or the Department's lot test fall outside the sublot rejection limits, the two tests will be averaged and the average of the two test results used to determine acceptance or rejection of the sublot. The average of the two test results will also be used as a single value to compute the average for the lot for acceptance and adjustment.

For density, if a test for a sublot is more than 2.0 percentage points above or below the specification limits for the type of mix, that sublot will be further evaluated as follows:

Two additional density tests will be performed by the Department on a statistically random basis within that sublot, except that only one additional test will be performed if the sublot contains both a Contractor sublot test and a Department lot test. If the average of the three tests is within 2.0 percentage points above or below the compliance limits, the sublot will be accepted. The average of the three test results will be used as a single value to compute the average for acceptance and adjustment of the lot.

If the average is outside the sublot rejection limits, the sublot shall be removed and replaced at no cost to the Department. In that case, the result of a density test performed on the replacement material will be used to calculate the average for acceptance and adjustment of the lot.

(2) Pavement Smoothness. The finished surface, when checked with a 10′ (3 m) straight-edge parallel to the centerline, shall show no variation more than 3/16″ (5 mm) for binder courses and not more than 1/8″ (3 mm) for surface courses when the profile grade line is shown on the plans. If the profile grade line is not shown on the plans, the variations shall be not more than ¼″ (6 mm) for binder courses and not more than 3/16″ (5 mm) for surface courses. When surface tests indicate surface tolerances do not meet these requirements, corrections to the pavement and changes to the paving operations shall be made before beginning the next day’s operations.

All transverse joints shall be straightedged immediately following rolling of the joint. Paving will not continue until the transverse joint meets the applicable surface tolerances shown above.

The Engineer will test the finished surface of each course on main lanes and ramps with a rolling straightedge immediately following the final rolling as conditions permit. All testing will be made in a longitudinal direction and at least one pass shall be made for the full length of each lane.

Areas not meeting the above surface test requirements for all except the final surface course may be corrected by skin patching, featheredging, or other methods that would provide the required smoothness.

Areas not meeting the above surface test requirements for the final surface course shall be corrected in such a manner as to maintain a quality pavement having the same uniform texture and appearance as the adjoining surface. Skin patching will not be permitted. Featheredging will be permitted only at the beginning and the end of the job. When the corrective action involves removing and replacing a section of the final surface, the minimum area to be removed shall be 50 linear feet (15 m) of length for the full width of the course placed. Replacement of the final surface shall be accomplished using a paver.

Grinding will be allowed, if necessary, to correct surface tolerance deficiencies. The grinding equipment shall be power driven and specifically designed to smooth and uniformly texture the pavement by means of diamond blades.

All corrective work and material necessary to correct surface tolerance deficiencies for binder or surface courses shall be at no cost to the Department.

(3) Segregation. Segregation in asphalt concrete hot mix paving is the non-uniform distribution of aggregate that results in non-uniform surface texture. If a pattern of segregation develops, or if segregation occurs over a large area (3 square yards [3 sq m] or more), paving shall cease until the problem has been corrected.

TABLE 410-1
COMPLIANCE, PRICE REDUCTION AND REJECTION LIMITS FOR ACHM COURSES

Property	Compliance Limits	Price Reduction Limits	Lot Rejection Limits	Sublot Rejection Limits
Asphalt Binder Content (ALL MIXES)	±0.3 from mix design value	more than ±0.3, to ±0.6 from mix design value	more than ±0.6 from mix design value	±0.8 from mix design value
Air Voids (AV) (ALL MIXES)	3.0% to 5.0%	2.5% to 3.0% 5.0% to 5.5%	2.4% or less; 5.6% or more	1.9% or less; 6.1% or more
Voids in Mineral Aggregate (VMA)*				
ACHM Base Course (1 ½″ [37.5 mm])	11.0% to 13.0%	10.5% to 10.9%; 13.1% to 13.5%	10.4% or less; 13.6% or more	9.9% or less; 14.1% or more
ACHM Binder Course (1″ [25 mm])	12.0% to 14.0%	11.5% to 11.9%; 14.1% to 14.5%	11.4% or less; 14.6% or more	10.9% or less; 15.1% or more
ACHM Surface Course (1/2″ [12.5 mm])	13.5% to 16.0%	13.0% to 13.4%; 16.1% to 16.5%	12.9 % or less; 16.6% or more	12.4% or less; 17.1% or more
ACHM Surface Course (3/8″ [9.5 mm])	14.5% to 17.0%	14.0% to 14.4%; 17.1% to 17.5%	13.9% or less; 17.6% or more	13.4% or less; 18.1% or more
Density (% of theoretical) BASES, BINDER, AND SURFACES	92.0% to 96.0%	91.0% to 91.9%; 96.1% to 97.0%	90.9% or less 97.1% or more	89.9% or less** 98.1% or more
Density (% of theoretical) for ACHM Courses where minimum specified is 90.0%	90.0% to 96.0%	89.0% to 89.9% 96.1% to 97.0%	88.9% or less 97.1% or more	87.9% or less**; 98.1% or more

* The values for VMA(actual) shall be determined by calculating the VMA(effective) and reducing it by the correction factor shown on the mix design.
**Subject to further evaluation, see text.

Visual inspection of the compacted pavement will be made to determine the extent of any segregation. In addition to the visual inspection, objectionable areas may be tested. Samples will be obtained from the areas identified as objectionable by the Engineer. Gradation, density, and asphalt binder content of the samples will be determined according to the test methods in Section 404.04. The test values obtained shall be within the tolerances for gradation in Section 404.04 and within the compliance limits for asphalt binder content and density in Section 410. If any of the test results do not meet the requirements, the area/areas will be considered non-complying. If the non-complying material is deemed reasonably acceptable according to Subsection 105.04, it may be left in place at a reduced cost to the Department.

In the event the material is found unacceptable relative to segregation and it is determined that the material must be removed, the area(s) of segregation shall be removed full depth of the course paved. Replacement of the material by dumping and spreading by hand or motor grader will be permitted on base and binder courses for areas less than 50 linear feet (15 m) in length. Replacement of larger areas of base and binder and replacement of any surface course will be accomplished with a paver. On surface course, the minimum area to be removed shall be 50 linear feet (15 m) of the full width of the mat paved.

(4) Pavement that is determined to be non-complying for any reason other than the properties listed in Table 410-1 will be evaluated under Subsection 105.04. The Engineer will determine whether the non-complying pavement must be corrected, removed and replaced, or may be left in place at a reduced cost to the Department. Price reductions determined under Subsection 105.04 will be in addition to the price reductions, if any, determined under Subsection 410.09(d). If the total price reduction is determined to be greater than 50% for any lot, that lot will not be accepted. When two consecutive lots or any three out of five lots fail to qualify for full payment for any reason, work will be stopped until corrective action is taken.

(c) Unacceptable Pavement. Any lot or sublot of any ACHM course that is not accepted for any reason shall be removed and replaced by the Contractor at no cost to the Department. Payment for sections where removal and replacement is required will be

withheld or recovered, and released after replacement has been acceptably completed. The quantity for payment will be the original quantity and measurement of the quantity used in replacement operations will not be considered.

(d) Adjustments. Adjustments will be made by reducing the contract price of the lot according to the schedules below. Price reductions will be computed from the schedules below for each property, and reductions for each property added together to obtain the total price reduction for the lot. The total price reduction will be applied to all components of the course for the entire quantity of the lot. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction. When the number of deviations for any property shown exceeds the maximum specified, or when the total price reduction for a lot is greater than 50%, that lot will not be accepted. Continuous production of material not qualifying for full payment will not be allowed.

(1) For Asphalt Binder Content, the contract price of the entire lot will be reduced by 12% for each deviation outside the compliance limits, up to a maximum of 3 deviations. One deviation is 0.1 percentage point.

(2) For Air Voids, the contract price of the entire lot will be reduced by 10% for each deviation outside the compliance limits, up to a maximum of 5 deviations. One deviation is 0.1 percentage point.

(3) For VMA, the contract price of the entire lot will be reduced by 10% for each deviation outside the compliance limits, up to a maximum of 5 deviations. One deviation is 0.1 percentage point.

(4) For Density, the contract price of the entire lot will be reduced by 4% for each deviation outside the compliance limits up to a maximum of 10 deviations. One deviation is 0.1 percentage point.

410.10 Incentives. It is the intent of this specification to produce a pavement that is durable and consistently exceeds the minimum test values established in these specifications. To that end, incentives will be included in the pay schedule for ACHM Binder Course and/or ACHM Surface Course. Incentive pay will be according to the following guidelines.

When the entire quantity of either the ACHM Binder Course or ACHM Surface Course (including any sublots used for leveling) meets the following criteria, an incentive of the percentage designated will be applied to the dollar amount for all the components of the designated mix. For the purpose of incentives, the only tests to be considered shall be the average test results for each lot. Incentive payments will be accomplished by Change Order and will be shown on the final estimate as a separate item increase. An accumulated maximum 6.0% incentive payment is available as follows:

(a) An incentive payment of 3.0% will be added if:

- the asphalt binder content is within ±0.2 percentage point of the mix design value, and
- the total variation, low to high, in air voids is no more than 0.6%, with none outside of the compliance limits, and
- all densities fall between 92.0%* and 96.0%, and
- there are no areas of segregation outside of the compliance limits as verified by testing according to Subsection 410.09(b)(3)

*When the minimum specification density is 90.0%, this value is changed to 90.0%.

(b) An additional incentive payment of 2.0% will be added if the requirements of (a) above are met and if the VMA are within the compliance limits.

(c) If the Contractor elects, an additional incentive payment of 1.0% of the total ACHM Surface Course quantities used on the project will be added if:

- the pavement smoothness incentive criteria are met, and
- there are no corrective patches*, and
- the requirements of both (a) and (b) above are met.

*Note: Any repaved section of 1000' (300 m) or greater in length for a full lane width will not be considered a patch.

To achieve the smoothness incentive payment, the Contractor shall furnish and operate a California-style profilograph meeting the specifications of ASTM E 1274 or an automated lightweight profilometer complying with ASTM E 950, Class I and calibrated to the California-style profilograph scale, and:

(1) The finished surface shall have a maximum profile index of 3"/mile (± 0.1" blanking band) per 0.1 mile section (50 mm/km [± 2.5 mm blanking band] per 200 m section), or portion thereof, for the entire project. Individual sections will not be considered for the incentive.

In addition to the above requirements for profile indices, on the final surface course, no areas representing high or low points having a deviation greater than 0.3" in 25' (7.5 mm in 7.5 m) as determined by the profilograph shall be present.

(2) The Contractor shall take all profiles required by this subsection under the observation of the Engineer. All data obtained from the profiling operations will be furnished to the Engineer to be considered for any incentive payment.

The Engineer will verify the calibration of the profilograph equipment as frequently as necessary to assure proper operation.

The profile will be taken near the center of each main traffic lane using a California-style profilograph or lightweight profilometer. For daily operations, the profile shall begin 10' (3.25 m) back onto the previous day's run and shall be continuous to within 10' (3.25 m) of an existing structure or existing pavement, or the end of the pavement. The profile may also be determined upon completion of the project by a trace that shall run continuously to within 10' (3.25 m) of an existing structure or existing pavement, or the end of the pavement. In either case, the incentive payment will be determined at the completion of the project and when all profile traces have been submitted to the Engineer for the project files.

Scheduling and testing will be coordinated with the Engineer. The Contractor shall provide all traffic control associated with the surface testing operations.

410.11 Widening and Overlay Operations. When pavement construction results in vertical differentials at the lane lines or at the edge of the traveled lanes, the Contractor shall comply with the requirements of Subsection 603.02(d).

When asphalt hot mix material is to be placed in a trench for widening an existing pavement and the trench is inaccessible to normal rolling operations, compaction both of the subgrade and of

the asphalt material shall be accomplished by means of a trench roller or by other approved methods.

410.12 Seasonal and Temperature Limitations. Hot mix asphalt materials shall not be mixed or placed when the surface temperature is below 40° F (5° C), or when there is frost in the base or subgrade, or at any other time when weather conditions are unsuitable for the type of material being placed.

Placement of ACHM Base Course and ACHM Binder Course shall be scheduled to minimize exposure to inclement weather. The amount of ACHM Base and/or Binder exposed at any time between December 1 and March 14 shall be limited to the area that can be covered with binder and/or surface course in one (1) day's normal production. Placing additional ACHM Base or Binder will not be allowed until the exposed course has been covered with binder and/or surface course. The succeeding course shall be placed as soon as weather and ground conditions allow.

SECTION 411
ASPHALT CONCRETE COLD PLANT MIX

411.01 Description. This item shall consist of an asphalt concrete cold plant mix, composed of a mixture of mineral aggregate and asphalt, according to these specifications.

411.02 Materials. The asphalt concrete cold plant mix shall be furnished from sources listed on the Department's Qualified Products List. Materials used in the mix shall conform to the following:

(a) Asphalt. The Engineer will specify the type and grade of asphalt to be used.

The asphalt shall be an MC-250, MC-800, MC-3000, a, or an inverted emulsion type asphalt.

Medium curing asphalt shall comply with the requirements of Subsection 403.03.

Inverted emulsion type asphalt shall comply with the following requirements:

Inverted Emulsions

Characteristics	Minimum	Maximum
-Flash Point, Tag Open Cup °F	200	-
-Viscosity (SF), sec at 140°F (AASHTO T 59)	100	-
-Stone Coating[A]		
Coating, %	90	-
Asphalt Run-off, %	-	0
-Test on Residue from Distillation 500°F (AASHTO T59) Residue by Distillation, % by Mass	80	-
Oil distillate, % by Volume	2	-
-Test on Residue from Cutback Distillation (AASHTO T 78)		
Absolute Viscosity, P (AASHTO T 202)	30	800
Solubility, % (AASHTO T44)	97.5	-

A-Stone Coating Test (at 140°F)

Weigh 200 grams of dry aggregate (at the gradation of the mix design) into a beaker.

Weigh 4 grams of distilled water into the beaker containing the dry aggregate and mix for 30 seconds.

Dose dry aggregate with inverted emulsion at optimum AC% and add to the beaker containing the damp aggregate and mix vigorously for 120 seconds.

Dump contents in beaker onto a metal pan or suitable surface and visually check coating of aggregate. There shall be no evidence of asphalt run-off.

(b) Mineral Aggregate. Mineral aggregate shall conform to the requirements of Section 409.

411.03 Mix Design. The Contractor shall furnish a mix design performed by an asphalt design laboratory shown on the Department's QPL. The design will be performed in accordance with Section 404, AHTD Test Method 470 and the requirements of Table 411-1.

TABLE 411-1
DESIGN REQUIREMENTS FOR ASPHALT CONCRETE COLD PLANT MIX

SIEVE, mm	PERCENT PASSING	MAXIMUM MIX TOLERANCE (%)
½″ (12.5)	100	
#4 (4.75)	60-80	±7
#8 (2.36)	43-63	±5
#50 (0.300)	15-28	±4
#200 (0.075)	4-10	±2
Asphalt Binder Content	3.5%-6.5%	±0.4

411.04 Production Methods. The methods used in producing the mix and the equipment and plant machinery used shall be subject to the approval of the Engineer and shall conform, insofar as practicable, to the requirements of Section 409.

(a) Preparation of Asphalt. Medium curing cut-back shall be heated to a temperature not exceeding 250° F (120° C). Seasonal type asphalt shall be heated to a temperature not exceeding 175° F (80° C).

(b) Preparation of Mineral Aggregate. The coarse and fine aggregate shall be dried and heated at the mixing plant so that when delivered to the mixer, it shall be at as low a temperature as is consistent with proper mixing and in no case shall exceed 250° F (120° C) when using a medium curing cut-back or 175° F (80° C) when using a seasonal type asphalt.

(c) Preparation of Mixture. Mixture preparation shall conform to the applicable portions of Subsection 410.03.

411.05 Quality Control and Acceptance. (a) Quality Control. All acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures.* The Contractor shall perform all quality control sampling and testing in accordance with Subsection 404.04 except that the only properties determined shall be for gradation and asphalt content. Either one of the following two

methods shall be used for determination of gradation and asphalt content compliance:

- Asphalt content determined by extraction tests (AHTD 450) and sieve analysis (AASHTO T 30) of the extracted aggregate; or
- Asphalt content determined by a nuclear asphalt content gauge (AHTD 449/449A) and the sieve analysis (AASHTO T 30) of the aggregate sample obtained by washing (AHTD 460).

The Contractor shall provide an opportunity for the Engineer to observe all sampling and testing (including those for acceptance), provide an opportunity to review all test results, and shall furnish a building with facilities for the use of the Department's inspector according to Subsection 409.03(h).

(b) Acceptance. All acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The accepted mix design shall be field verified by the Contractor at the start of mix production or after an interruption of more than 90 calendar days. Verification shall consist of test results showing that the values for gradation and asphalt content are within the tolerances shown on the mix design.

Acceptance and adjustment will be in accordance with Subsection 410.09(a) except that there will be no sublots and the standard lot size will be 750 tons (750 metric tons). The Department will only perform verification testing as needed and acceptance and adjustment will be based on the Contractor's test results. All sampling and testing for acceptance and adjustment shall be performed using the test methods specified in Subsection 411.05(a) for quality control sampling and testing. Acceptance will be based on the adherence to the gradation and asphalt content tolerances as shown on job mix design.

When the results of either the quality control or acceptance tests indicate the mixture is outside the specified tolerances, further evaluation of the mixture will be made to determine its acceptability.

411.06 Construction Requirements. Construction methods in addition to the general requirements of these specifications shall conform, insofar as applicable, to Section 410.

411.07 Method of Measurement. Asphalt Concrete Cold Plant Mix will be measured by the ton (metric ton) of mix.

When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weight will be used in lieu of truck scale weights.

411.08 Basis of Payment. Work completed and accepted and measured as provided above, will be paid for at the unit price bid per ton (metric ton) for Asphalt Concrete Cold Plant Mix, which price shall be full compensation for furnishing materials; for heating and mixing; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for hauling, stockpiling, placing, rolling, and finishing, as applicable; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Asphalt Concrete Cold Plant Mix	Ton (Metric Ton)

SECTION 412
COLD MILLING ASPHALT PAVEMENT

412.01 Description. This item shall consist of cold milling the asphalt pavement at the location(s) designated on the plans or by the Engineer and removing the resulting material from the highway right-of-way. Unless otherwise provided, the reclaimed pavement shall become the property of the Contractor. The pavement remaining after milling shall provide a surface suitable for maintaining traffic.

412.02 Equipment. The Contractor shall provide self-propelled equipment with sufficient power, traction, and stability to maintain an accurate depth of cut and slope. The equipment shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing from the existing pavement by means of a ski or matching shoe or from an independent grade control and shall have an automatic system for controlling cross

slope at a given rate. The milling machine shall have an effective means for preventing dust resulting from the operation from escaping into the air.

Provision shall be made, either integrally with the milling machine or by the use of additional equipment, to remove the material being cut from the surface of the roadway.

412.03 Construction Requirements. The existing pavement shall be cold milled to the depth shown on the plans. The number of passes and the depth of each pass required to obtain the total depth to be removed will be determined by the Contractor, unless specified in the plans. The transverse joint left at the end of each day's run shall be tapered to provide a smooth ride. When cold milling asphalt pavement results in vertical differentials at the lane lines or at the edge of the traveled lanes, the Contractor shall comply with the requirements of Subsection 603.02(d). At the end of a day's run, vertical differentials will only be permitted at the centerline or lane lines. The equipment shall be operated at a rate of travel that will provide a surface meeting the applicable surface requirements.

412.04 Method of Measurement. Cold Milling Asphalt Pavement will be measured by the square yard (square meter) of pavement milled to the depth specified.

412.05 Basis of Payment. Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Cold Milling Asphalt Pavement, which price shall be full compensation for all work as prescribed herein, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Cold Milling Asphalt Pavement	Square Yard (Square Meter)

SECTION 413 VACANT

SECTION 414
ASPHALT CONCRETE PATCHING FOR MAINTENANCE OF TRAFFIC

414.01 Description. This item shall consist of an asphalt concrete material composed of mineral aggregate and asphalt binder for use in patching to maintain traffic.

414.02 Materials and Composition. Materials and equipment shall conform to the requirements of ACHM Surface Course, Section 407, or Asphalt Concrete Cold Plant Mix, Section 411.

414.03 Construction Requirements. Construction requirements shall conform, insofar as possible, to Section 415.

414.04 Method of Measurement. Asphalt Concrete Patching for Maintenance of Traffic will be measured by the ton (metric ton) of mix.

414.05 Basis of Payment. Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Concrete Patching for Maintenance of Traffic, which price shall be full compensation for furnishing materials; for heating, mixing, hauling, placing, and compacting; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Asphalt Concrete Patching for Maintenance of Traffic	Ton (Metric Ton)

SECTION 415
ASPHALT CONCRETE HOT MIX PATCHING OF EXISTING ROADWAY

415.01 Description. This item shall consist of patching the existing roadway using an asphalt concrete material composed of mineral aggregate and asphalt binder.

415.02 Materials and Composition. Materials shall conform to the requirements of Section 401, Tack Coat and Section 406, ACHM Binder Course or Section 407, ACHM Surface Course.

415.03 Construction Requirements. Unstable areas in existing roadways and shoulders, designated by the Engineer to be repaired, shall be removed to provide firm vertical sides and a firm, stable, bottom generally parallel with the existing surface. All loose or foreign material shall be removed from the hole.

A tack coat of emulsified asphalt shall be applied to the sides of the hole. Asphalt Concrete Hot Mix Binder or Surface Course shall be placed in the hole in uniform layers, not to exceed 4″ (100 mm) loose measurement. Compaction, satisfactory to the Engineer, shall be accomplished with a mechanical tamper or other approved methods. The finished surface shall be smooth and level with the surrounding surface.

415.04 Method of Measurement. Asphalt Concrete Hot Mix Patching of Existing Roadway will be measured by the ton (metric ton) of mix.

415.05 Basis of Payment. Work completed and accepted and measured as provided above, will be paid for at the contract unit price bid per ton (metric ton) for ACHM Patching of Existing Roadway, which price shall be full compensation for excavation of the existing roadway; for removal and disposal of excavated material; for compacting and tacking the excavated area; for furnishing materials; for heating, mixing, hauling, placing, and compacting the materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
ACHM Patching of Existing Roadway	Ton (Metric Ton)

SECTION 416
RECYCLED ASPHALT PAVEMENT

416.01 Description. This item shall consist of an asphalt concrete base, binder, or surface course mixed at a central plant and constructed on the completed and approved subgrade, base, or surface course in conformance with the lines, grades, and dimensions shown on the plans, and according to the provisions of these specifications.

Unless otherwise provided, these provisions allow the Contractor to utilize recycling of reclaimed asphalt pavement material in any type mixture specified in Sections 405, 406, 407, and 417. The recycled mixture shall meet all of the requirements of the mixture type specified on the plans.

416.02 Materials and Equipment. Materials and equipment shall meet the requirements of Section 409 except as modified herein.

416.03 Materials and Composition. If the Contractor elects to use reclaimed asphalt pavement in the job mixture, the mixture shall contain a minimum of 70% virgin material. The grade of asphalt will be determined at the mix design stage. An approved softening agent may be required in conjunction with a new asphalt. The softening agent with accompanying specifications shall be submitted and approved prior to use. The Contractor shall supply a temperature viscosity curve for the blend of reclaimed and virgin asphalts. A temperature viscosity curve will not be required for the blend of virgin and Recycled Asphalt Pavement (RAP) material when the binder used is a PG 64-22 grade and the design incorporates less than 15% RAP. Overall blend angularity will be determined by extracting the aggregate from the RAP material and combining the extracted aggregate with the virgin mineral aggregate.

The design and quality control of Reclaimed Asphalt Pavement mix shall be according to the provisions of Section 404.

The acceptance of a reclaimed pavement stockpile for recycling will be determined on the uniformity of the stockpiled material, the results of tests on the reclaimed material, and the satisfactory design of a mixture meeting all the specification requirements. When significant differences in the properties of reclaimed pavements exist, separate stockpiles shall be required.

The maximum size of the reclaimed material shall be 3" (75 mm) when introduced into the mixer.

416.04 Equipment. The equipment used in this construction shall conform to Section 409. When the recycling process is utilized, a central mixing plant complying with Section 409 and modified to process recycled material shall be used. The plant modifications shall be according to the manufacturer's recommendations. The plant used shall be designed, equipped, and operated in such a manner that will comply with Section 409.

416.05 Construction Requirements. Construction requirements shall comply with Section 410.

416.06 Method of Measurement and Basis of Payment. Method of Measurement and Basis of Payment shall be according to Sections 405, 406, 407, or 417, as applicable. If the Contractor elects to use reclaimed material in the mix, the percentages of asphalt binder and mineral aggregate to be paid for will be determined from the accepted mix design. The residual asphalt in the reclaimed material will be paid for at the contract unit price bid for Asphalt Binder in ACHM. The mineral aggregate in the reclaimed material will be paid for at the contract unit price bid for Mineral Aggregate in ACHM.

Softening agent will not be measured for payment, but will be considered included in the contract unit prices bid for the other items in the mix.

SECTION 417
OPEN GRADED ASPHALT BASE COURSE

417.01 Description. This item shall consist of a base course composed of a consolidated mixture of crushed stone and asphalt binder and shall be constructed on the existing pavement according to these specifications and in substantial conformity with the lines, grades, and typical cross sections shown on the plans.

417.02 General. The base course shall be composed of a mixture of mineral aggregate and asphalt proportioned to meet the requirements for design of Open Graded Asphalt Base Course mixtures as shown in Table 417-1.

TABLE 417-1

REQUIREMENTS FOR OPEN GRADED ASPHALT BASE COURSE				
Sieve, (mm)	**Percent Passing**			
	Type 1	**Type 2**	**Type 3**	**Type 4**
3″ (75.0)	100	--	--	--
2½" (63.0)	95-100	--	--	--
2" (50.0)	--	100	--	--
1½" (37.5)	30-70 [±7]	75-90 [±7]	--	--
1" (25.0)	--	--	--	100
3/4" (19.0)	0-15 [±7]	50-70 [±7]	100	90-100
1/2" (12.5)	--	--	90-100	--
3/8" (9.5)	0-2	--	--	20-55 [± 5]
#4 (4.75)	--	8-20 [± 5]	0-15 [± 5]	0-10
#8 (2.36)	--	--	0-3	0-5
#100 (0.150)	--	0-5	--	
Asphalt Content	1.5 - 4.0	1.5 - 4.0	1.5 - 4.0	2.5 - 3.0

NOTE: The number in brackets is the allowable tolerance from the mix design value.

The design of Open Graded Asphalt Base Course Types 1, 2, 3, and 4 shall be according to AHTD Test Method 481. The mix design shall be performed by the Department.

The mix design for Type 4 shall include an effective asphalt content, as determined by AHTD Test Method 481, within the range of 2.5%-3.0% by weight of total mix.

417.03 Materials. The materials and equipment used in this construction, in addition to the general requirements of these specifications, shall conform to the provisions of Section 409.

417.04 Equipment. The equipment used shall conform to the requirements of Section 409, except as amended herein.

417.05 Construction Requirements. Construction requirements shall conform to the requirements of Section 410, except that Subsection 410.03 is amended to include the requirements of Subsection 417.05(a), that the temperature requirements of 410.07 are amended as per Subsection 417.05(b), and that 410.08 is deleted.

(a) Preparation of Mixture. The temperature of the aggregate before adding the asphalt binder shall be not less than 275° F (135° C) nor more than 325° F (163° C).

The continuous production of Open Graded Asphalt Base Course shall be within plus or minus 25° F (14° C) of the mixing temperature shown on the approved mix design. Momentary temperature spikes shall be kept to a minimum.

(b) Spreading and Finishing. The mixture shall be placed within 2 hours after production. The mixture shall not be mixed or placed when the surface temperature is below 40° F (4° C). The mixture, after being spread, shall be compacted in one layer according to one of the following methods selected by the Contractor:

(1) The mixture shall be delivered to the paver at no more than 25° F (14° C) above the mixing temperature shown on the approved mix design, as measured in the hopper of the paving machine. Compaction shall be accomplished with one complete coverage with a steel-wheeled, 2-axle tandem roller weighing 3.0 - 5.0 tons (2.7 - 4.5 metric tons). A coverage is a forward pass and a back pass over the same portion of the open graded asphalt base course. Compaction shall begin as soon as the mixture has cooled sufficiently to support the weight of the rolling equipment without undue displacement.

(2) Compaction shall be accomplished with one complete coverage with a steel-wheeled, 2-axle tandem roller weighing 7.0 - 11.0 tons (6.4 - 10.0 metric tons). Compaction shall begin when the temperature of the mixture is not more than 180° F (82° C) and shall be completed before the mixture has cooled below 100° F (38° C).

Vibratory rollers meeting the above requirements may be used provided the vibratory unit is turned off.

(c) Rolling and Density Requirements. The mixture shall be consolidated, to the satisfaction of the Engineer, while in a plastic condition and as soon after being spread as it will bear the weight of the rollers without undue displacement.

(d) Surface Tests. The finished surface of the open graded asphalt base course, when checked with a 10′ (3 m) straightedge operated parallel to the centerline, shall show no variation more than ½″ (12 mm) when the profile grade is shown on the plans. When surface tests indicate surface tolerances do not meet this requirement, corrections to the pavement and/or changes in the paving operations shall be made before beginning the next day's

operations. The open graded asphalt base course shall be corrected with open graded asphalt base course mixture meeting these specifications, or if permitted by the Engineer the high spots may be removed to within the specified tolerances by any method that does not produce contamination of the base with fines nor damage to the base course remaining in place. Grinding will not be allowed.

Hardened open graded asphalt base course with a surface tolerance more than ½″ (12 mm) below the grade indicated by the surface tests shall be corrected with open graded asphalt base course mixture meeting these specifications. All corrective work and material necessary to correct surface tolerances shall be at no cost to the Department.

Care shall be exercised to prevent contamination of the base course with fines. Open graded asphalt base course that in the opinion of the Engineer has been contaminated with fines shall be corrected at no cost to the Department.

(e) Weight Limitations. No traffic or Contractor's equipment except the paver will be permitted on the hardened open graded asphalt base course. The work of placing the subsequent layer shall not begin until the base has been placed on the shoulders flush with the open graded asphalt base course. Placing the subsequent layer shall be accomplished by unloading the material from the haul trucks at the shoulder and conveying the material to the paver. The Contractor may propose alternates to the Engineer for the paving method, but no haul trucks of any type shall be permitted on the open graded asphalt base course. Any damage to the base shall be repaired promptly by the Contractor at no cost to the Department and as directed by the Engineer.

417.06 Quality Control, Acceptance, and Adjustments. (a) Quality Control. The quality control for all types of Open Graded Asphalt Base Course shall be according to Subsection 404.04 except that the only properties determined shall be for gradation and asphalt binder content.

(b)Acceptance of the Pavement. Acceptance and adjustment will be by the lot as specified in Subsection 410.09(a).

(1) Asphalt Binder Content. Acceptance of the pavement mixture will be according to the applicable parts of Subsection 410.09(b) except that references to Table 410-1 will be interpreted to be Table 417-2.

(2) Gradation. Acceptance of the pavement mixture will be according to the criteria that is listed in Table 417-2.

(c) Unacceptable Pavement. The removal and replacement of unacceptable pavement will be according to Subsection 410.09(c).

(d) Adjustments. Adjustments will be made according to Subsection 410.09(d) and the following:

(1) For aggregate gradation, the contract price of the entire lot will be reduced by 5.0% for each deviation outside of the compliance limits from the mix design value up to a maximum of 8 deviations. One deviation is 1%.

(e) Pavement that is determined to be non-complying for any reason other than asphalt content or aggregate gradation will be evaluated according to Subsection 105.04. The Engineer will determine whether the non-complying pavement must be corrected or removed and replaced or may be left in place at a reduced cost to the State. Cost reductions according to the provisions of Subsection 105.04 will be in addition to the cost reductions, if any, determined for asphalt content, and aggregate gradation. If the total cost reduction is determined to be greater than 50% for any lot, that lot will not be accepted.

When two consecutive lots or any three out of five lots fails to qualify for full payment with a price adjustment for any reason, work will be stopped until corrective action is taken.

417.07 Method of Measurement. (a) Mineral aggregate will be measured by the ton (metric ton). Mineral filler will not be measured or paid for separately but will be considered included in the contract unit price bid for mineral aggregate.

(b) Asphalt binder will be measured by the ton (metric ton). Anti-strip additives will not be measured or paid for separately but will be considered included in the contract unit price bid for asphalt binder.

Quantities of aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weights will be used in lieu

of truck scales to determine the total weight of the composite mixture.

417.08 Basis of Payment. Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral Aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in Open Graded Asphalt Base Course (Ty__).

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt Binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG __) in Open Graded Asphalt Base Course (Ty__).

The contract unit prices mentioned above shall be full compensation for furnishing materials; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Mineral Aggregate in Open Graded Asphalt Base Course (Ty__)	Ton (Metric Ton)
Asphalt Binder (PG __) in Open Graded Asphalt Base Course (Ty__)	Ton (Metric Ton)

TABLE 417-2
COMPLIANCE, PRICE REDUCTION, AND REJECTION LIMITS FOR OPEN GRADED ASPHALT BASE COURSES

Property	Compliance Limits (from mix design value)	Price Reduction Limits (from mix design value)	Lot Rejection Limits (from mix design value)	Sublot rejection Limits (from mix design value)
Asphalt Binder Content	± 0.3	more than ± 0.3, to ± 0.6	more than ± 0.6	more than ± 0.8
Aggregate Gradation				
Type 1				
1½" (37.5 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
3/4" (19.0 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
Type 2				
1½" (37.5 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
3/4" (19.0 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
#4 (4.75 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
Type 3				
#4 (4.75 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
Type 4				
3/8" (9.5 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%

SECTION 418
SLURRY SEAL

418.01 Description. This work shall consist of the application of a mixture of emulsified asphalt, mineral aggregate, mineral filler, water and other additives, properly proportioned, mixed, and spread on the surface according to this specification, and as directed by the Engineer.

418.02 Materials. (a) Asphalt Material. The asphalt emulsion used shall include cationic emulsified asphalt or polymer modified cationic emulsified asphalt. The cationic emulsified asphalt shall be a CQC-1h meeting the requirements of AASHTO M 208, except that the cement mixing test requirement is excluded. The polymer modified emulsified asphalt shall be CQS - 1h that has been modified to meet the following requirements by addition of polymers:

	Min.	Max.
Viscosity, Saybolt Furol at 77° F (25° C), Sec.:	20	100
Storage stability test, one day		1%
Particle Charge test:	Positive	
Sieve test, percent:		0.1
Distillation*:		
Oil distillate, by vol. of emulsion, %:		0.5
Residue from distillation:		62.0
Polymer Solids, percent	3.0	
Penetration, 77° F (25° C), 100 g, 5 sec.:	55	90
Ductility, 77° F (25° C), 5 cm/min., cm:	70	
Solubility in tricholoroethylene: **	97%	
Softening point, R. & B., ° F	135° (57° C)	

* The standard distillation procedure shall be modified as follows: The temperature on the lower thermometer shall be brought slowly to 349° F ± 11° F (176° C ± 6°C) and maintained at this point for 20 minutes. Complete the total distillation in 60 ± 5 minutes from the application of heat.

** Base Asphalt Binder

Prior to beginning work the emulsion supplier shall furnish the Department samples of the base asphalt and polymer used in the finished emulsion.

The emulsified asphalt and the modified emulsified asphalt shall be so formulated that when the paving mixture is applied with the relative humidity at not more than 50% and ambient air temperature of at least 77° F (25° C), it will cure sufficiently that rolling traffic can be allowed to use the surface in two hours (one hour for polymer modified slurry seal) with no damage to the surface.

(b) Mineral Aggregate. The aggregate shall be crushed steel slag, crushed gravel or crushed stone meeting the requirements of Section 409. Limestone aggregates shall not be used as mineral aggregate. The aggregate shall meet the following gradation requirements:

	Type II	**Type III**
Sieve Size, (mm)	**Percent Passing (by weight)**	
3/8" (9.5)	100	100
#4 (4.75)	90 - 100	70 - 90
#8 (2.36)	65 - 90	45 - 70
#16 (1.18)	45 - 70	28 - 50
#30 (0.600)	30 - 50	19 - 34
#50 (0.300)	18 - 30	12 - 25
#100 (0.150)	10 - 21	7 - 18
#200 (0.075)	5 - 15	5 - 15
Los Angeles Test (AASHTO T 96)	35 max.	35 max.
Sand Equivalent Test (AASHTO T 176)	45 min.	60 min.

(c) Mineral Filler. Mineral filler, if used, shall be Portland Cement or hydrated lime which meets the requirements of AASHTO M 17.

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

(d) Water. Water shall be potable and free of harmful soluble salts.

(e) Other Additives. Additives supplied by the emulsion manufacturer may be added to the emulsion mix or to any of the component materials to provide control of the set time in the field.

418.03 Design and Quality Control of Mixture. The design of the Slurry Seal shall be the responsibility of the Contractor and shall meet or exceed the criteria set forth by the International Slurry Seal Association's A-105 and A-143. Quality control of the mix shall be according to Section 404.04 to the Standard Specifications.

Composition of Mixture. The mix design and materials and methods must receive the approval of the Engineer prior to use on the project. The proportions to be used shall be within the following limits:

Residual Asphalt: 6.5% - 13.5% for slurry seals and 5.5% - 9.5% for polymer modified slurry seals by weight of dry aggregate.

Mineral Filler: 0.5% - 2.0 % by dry weight of aggregate.

Polymer Modifier: When specified to provide the required properties.

Field Control Additive: As required to provide the specified properties.

Water: As required to provide the proper consistency.

418.04 Equipment. All equipment used for materials handling and mixing and placing of mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective with a potential for affecting the quality of the paving mixture will be rejected by the Engineer and must be replaced or repaired before its use or continued use.

The material shall be mixed by a self-propelled mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, additives, and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, and water to maintain an adequate supply to the proportioning controls. The machine shall be equipped with self-loading devices which provide for the loading of all

materials while continuing to lay slurry seal, thereby minimizing construction joints.

Individual volume or weight controls for proportioning each material to be included in the mixture shall be provided. Each material control device shall be calibrated and properly marked. Calibration shall be performed prior to starting the project and in the presence of the Engineer. Documentation shall be included for each individual calibration of material at the various settings, which can be related to the machine's metering devices. The machine will be equipped with a metering device for the mineral filler which indicates the quantity used. No machine will be allowed to work on the project until the calibration has been completed and/or accepted. Calibration shall be verified by the Contractor using AHTD Test Method 466 under observation by the Engineer.

The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.

The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box.

The mixing machine shall be equipped with an approved fines feeder and liquid additives feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler.

418.05 Stockpiling and Storage. (a) Aggregate Storage. If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. The grading of aggregates supplied to the mixing plant shall be uniform. Suitable equipment of acceptable size shall be furnished by the contractor to work the stockpiles and prevent segregation of the aggregates. If a polymer modified slurry seal is specified, a scale system shall be supplied by the Contractor to weigh the aggregate. The scale shall provide printed tickets for each truck loaded.

(b) Storage and Heating of Asphalt Materials. The asphalt material storage shall be ample to meet the requirements of the plant. Asphalt emulsion shall not be heated to a temperature in excess of 160° F (71° C). All equipment used in the storage and handling of asphalt material shall be kept in a clean condition at all

times and shall be operated in such manner that there will be no contamination by foreign matter.

418.06 Construction Methods. (a) General. It shall be the responsibility of the Contractor to produce, transport, and place the specified paving mixture according to these specifications and as approved by the Engineer.

(b) Seasonal Limitations. No slurry seal shall be placed after October 15 or before May 1 without prior approval by the Engineer. Slurry seal shall not be applied if either the pavement or ambient temperature is 55° F (13° C) or less.

(c) Surface Preparation. The area to be sealed shall be thoroughly cleaned of all vegetation, loose aggregate and soil. Utility entrances within the area to be sealed shall be protected from the slurry seal by the use of plastic coverings or other methods. All utility entrances shall be uncovered before the surface is reopened to traffic. Water used to pre-wet the surface ahead of and outside the spreader box shall be applied at a rate which will dampen the entire surface without any free flowing water ahead of the spreader box.

(d) Traffic Control. It shall be contractor's responsibility to provide adequate traffic control measures, such as barricades, cones, advance warning signs, flagmen, etc., to protect the uncured slurry seal from all types of traffic and to provide traffic safety in the construction area. These measures shall be employed in a safe manner and must not be used until approved by the Engineer.

Opening the roadway surface to traffic does not constitute acceptance of the work. Any damage to the uncured slurry seal material will be the responsibility of the Contractor and the damaged surface shall be repaired to the satisfaction of the Engineer. Interim pavement marking shall be provided according to Subsection 604.03(f).

(e) Spreading Equipment. The paving mixture shall be spread uniformly by means of a mechanical type squeegee box attached to the mixer and equipped with paddles to agitate and spread the materials throughout the box. A front seal shall be provided to ensure no loss of the mixture at the road contact surface. The rear seal shall act as a final strike off and shall be a uniform skid resistant application of aggregate and asphalt on the surface. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved while producing a free flow of

material to the rear strike-off. A secondary strike-off shall be used to provide uniformity. The seam where two spreads join shall be neat and uniform in appearance.

(f) Rut Filling. When ruts exceed 1/2" (12 mm) in depth on projects that specify polymer modified slurry seal, a separate leveling course shall be placed to fill the ruts. The leveling course shall be placed utilizing a rut filling vee-box. The ruts shall be reprofiled as to allow a crown of 1/4" (6 mm) for every 1″ (25 mm) of rut depth. Traffic shall be allowed to compact the filled ruts for 24 hours prior to the placement of the full width seal course.

(g) Workmanship. No excessive buildup, uncovered areas or unsightly appearance will be permitted at longitudinal or transverse joints.

Longitudinal joints shall be placed at lane lines. Excessive overlap will not be permitted. Care shall be taken to ensure straight lines along the roadway centerline, lane lines. shoulder, or curb lines. Lines at intersections shall be kept straight to provide a good appearance.

Care shall be exercised in areas that require hand work so that the finished surface is uniform in texture, density, and of overall appearance comparable to that produced by the spreader box.

Areas of non-uniform texture, density, or appearance will be patched as directed. Patching shall be done using the same process and equipment that originally surfaced the area. Handworking of patches will not be permitted, except as authorized by the Engineer.

The Contractor shall supervise and direct the work, using their best skill and attention. The work shall be directed using any means as is the custom of the trade to complete the work in an acceptable manner.

(h) Acceptance of the Slurry Seal and Adjustments.

(1) General. Acceptance and adjustment will be based on the test results for asphalt content and gradation listed in Table 418-1 by the lot, which will be defined as 120,000 square yards (100,000 square meters), and the sublot, which will be defined as 30,000 square yards (25,000 square meters), with no less than one test per project. Asphalt content shall be determined using AHTD Test Methods 449/449A , AHTD Test Method 450 or 451, or AHTD Test Method 467 as directed by the Engineer.

Gradation shall be determined using either AHTD Test Method 460 or 467 as directed by the Engineer. The Department shall determine the location for each sample in the sublot by AHTD Test Method 465.

The Department will obtain and test one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. The location of the lot sample will be determined by the Department using AHTD Test Method 465.

(a) Acceptance of the Pavement. Acceptance of a standard lot for asphalt content and gradation listed in Table 418-1 will be based on the average of the five (5) tests performed on the lot. Acceptance of a partial lot will be based on the average of the actual number of tests made on that partial lot. Acceptance of a sublot will be based on the results of the test(s) performed on samples from that sublot.

In Table 418-1, the term "specification limit(s)" refers to those limits and/or values shown in the tables of design values for the various types of mix. The term "mix design value" refers to the value shown in the accepted mix design.

When the average of the test results for a lot fall within the range shown in Table 418-1 as "Compliance Limits", the lot will be accepted with no price reduction for those properties. If the average of the test results for a lot for any single property listed in the table falls within the limits shown as "Price Reduction Limits", the material may be left in place at a reduced price as specified in Subsection 418.06(h)(1)(c) below. If the average of the test results for a lot for any single property listed in the table falls outside the limits shown as "Lot Rejection Limits", the entire lot shall be removed and replaced at no cost to the Department. Sampling and testing of the replacement material will be according to the same sampling and testing requirements specified above.

For any single property, if the result of the single test in a sublot falls outside the limits shown as "Sublot Rejection Limits", that sublot shall be removed and replaced at no cost to the Department. In the sublot containing the Department's lot test, if the result of either the Contractor's sublot test or the Department's lot test fall outside the sublot rejection limits, the

two tests will be averaged and the average of the two test results used to determine acceptance or rejection. The average of the two test results will also be used as a single value to compute the average for the lot for acceptance and adjustment.

(b) Unacceptable Pavement. Any lot or section of any slurry seal course that is not accepted for any reason shall be removed and replaced by the Contractor at no cost to the Department. Payment for sections where removal and replacement is required will be withheld or recovered, and released after replacement has been acceptably completed. The quantity for payment will be the original quantity and measurement of the quantity used in replacement operations will not be considered.

(c) Adjustments. Adjustments will be made by reducing the contract price of the lot according to the schedules below. Price reductions will be computed from the schedules below for each property, and reductions for each property added together to obtain the total price reduction for the lot. The total price reduction will be applied to all components of the course for the entire quantity of the lot. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction. When the number of deviations for any property shown exceeds the maximum specified, or when the total price reduction for a lot is greater than 50%, that lot will not be accepted. Continuous production of material not qualifying for full payment will not be allowed.

(1) For Asphalt Binder Content, the contract price of the entire lot will be reduced by 12% for each deviation outside the compliance limits, up to a maximum of 3 deviations. One deviation is 0.1 percentage point.

(2) For aggregate gradation, the contract price of the entire lot will be reduced by 5.0% for each deviation outside of the compliance limits from the mix design value up to a maximum of 8 deviations. One deviation is 1%.

418.07 Method of Measurement. Slurry Seal will be measured by the square yard (square meter). Aggregate in Slurry Seal (Polymer Modified), which shall include the aggregate and mineral

filler, will be measured by the ton (metric ton). Asphalt in Slurry Seal (Polymer Modified), which shall include the polymer modifier, will be measured by the gallon (liter).

418.08 Basis of Payment. Work completed and accepted and measured as provided above will be paid for as follows:

(a) Slurry Seal will be paid for at the contract unit price bid per square yard (square meter) for Slurry Seal.

(b) Mineral aggregate and mineral filler in Slurry Seal (Polymer Modified) will be paid for at the contract unit price bid per ton (metric ton) for Aggregate in Slurry Seal (Polymer Modified).

(c) Asphalt emulsion in Slurry Seal (Polymer Modified) will be paid for at the contract unit price bid per gallon (liter) for Asphalt in Slurry Seal (Polymer Modified).

Field control additives will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Slurry Seal or Slurry Seal (Polymer Modified).

The contract unit prices mentioned above shall be full compensation for furnishing materials; for designing the mixture, including trial mixtures required; for performing quality control and acceptance sampling and testing; for preparation of the surface; for heating, mixing, hauling, placing, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Water used in preparing the surface will not be measured or paid for separately.

Tack coat, if used, will be measured and paid for in accordance with Section 401.

Payment will be made under:

Pay Item	**Pay Unit**
Slurry Seal	Square Yard (Square Meter)
Aggregate in Slurry Seal (Polymer Modified)	Ton (Metric Ton)
Asphalt in Slurry Seal (Polymer Modified)	Gallon (Liter)

TABLE 418-1
COMPLIANCE, PRICE REDUCTION, AND REJECTION LIMITS FOR SLURRY SEALS

Property	Compliance Limits (from mix design value)	Price Reduction Limits (from mix design value)	Lot Rejection Limits (from mix design value)	Sublot Rejection Limits (from mix design value)
Asphalt Binder Content	± 0.3	more than ± 0.3, to ±0.6	more than ± 0.6	more than ± 0.8
Aggregate Gradation				
Sieve Sizes				
#4 (4.75 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
#8 (2.36 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
#16 (1.18 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
#30 (0.6 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
#50 (0.30 mm)	± 4%	more than ± 4%, to ± 12%	more than ± 12%	more than ± 22%
#100 (0.15 mm)	± 3%	more than ± 3%, to ± 11%	more than ± 11%	more than ± 21%
#200 (0.075 mm)	± 2%	more than ± 2%, to ± 10%	more than ± 10%	more than ± 20%