

ALABAMA DEPARTMENT OF TRANSPORTATION

DATE: May 13, 2014

Special Provision No. 12-0263(3)

EFFECTIVE DATE: June 1, 2014

SUBJECT: Asphalt Pavement.

Alabama Standard Specifications, 2012 Edition, shall be amended by modifying Section 106 and by replacing Sections 410, 420, 423, and 424 as follows:

SECTION 106 CONTROL OF MATERIALS

106.09 Quality Control and Quality Assurance (QC/QA) Requirements for Hot Mix Asphalt (HMA) Pavement.

Article 106.09 shall be replaced with the following:

106.09 Quality Control and Quality Assurance (QC/QA) Requirements for Hot Mix Asphalt (HMA) Pavement.

(a) GENERAL.

The following modifications apply only to the materials and work performed under Sections 327, 410, 420, 423 and 424.

In all cases, the Department's testing will be separate from the Contractor's testing and both shall be conducted by certified technicians.

All Quality Control aspects of this provision shall be the responsibility of the Contractor. Quality Control is defined as the activities that are related to the production of Hot Mix Asphalt Pavement which meet all the requirements of the Specifications, including mix design, process control testing, sampling and acceptance testing (when so designated by the Department) for determination of Pay Factors, and necessary adjustments to the production process.

All Quality Assurance aspects of this provision shall be the responsibility of the Department and will be accomplished in the following ways:

1. By conducting assurance/verification testing, on a random basis, of independent samples obtained by the Department, at a frequency of one or more per day;
2. By periodically observing tests performed by the Contractor;
3. By monitoring required Contractor control charts exhibiting test results of control parameters.

All Superpave Gyratory Compactors shall have their angle of gyration verified by the Engineer following the procedure in AASHTO **T 344**, "Standard Method of Test for Evaluation of Superpave Gyratory Compactor (SGC) Internal Angle of Gyration Using Simulated Loading". This includes all design, quality control, and quality assurance SGCs. The compactors shall tilt the specimen molds at an average internal angle of 20.2 ± 0.35 mrad (1.16 ± 0.02 degrees).

(b) QUALITY CONTROL.

The Contractor shall provide and maintain a quality control system that will provide reasonable assurance that all materials, products, and completed construction submitted for acceptance conform to contract requirements whether manufactured or processed by the Contractor or procured from subcontractors or vendors. Quality control managers, laboratory technicians and roadway technicians will be certified by the Department as outlined in ALDOT-374, "Certification Requirements for Hot Mix Asphalt Technicians". This quality control system shall conform to ALDOT-375, "Contractor Quality Control System for Hot Mix Asphalt".

The sampling and testing frequencies shall conform to the requirements given in Table 1 for a pay item when the accumulated amount of asphalt mix placed for that pay item exceeds 250 tons (250 metric tons). The accumulated amount of asphalt mix shall be the current total amount of asphalt mix that has been placed beginning from the start of construction. The sampling and testing frequencies given in Table 1 may be waived by the Division Materials Engineer and the asphalt mix may be accepted by visual observation for a maximum accumulated asphalt mix placement quantity of 250 tons (250 metric tons) or less for any individual pay item. The Engineer will record the results of the acceptance of the asphalt mix on form BMT-16 if sampling and testing is not required.

SECTION 327 E and 420 MIXES						
TABLE I SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS						
Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1. Asphalt Content *	ALDOT Sample = 55 lb (25 kg) Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-354 or AASHTO T 308 ***	1 per day per LOT	++ 1 per 700 tons
2. Mixture Gradation * *	Contractor Sample = 55 lb (25 kg) Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-371 AASHTO T 308	1 per day per LOT	++ 1 per 700 tons
3. Asphalt Draindown	12 lb (5 kg)	AASHTO T 168 & ALDOT-210	+Loaded Truck	AASHTO T 305	As Required	As Required
<p>* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.</p> <p>** If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.</p> <p>+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons. If the random number selected falls within the first 50 tons, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton produced.</p> <p>++ One sample for each 500 tons (500 metric tons) for Section 420 mixes.</p> <p><u>Note:</u> The testing increment shall have a 150 ton buffer between each increment.</p> <p>+++ Under AASHTO T 308, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight (mass) and percent weight (mass) loss is computed and produced on hard-copy output.</p>						

TABLE I (CONT'D.)		SECTION 423 MIXES			(STONE MATRIX ASPHALT)	
SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS						
Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1. Asphalt Content *	ALDOT Sample = 90 lb (40 kg) Split into 2 equal samples Contractor Sample = 90 lb (40 kg) Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-354 or AASHTO T 308 +++++	1 per day per LOT	++ 1 per 700 tons
2. Maximum Specific Gravity *		AASHTO T 168 & ALDOT-210	+Loaded Truck	AASHTO T 209 (Flask determination with dry back)	1 per day per LOT	++ 1 per 700 tons
3. Air Void Content & VMA *		AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-353 & ALDOT-307	1 per day per LOT	++ 1 per 700 tons
4. Mixture Gradation **		AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-371 AASHTO T 308	1 per day per LOT	++ 1 per 700 tons
5. Retained Tensile Strength Note: The TSR test is not required for any pay item less than a full lot.	25 lb (12 kg)	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-361	1 set of 6 for the first full lot (2,800 tons (2,800 metric tons)) and 1 set of 6 for the next 10,000 tons (10,000 metric tons) and 1 set of 6 for each additional 20,000 tons (20,000 metric tons) or portion thereafter	1 set of 6 for the first full lot (2,800 tons (2,800 metric tons)) and 1 set of 6 for the next 10,000 tons (10,000 metric tons) and 1 set of 6 for each additional 20,000 tons (20,000 metric tons) or portion thereafter
6. Mat Density *		ALDOT-210	Roadway	ALDOT-222 & ALDOT-350		As per Contractor's QC plan (ALDOT-375)
				ALDOT-403 AASHTO T 166 Method A AASHTO T 275 AASHTO T 331	°° 1/3000 lane feet/lift (1/900 lane m/lift)	
7. Clay Content	Adequate Quantity	AASHTO T 2	Aggregate Stockpiles	AASHTO T 176	As required	As required
8. Asphalt Draindown	12 lb (5 kg)	AASHTO T 168 & ALDOT-210	+Loaded Truck	AASHTO T 305	As Required	As Required
<p>* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.</p> <p>** If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.</p> <p>°° Cores shall be taken by the Contractor and the density will be determined by the Department.</p> <p>+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons. If the random number selected falls within the first 50 tons, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton produced.</p> <p>++ The sample shall be one set of three Marshall samples or one set of two gyratory samples +++. <u>Note:</u> The testing increment shall have a 150 ton buffer between each increment.</p> <p>+++ When slag is used as an aggregate in the mixture, four Marshall samples or three gyratory samples shall be compacted. The test result the furthest away from the average of the four test results shall be discarded and the remaining three test results shall be averaged for use in the computation of air voids.</p> <p>++++ Under AASHTO T 308, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight {mass} and percent weight {mass} loss is computed and produced on hard-copy output.</p>						

TABLE I (CONT'D.)		SECTION 424 MIXES			(SUPERPAVE)	
SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS						
Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1. Asphalt Content *	ALDOT Sample = 135 lb (60 kg) Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-354 or AASHTO T 308 +****	1 per day per LOT	++ 1 per 700 tons
2. Maximum Specific Gravity *		AASHTO T 168 & ALDOT-210	+Loaded Truck	AASHTO T 209 (Flask determination with dry back)	1 per day per LOT	++ 1 per 700 tons
3. Air Void Content & VMA	Contractor Sample = 135 lb (60 kg) Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-384 ALDOT-388 ALDOT-353	1 per day per LOT	++ 1 per 700 tons
% Gmm @ Nd *					As needed	
4. Mixture *** Gradation & Dust to Asphalt Ratio *		AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-371 AASHTO T 308	1 per day per LOT	++ 1 per 700 tons
5. Retained Tensile Strength Note: The TSR test is not required for any pay item less than a full lot.	25 lb. (12 kg)	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT-361	1 set of 6 for the first full lot (2,800 tons (2,800 metric tons)) and 1 set of 6 for the next 10,000 tons (10,000 metric tons) and 1 set of 6 for each additional 20,000 tons (20,000 metric tons) or portion thereafter	1 set of 6 for the first full lot (2,800 tons (2,800 metric tons)) and 1 set of 6 randomly for the next 10,000 tons (10,000 metric tons) and 1 set of 6 for each additional 20,000 tons (20,000 metric tons) or portion thereafter
6. Mat Density *		ALDOT-210	Roadway	ALDOT-222 & ALDOT-350		As per the Contractor's QC plan (ALDOT-375)
				ALDOT-403 AASHTO T 166 Method A AASHTO T 275 AASHTO T 331	° 1/3,000 lane feet/lift {1/900 lane m/lift}	
7. Fine Aggregate Angularity * FAA Note: The FAA test is not required for any pay item less than a full lot.	Adequate quantity to run AASHTO T 304, Method A or ASTM C 1252, Method A	AASHTO T 2	+Loaded Truck	AASHTO T 304, Method A Or ASTM C 1252, Method A	1 for the first full lot (2,800 tons (2,800 metric tons)) and 1 for the next 10,000 tons (10,000 metric tons) and 1 for each additional 20,000 tons (20,000 metric tons) or portion thereafter	1 for the first full lot (2,800 tons (2,800 metric tons)) and 1 randomly for the next 10,000 tons (10,000 metric tons) and 1 randomly for each additional 20,000 tons (20,000 metric tons) or portion thereafter
8. Clay Content	Adequate quantity	AASHTO T 2	Stockpile	AASHTO T 176	As required	As required
9. Asphalt Draindown	12 lb (5kg)	AASHTO T 168 & ALDOT-210	+Loaded Truck	AASHTO T 305	As Required	As Required
10. Split Tensile **	35 lb. (17 kg)	AASHTO T 168 & ALDOT-210	+Loaded Truck	ALDOT 361 (Report the Unconditioned Sample for Split Tensile)	N/A	1 for the first full lot and 1 randomly for each additional 10,000 tons thereafter

TABLE I (CONT'D.)	SECTION 424 MIXES	(SUPERPAVE)
SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS		
* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.		
** In virgin mixes, the sample may be taken from the cold feed conveyor.		
*** If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.		
°° Cores shall be taken by the Contractor and the density will be determined by the Department.		
+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons. If the random number selected falls within the first 50 tons, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton produced.		
++ The sample shall be one set of two gyratory samples+++.		
<u>Note:</u> The testing increment shall have a 150 ton buffer between each increment.		
+++ When slag is used as an aggregate in the mixture, three gyratory samples shall be compacted. The test result the furthest away from the average of the three test results shall be discarded and the remaining two test results shall be averaged for use in the computation of air voids.		
++++ Under AASHTO T 308, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight {mass} and percent weight {mass} loss is computed and produced on hard-copy output.		

(c) QUALITY ASSURANCE.

1. ACCEPTANCE PROCEDURES.

All materials will be evaluated for acceptance and payment through the Department's Acceptance Procedures specified herein. The Department will be responsible for determining the acceptability and pay factor of the construction and materials incorporated therein.

The Department will utilize the Contractor's QC System test results for liquid asphalt binder content and laboratory compacted air void content for pay purposes except where:

- a. The Department's Quality Assurance testing, as described in Item 3 below and Subarticle 410.08, does not validate the quality of the material.
- b. QC sampling and testing was not performed in accordance with specified procedures.

The Department will determine the sample locations.

The sampling and testing frequencies shall conform to the requirements given in Table 1 for a pay item when the accumulated amount of asphalt mix placed for that pay item exceeds 250 tons {250 metric tons}. The accumulated amount of asphalt mix shall be the current total amount of asphalt mix that has been placed beginning from the start of construction. The sampling and testing frequencies given in Table 1 may be waived by the Division Materials Engineer and the asphalt mix may be accepted by visual observation for a maximum accumulated asphalt mix placement quantity of 250 tons {250 metric tons} or less for any individual pay item. The Engineer will record the results of the acceptance of the asphalt mix on form BMT-16 if sampling and testing is not required.

All conforming and nonconforming inspections and test results will be monitored in accordance with ALDOT-353 and ALDOT-370 and shall be recorded on approved forms and charts which shall be kept up to date and complete and shall be available at all times to the Department during the performance of the work. Only those tests designated by the Department in advance as acceptance tests will be utilized in the computation of pay factors. Test properties shall be charted on forms that are in accordance with the applicable requirements of the Department. A copy of each chart and form to be used by the Contractor will be furnished by the Department. The Contractor shall furnish his own supply of the charts and forms. The Contractor or Producer may design their own forms and charts; however, these must be approved by the Engineer prior to their use.

A LOT is normally defined as 2,800 tons {metric tons} for Section 327, 423 and 424 mixes, and 2,000 tons {metric tons} for Section 420 mixes, consisting of four QC test sets of laboratory tests (liquid asphalt binder content and laboratory air voids or gradation), unless specifically stated otherwise in this item or elsewhere in the specifications. A LOT will usually consist of at least four density tests; however, a LOT may have fewer than four density tests. The Engineer will round a testing increment or a LOT to the nearest truckload of material.

A LOT lasting longer than thirty calendar days or a LOT with inactivity for longer than 30 calendar days will be terminated. Mix produced after the completion of the last full LOT, a terminated LOT, and small production projects will be evaluated and pay factors computed and may be accepted on the basis of less than four laboratory tests (liquid asphalt binder content and laboratory air voids or gradation).

Each LOT will be accepted on the basis of the actual number of test sets run for that LOT. If the production process is considered out of control (any individual test result for asphalt content, gradation (single sieve), or air voids has a pay factor equal to 0.80 computed from the "1 Test" column in Table II, Table III, or Table VI, of Subarticle 410.08 whichever is appropriate), production shall be suspended and corrections made as outlined in Subarticle 410.08. Gradation pay factors are normally computed on each screen tested and then averaged, however, if any individual screen has a pay factor of 0.80 (before being averaged with the other screen(s)), the process is considered out of control.

The Contractor may voluntarily terminate a LOT when the pay factor will be less than 0.90 when calculated using the one test row of table II, III, and VI in Section 410. If the Contractor terminates a LOT, production shall be suspended and corrections made as outlined in Subarticle 410.08. The voluntary termination of a LOT may only be done once per pay item, per project.

All sampling, testing and computations for a LOT will be completed and pay factors provided the Contractor as soon as possible.

All sampling and testing of materials, including frequency of samples and tests for the Contractor's Quality Control and the Department's verification, shall be performed in strict conformance with the Department's Testing Manual as modified in Table I. This Manual (available on the ALDOT Internet Site) contains guidance for sampling and testing procedures from AASHTO, ASTM, and ALDOT procedures.

2. ACCEPTANCE OR REJECTION.

The decision of the Engineer will be final as to the acceptance, rejection, or acceptance at an adjusted payment of each LOT. Rejected LOTS shall be removed at no cost to the Department and replaced at the contract unit bid price.

3. SAMPLING OF LOTS AND SUBLOTS.

It is the intent of these specifications that each LOT (for mixture testing) and each SUBLLOT (for mat density testing) will meet specification requirements at the time of initial evaluation. No resampling or retesting (other than referee testing described below) will be allowed. The Department will, however, perform at least one liquid asphalt binder content, one maximum specific gravity, one mixture gradation, and one set of laboratory compacted samples for air void content tests per day per Lot, as specified in Table I, to verify the Contractor's test results. If the Contractor is not required to perform a test that day (the tonnage calculated by the random number is not reached), the Department will not run a verification test. The Department will perform a verification test for each LOT, even where there is more than one LOT per day.

The Contractor will be notified by the Engineer as to the point in production at which to procure mixture acceptance samples. The Contractor shall sample the mixture and split it into two samples: the Contractor's primary sample and a referee sample. The portions of mixture for the referee sample shall be bagged, labeled, and stored for testing, if required. All referee samples will be kept by the Department until they are tested (if required).

The Contractor shall obtain a verification testing sample from each LOT each day for testing by the Department. The verification testing samples shall be taken at locations directed by the Engineer. These locations will be different from the Contractor's mixture acceptance sample locations. The Contractor may take half of each sample for verification testing. The Department will compare the verification sample to the closest (in tonnage) Contractor's primary sample. The sampling of Hot Mix Asphalt is outlined in ALDOT-380, Forms and Examples for Sampling and Computing Pay Factors for Hot Mix Asphalt.

4. TESTING AND LOT VERIFICATION.

Air voids shall be computed on the Contractor's sample by using the running average of the Contractor's last four maximum specific gravities. If slag is used as an aggregate in the mixture, the running average of the Contractor's four most recent determinations for the bulk specific gravity of the compacted mixture shall be used in the computation of the air voids for the Contractor's sample. The calculation of the running averages of both maximum specific gravity and bulk specific gravity shall start with the first LOT. The test strip is independent of the LOTS. Air voids shall be computed on the Department's sample by using the Department's individual maximum specific gravity and bulk specific gravity. The Department and the Contractor shall compare test results with each other for the above mentioned testing increments. If there are no differences or if the differences are within the

tolerances listed in Tables V or VI, Section 410, for each parameter, no further testing and analysis will be necessary and the Contractor's test values will be used in the computation of the appropriate LOT pay factor.

If the Contractor's air voids do not compare with the Department's test results, the Contractor shall re-compute test results using the individual maximum specific gravity for that particular testing increment and re-compare with the verification test result. If the results compare within the tolerances in Table V, Section 410, using the individual maximum specific gravities, no further testing will be required and the Contractor's running average of the last four maximum specific gravities will be used to compute air voids for pay factor determination.

Also, if the Contractor's air voids do not compare with the Department's test results, and the Contractor is using slag as an aggregate, the Contractor shall re-compute test results using the individual bulk specific gravity for that particular testing increment and re-compare with the verification test result. If the results compare within the tolerances in Table V, Section 410, using the individual bulk specific gravity, no further testing will be required and the Contractor's running average of the last four bulk specific gravities will be used to compute air voids for pay factor determination.

If the results of the Department's verification test and the Contractor's test do not compare within the tolerances in Tables V or VI, Section 410, but yield the same pay factor for the LOT when the Department's result is substituted for the Contractor's result, no further testing will be required. Where the Contractor's test results and the Department's test results do not compare and cannot be resolved by the above mentioned methods but the pay factor dispute is between 1.00 and 1.02 the Contractor may elect to accept the 1.00 pay factor and waive referee testing.

When differences between test results of the verification samples are not within the tolerances listed in Tables V or VI, Section 410, and cannot be resolved by the above mentioned methods, referee testing will be required.

All referee samples will be tested by the Bureau of Materials and Tests, Central Laboratory, 3704 Fairground Road, Montgomery, AL 36110. The Bureau of Materials and Tests Central Laboratory is an AASHTO accredited laboratory (see AASHTO R 18, Recommended Practice for Establishing and Implementing a Quality System for Construction Materials Testing Laboratories).

5. REFEREE TESTING

Laboratory:

All testing increments of the referee samples for the entire LOT shall be tested in the Bureau of Materials and Tests Hot Mix Laboratory for the pay factor parameter(s) (liquid asphalt binder content, laboratory compacted air voids, or gradation) in question. The Contractor's results (using the individual air voids and maximum specific gravities) will be compared to the Bureau of Materials and Tests results (using Materials and Tests individual bulk and maximum specific gravities) for each testing increment in the LOT. When the Contractor's results and the Bureau of Materials and Tests results are within the tolerances listed in Tables V or VI, Section 410, the Contractor's results will be used. When the Contractor's results are not within the tolerances listed in Tables V or VI, Section 410, the Bureau of Materials and Tests Central Laboratory results will be used for final pay factors. The Bureau of Materials and Tests Central Laboratory will record the Contractor's field results and the Central Laboratory's results of the parameter(s) in question on form BMT-135.

For each testing increment these results, either the Contractor's or the Bureau of Materials and Tests', will be used in the computation of the appropriate LOT pay factor.

Should differences between test results, that are not within the tolerances listed in Table V or VI, Section 410, for liquid asphalt binder content, air voids, or gradation continue for two consecutive days, operations shall be halted until testing discrepancies can be resolved. The Bureau of Materials and Tests will monitor testing procedures by Department and Contractor technicians until consistent test results are achieved.

Cores:

If the Contractor believes that the core density values determined by the State are in error, the Contractor shall notify the Division Materials Engineer in writing that referee testing is requested. Using the original cores, the Division will again determine the densities of the cores in question using a technician different from the technician who originally determined the core density. If these new densities result in a different pay factor, the new pay factor shall be applied to the tonnage in question (this may increase or decrease the Contractor's pay adjustment).

6. ADJUSTED PAYMENT FOR DEFICIENCIES.

The payment for each LOT will be adjusted on the basis of acceptance test results in accordance with the requirements given in this Section. Accurate records shall be kept of the quantity (tonnage) of plant mix in each LOT.

Pay factors shall be determined for each LOT from the values given in Tables II, III, IV, and VI, Section 410, in accordance with the following:

Pay Factor For:	Mix 327	Mix 420	Mix 423	Mix 424
Air Voids	N/A	N/A	Table II	Table III
Asphalt Content	Table II	Table II	Table II	Table III
Mat Density	N/A	N/A	Table IV	Table IV
Gradation	N/A	Table VI	N/A	N/A

The lowest numerical pay factor in a Lot will be applied to the contract price for the total tonnage {metric tonnage} in the LOT. This will result in an adjustment to the compensation for the Lot that will be shown in a separate line item on the payment estimates.

Pay factors above 1.00 will not be applied to mixes that are tested on fewer than three characteristics or when there are less than four laboratory tests (percent liquid asphalt binder and laboratory air voids or gradation) per characteristic; it is not necessary to obtain four roadway densities to obtain a pay factor above 1.00. When the pay factor is calculated to be greater than 1.00, a pay factor of 1.00 will be applied.

Pay factors above 1.00 will not be applied to mixes where the roadway density requirement has been lowered below 94%.

(d) ADJUSTMENT PERIOD.

During start-up operations, an adjustment period (test strip) as described below shall be required when producing a new job mix formula. The purpose of the adjustment period will be to permit the Contractor to adjust his production process and for Contractor QC personnel and ALDOT QA personnel to calibrate and coordinate their testing procedures. The Contractor has the option of running a test strip or waiving the test strip, if the proposed job mix formula has been produced satisfactorily on previous projects. The waiver of a test strip shall be in writing to the Project Manager prior to any production and placement of the previously produced job mix design. The Contractor assumes the risk of milling and relaying unacceptable mix with no additional compensation if the test strip is not utilized.

A test strip of not more than 500 tons {500 metric tons} shall be constructed. If the placement of a test strip is not completed the same day it is begun, the Contractor shall construct a new test strip. Production shall stop until the Contractor has completed one liquid asphalt binder content, one air void content, and four mat density tests for mixes other than 327 and 420. For 327 and 420 mixes the Contractor shall complete one liquid asphalt binder content and one gradation. The pay factors for liquid asphalt binder content, air void content, and gradation will be calculated using the one test row of Table II, Table III and Table VI, and the pay factor for mat density will be calculated using the four test row of Table IV in Section 410. The production point at which the mix shall be sampled shall be determined by the Contractor. This sample does not have to be randomly selected, but should be representative of the mix produced. Contractor mat density tests shall be performed with non destructive density testing devices, meeting the requirements of Section 306, which have been calibrated for the layer being placed according to ALDOT-222, ALDOT-350, or Section 306. The Contractor shall cut cores at these locations and immediately turn the cores over to the Department for density measurements and determination of the pay factor. The Department will conduct the same tests for verification at the same time the Contractor is conducting his tests. If a pay factor of less than 1.00 is obtained using the one test row of Table II, Table III and Table VI, and using the four test row of

Table IV in Section 410, a second test strip consisting of 200 tons {200 metric tons} shall be constructed. If a pay factor of less than 1.00 is obtained using the one test row of Table II, Table III and Table VI, and using the four test row of Table IV in Section 410 in the second test strip, additional 200 ton {200 metric ton} test strips shall be constructed until pay factors are equal to 1.00, at which time production can begin. A test strip is determined to be complete when the results of the tests are known.

The Engineer may require any test strip to be removed and replaced at no cost to the Department if the pay factor determined from the four test row for mat density and the one test row for other tests is 0.80. For actual payment purposes, a pay factor of 1.00 will be used for all first and second test strips allowed to remain in place. Pay factors will be applied to the third and all subsequent 200 ton test strips at the average of the computed rate (using the one test row) and 1.00.

SECTION 410 ASPHALT PAVEMENTS

410.01 Description.

The work under this Section covers the general requirements that are applicable to all types of hot and warm mix asphalt pavements of the plant mix type. Deviations from these general requirements will be indicated in the specific requirements for various types of mixes noted in the following sections of these Specifications.

This work shall consist of one or more courses of hot and warm mix asphalt plant mix constructed in accordance with these specifications and the specific requirements of the type of mixture required and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer. The Contractor may use either hot mix or warm mix for all Superpave ESAL Range mixes in Section 424. Warm mix asphalt shall be defined as the use of an approved warm mix technology in the plant mix at the time of production.

This work shall also include the preparation of the underlying surface on which the plant mix is to be placed, including patching and/or leveling as shown on the plans or directed.

In addition, this work shall also include the placing of widening at locations shown on the plans and/or directed by the Engineer. In general, widening shall consist of (1) narrow width build-ups, three feet or less {one meter or less}, required for widening existing pavement, (2) paving for turn-outs beyond three feet {one meter} from the edge of pavement, (3) pavement crossovers, and (4) turning lanes of less than 200 feet {60 m} for crossovers. Paving used on turn-outs for intersecting paved roads and shoulder paving will not be considered as widening unless shown on the plans.

Surface layers and wearing layers are defined as those layers where the pay item contains the wording "Wearing Surface".

All ALDOT procedures referenced are applicable to both hot and warm mix asphalt.

410.02 Materials.

(a) APPLICABLE SECTIONS OF SPECIFICATIONS.

Materials shall conform to requirements given in Sections 327, 420, 423 and 424.

(b) PRODUCTS AND PROCESSES FOR THE PRODUCTION OF WARM MIX ASPHALT.

Warm Mix Asphalt products and processes shall be selected from List II-27, "Warm Mix Asphalt Products and Processes" of the Department's manual titled "Materials, Sources, and Devices with Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

(c) ANTI-STRIPPING AGENTS.

All warm mix asphalt mixtures shall include an anti-stripping agent. The warm mix additive supplier may certify that an anti-stripping agent is an integral part of the warm mix additive.

All hot mix asphalt mixtures except 327 and 420 shall be tested during design to determine if an anti-stripping agent is needed. During design and production, all other mixes shall have a tensile strength ratio (TSR) of at least 0.80 when tested in accordance with AASHTO T 283 as modified by ALDOT-361. If any TSR value falls below the minimum specified above, plant operations shall cease

until corrective measures are taken. However, if any visual stripping occurs in the design or field production, an anti-stripping agent shall be required if deemed necessary by the Engineer. Should it become necessary for the Contractor to include an anti-strip agent in the mix due to the occurrence of visual stripping during field production of the mix after the design tests indicated that the same mix met the above listed TSR requirement, such work will be paid for as Extra Work as defined by Article 104.03. Additional payment for the anti-strip agent will not be made in cases where the same mix has been previously used in field production and visual stripping occurred.

The amount of anti-stripping agent, when required, shall be 0.25 to 1.0 % by weight {mass} of the liquid asphalt binder content for liquid agents and 0.5 to 2.0 % by weight {mass} of the total aggregate for powdered agents. Liquid anti-stripping agent shall be added to the liquid asphalt binder by approved on-line blending equipment either at the refinery or the Contractor's mixing plant within $\pm 10\%$ of the specified rate.

Silicone may be used in liquid asphalt binder, not to exceed 2 ounces per 5000 gallons {3 ml per 1000 L}. Except when producing Warm Mix Asphalt, other additives shall not be added to the liquid asphalt binder unless expressly authorized in writing by the Materials and Tests Engineer.

The use of any unauthorized additive will be cause for rejection of the mixture.

(d) COMPOSITION OF MIXTURES.

1. ADJUSTMENTS TO RATE OF PLACEMENT.

The project designated rate per square yard {square meter} of the plant mix layers are designed assuming a compacted mix unit weight {mass} of not greater than 158 pounds per cubic foot {2530 kg/m³} for dense graded mixes (light weight aggregates excepted.) Hence, a correction to the plan designated rate per square yard {square meter} will be made in accordance with the following:

- If the compacted mix density as determined in the job mix formula design exceeds 158 , or is below 130, pounds per cubic foot, {2530 kg/m³, or is below 2080 kg/m³}, the correction will be based on the formula:

$x = ab/158$ { $x = ab/2530$ }, where

x = corrected rate per square yard {square meter},

a = laboratory compacted mix unit weight in pounds per cubic foot {density in kilograms per cubic meter} as shown in the job-mix formula, and

b = project designated rate per square yard {square meter} of plant mix as shown on the job plans.

- If the laboratory compacted density is between 130 pounds per cubic foot and 158 pounds per cubic foot {2080 kg/m³ and 2530 kg/m³}, no correction will be made to the pounds per square yard {kilograms per square meter} designated by the plans or proposal.

- If the plans provide for the use of lightweight aggregate (expanded clay or shale), the pounds per square yard {kilograms per square meter} of the layer shown by the plans or proposal will not be adjusted.

- If the plans provide for the use of an "Open Graded" plant mix layer, the pounds per square yard {kilograms per square meter} of the layer shown by the plans or proposal will not be adjusted.

2. REQUIREMENT FOR APPROVED JOB MIX FORMULA.

Work shall not be started under this Section on a specific project until the Contractor has submitted and received approval of a job-mix formula from the Materials and Tests Engineer and the job mix formula has been checked by the Division Materials Engineer for use on the project.

A change in aggregate sources will require a new job-mix formula before the new material is used. A change in liquid asphalt binder source and anti-stripping agent will be allowed without a new job-mix formula provided the design criteria is met by a one-point check of the mixture. The one-point check shall include the Air Void, VMA, Stability, Flow, and TSR (Tensile Strength Ratio) and may be determined during the production of the mix. However, no change in the grade of liquid asphalt binder will be allowed without the approval of the Materials and Tests Engineer.

3. CONTRACTOR'S RESPONSIBILITY FOR JOB-MIX FORMULA.

Designs for all mixes shall be the responsibility of the Contractor and shall be submitted by the Contractor for approval. Refer to applicable Sections (420, 424, etc.) for design criteria. The submitted formula shall have been designed by a certified technician (Level III - Designer) in a laboratory that has been certified by the Department.

4. APPROVAL OF JOB MIX FORMULA BY MATERIALS AND TESTS ENGINEER.

The Contractor shall submit to the Materials and Tests Engineer, for approval, a Job Mix Formula (JMF) for each mixture to be supplied from a specific plant. The Contractor shall allow at least four weeks for the evaluation and approval of the job mix formula.

The submitted formula shall include any additive by type and trade name and be accompanied by samples from the material sources he proposes to use in producing the mix. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of liquid asphalt binder to be added to the aggregate, a single percentage of any additive, and a mixing temperature range suitable for the type, grade, etc. of liquid asphalt binder to be used in the mix. Each job-mix formula shall be accompanied by a test report from an approved laboratory certifying that all current Departmental design test parameters have been met (copies of the Departmental current design test parameters may be obtained from the office of the Materials and Tests Engineer). There will be no charge for the Department's checking of the Contractor's job-mix formula.

The approved job-mix formula for each mixture shall be in effect for a maximum of four years from the approval date on the JMF or until the Materials and Tests Engineer withdraws approval by written order.

5. APPROVAL OF JOB MIX FORMULA BY DIVISION MATERIALS ENGINEER.

At least two full working days prior to beginning the production of asphalt mix for a specific project, the Contractor shall submit a mix design (approved by the Materials and Tests Engineer) to the Division Materials Engineer. The project number shall be inserted on the approved job mix formula. The Division Materials Engineer will review the mix design to determine if the job mix formula is appropriate for the specific project. If the job mix formula is appropriate for the project, the Division Materials Engineer will sign the mix design as being approved, will note the date of approval, and will distribute copies for inspection of the asphalt production.

A copy of this approved job mix formula with the Materials and Tests Engineer's approval and the Division Materials Engineer's approval (with the date of approval) shall be available at the plant any time material is being delivered to the State.

6. ESTABLISHMENT OF DELIVERY TEMPERATURE.

The Engineer will check and record the temperature of the mixture upon delivery to the project site. The minimum delivery temperature for warm mix asphalt shall be 220 °F {104 °C}. The minimum delivery temperature for hot mix asphalt shall be 250 °F {121 °C}. The Engineer should monitor the work to ensure that there is not high variability in the delivery temperatures or isolated loads of temperature differentials that appear extreme. For pay items that do not require density as a pay factor (patching, widening, etc.) and / or for mixes that do not require density as a pay factor (OGFC, PATB, etc) the Contractor shall provide a + /- 25 °F {11 °C} delivery temperature range.

No loads will be accepted at a temperature greater than 350 °F {177 °C} for hot mix or warm mix asphalt.

7. CONFORMANCE TO APPROVED JOB MIX FORMULA.

All mixtures furnished for use on the project shall conform to the approved job-mix formulas within the following ranges of tolerances:

All liquid asphalt binders used shall meet the requirements given in Section 804. See appropriate pay factor table for liquid asphalt binder content requirements.

The mixing temperature shall not exceed 350 °F {177 °C}.

Tolerances for 327, 420 and 424 mixes:

- Plus or minus 7 % for the #4 {4.75 mm} and larger sieve requirements.
- Plus or minus 4 % for the #8 through #100 {2.36 mm through 150 µm} sieve requirements.

- Plus or minus 2.0 % for the #200 {75 µm} sieve requirement.

See Section 423 for gradation requirements for 423 mixes.

The initial setting of the controls for all materials shall be those amounts shown on the job-mix formula. The above tolerances are provided for slight variations inherent in job control applications. The Contractor shall make changes as necessary in order that the mixture will run as close as practical to the job-mix formula.

8. CONSISTENCY OF MIX DESIGN IN PLACEMENT OF WEARING LAYER.

More than one job mix formula may be submitted and approved for a layer of pavement. The placement of the entire wearing layer shall be from the same job mix unless otherwise approved in writing by the Engineer. For layers other than the wearing layer, the Contractor shall notify the Engineer in writing of the mix design change prior to changing production.

(e) RECYCLED ASPHALT PLANT MIX (RAP) AND RECLAIMED ASPHALT SHINGLES (RAS).

1. COMPLIANCE WITH ALDOT-372.

On all projects utilizing recycled/reclaimed material in the mixture, the Contractor's paving operation and RAP and RAS processing shall conform to the requirements given in ALDOT-372. The recycled hot and warm mix asphalt shall be a homogeneous mixture of reclaimed material, new aggregate (fine or coarse aggregate, or a mixture of fine and coarse aggregate) and new liquid asphalt binder material.

2. ALLOWABLE USAGE OF RAP AND RAS.

The Contractor shall have the option to use RAP and RAS in accordance with the requirements given in the following table unless shown otherwise on the plans:

ALLOWABLE USE OF RAP AND RAS Maximum Allowable Percent of RAP and RAS by mass of Total Aggregate Content		
Type of Mix	Maximum RAP Content #	Maximum RAP and RAS Content **
327, Plant Mix Bituminous Base	25 %	RAS Not Allowed
327-E, Permeable Asphalt Treated Base	10 %	RAS Not Allowed
420, Open Graded Friction Course	10 % RAP shall not contain chert*	RAS Not Allowed
423, Stone Matrix Asphalt 424, Superpave	Surface Layers: 20 % with no more than 15 % containing chert *; All Other Layers: 35 %	Surface Layers: 20 % *; All Other Layers: 35 %
* This limitation applies even if the surface layer is to be covered by an Open Graded Friction Course (Section 420). If the aggregate is chert gravel with a bulk specific gravity that is less than 2.550, a maximum of 15 % of the RAP will be allowed. RAP containing chert gravel shall be crushed so that 100 % of the RAP passes the 1/2 inch {12.5 mm} sieve. Additional RAP that does not contain chert gravel may be added to the mixture through a separate feeder. ** RAS shall be limited to 5 % by mass of the total aggregate content.		

3. PROCESSING AND RESTRICTIONS FOR AGGREGATE IN RAP.

RAP used in 3/8 inch {9.5 mm} Section 424 "Superpave" maximum size mix shall be processed so that 100 % of the RAP passes the 1/2 inch {12.5 mm} sieve. For all other mixes, the maximum size of the aggregate in the RAP shall meet the maximum size for the mix specified. The aggregate in the RAP shall meet the aggregate requirements of the mix it is used in and the requirements given in Sections 801 and 802 (no gravel in Section 327 PATB, Section 420 and Section 423 mixes). RAP used in Section 327 PATB and Section 420 mixes shall be processed so that 100 % of the RAP is retained on the No. 4 {4.75 mm} sieve.

4. RECLAIMED ASPHALT SHINGLES (RAS).

Reclaimed Asphalt Shingles (RAS) shall be handled, stored, and used in accordance with the requirements given for RAP and the following requirements.

The RAS shall be materials produced as a by-product of the manufacturing process for roofing shingles and/or scrap shingle (from roofing materials).

The RAS shall be free from foreign materials such as paper, nails, wood, and metal flashing. The RAS shall be shredded or ground prior to being incorporated into the mixture. The shredded RAS shall have 100% passing the 1/2 inch {12.5 mm} sieve in any dimension and a minimum of 95% passing the 3/8 inch sieve.

In addition to the requirements set forth in ALDOT-372, RAP stockpiles utilized for JMF's with RAP content greater than 25 % shall also meet the following requirements.

ADDITIONAL RAP STOCKPILE REQUIREMENTS FOR RAP USED IN A JOB MIX FORMULA WITH INCREASED RAP CONTENT	
Control Parameter	Standard Deviation*
Asphalt Content	0.5 %
% Passing #200 Sieve	1.5 %
Sieve with 50 % RAP Passing	5.0 %
*Based on a minimum of 10 tests	

Testing for RAP stockpile shall be included as part of the design JMF submittal.

(f) LIQUID ASPHALT BINDER DRAINDOWN.

1. FIBER STABILIZER.

A fiber stabilizer is required for some mix types (Section 420, 423, etc). A fiber stabilizer may be used on other mix types where asphalt binder cement draindown is a problem. Where RAS is included in the JMF, fiber stabilizer shall not be required provided the draindown requirements of 0.30% or less are met when tested in accordance with AASHTO T305 at 325°F {163°C} and 350°F {176°C}.

When fiber is used, the dosage rate shall produce a maximum liquid asphalt binder cement draindown of 0.30 % or less when tested in accordance with AASHTO T305 at 325°F {163°C} and 350°F {176°C}. When fiber is used, the sampling and testing frequency for all mixes for both Contractor and Department testing during production shall be one test for each 5000 tons {metric tons} or portion thereof. The fiber shall be listed on List II-23, Fibers for use in Hot Mix Asphalt (from the Materials, Sources, and Devices with Special Acceptance Requirements (MSDSAR) manual). If pelletized fibers are used, the fiber within the pellet shall be listed on List II-23. All fibers listed on List II-23 shall meet the requirements of either Item 2, 3, or 4 of this Subarticle.

2. CELLULOSE FIBERS.

The maximum length of the fiber shall be 0.25 inches {6.35 mm}. A representative 3 gram sample, when heated in a crucible between 1100 and 1200 °F {595 and 650 °C} for at least 2 hours, shall show between 13 % and 23 % non-volatiles. A representative 5 gram sample, when stirred into 100 ml of distilled water, shall have a pH between 6.5 and 8.5 after sitting for 30 minutes. A representative 5 gram sample, when saturated with mineral spirits for 5 minutes and then sieved for 10 minutes on a No. 40 {425 µm} sieve, shall absorb between 4 % and 6 % its own weight of mineral spirits. A representative 10 gram sample, when weighed and placed into a 250 °F {121 °C} oven for two hours, shall lose less than 5 % by weight when weighed immediately upon removal from the oven.

Sieve analysis of the cellulose fiber shall be either of the following methods:

- Using an Alpine Air Jet Sieve (Type LS), a representative 5 gram sample of the fiber is sieved for 14 minutes at a controlled vacuum of 11 psi {75.8 kPa}. The fibers remaining on the screen are weighed. The results of this analysis shall indicate that 60 % to 80 % of the fiber passes the No. 100 {150 µm} sieve. Or:

- Using a Mesh Screen Analysis, a representative 10 gram sample of the fiber is sieved using a shaker with two nylon brushes on each screen. The results of this analysis shall indicate that the fiber has the following amounts passing the specified screens: 75 % to 95 % on the No. 20 {850 µm} sieve, 55 % to 75 % on the No. 40 {425 µm} sieve, and 20 % to 40 % on the No. 140 {100 µm} sieve.

3. MINERAL FIBERS.

When tested according to the Bauer-McNett fractionation, the fiber length shall have a maximum mean test value of 0.25 inches {6.35 mm}. By using a phase contrast microscope, and a representative test sample of at least 200 fibers, the fiber diameter shall have a maximum mean test value of 0.0002 inches {5.1 µm}. The shot content passing the No. 60 {285 µm} sieve shall be 85% to 95%. The shot content passing the No. 230 {65 µm} sieve shall be 60 % to 80 %. This is a measure of non-fibrous material determined on vibrating sieves (for further information see ASTM C 612).

4. SYNTHETIC FIBERS.

Synthetic fibers shall include but are not limited to one or a combination of the following: polyolefins (such as polyethylene and polypropylene) and aramids (such as Kevlar, Twaron and Nomex). Fibers shall be twisted fibrillated, flat fibrillated or monofilament with a maximum fiber length of 0.75 inches {19 mm}

5. PLACING FIBER IN MIX.

a. Manual Method.

Provided it can be demonstrated to the satisfaction of the Engineer that the proper dosage of the fibers is uniformly distributed into the mix, manual introduction of fibers is acceptable when a batch plant is used to make the mix. When the fibers are available in prepackaged (weighed) containers, proper dosage may be pre-determined per batch. A device is required to interrupt mixture production and warn the plant operator if the operator manually feeding the fiber fails to introduce it properly. Dry mixing time shall be increased at least five seconds to insure adequate blending. Wet mixing time shall be increased at least five seconds for cellulose fibers and up to five seconds for mineral fibers. Manual introduction of fibers shall not be used in drum plants.

b. Automatic Method.

Methodology and equipment for metering bulk loose and pelletized fiber into asphalt plants has been developed by the fiber suppliers. Whenever the fiber supplier's recommendations are more stringent than this specification, the fiber supplier's recommendations are controlling. This specification requires specialized equipment that can accurately proportion and meter, by weight {mass}, the proper amount per batch (for batch plants) or continuously, in a steady uniform manner (for drum plants). Fiber, pelletized or loose, shall not be fed through the cold feed bins or through the rap bin.

These proportioning devices shall be interlocked with the plant system and controlled to +/-10% of the weight of the fibers required so as to maintain the correct proportions for all production rates and batch sizes. During the test strip, an equipment calibration check shall be performed to the satisfaction of the Engineer which shows the fiber is being accurately metered and uniformly distributed into the mix. These metering devices shall provide in process high flow (+ 10% or more) and low flow (-10% or less) plant operator notification and interrupt the mix production where the fiber rate is not properly controlled. The fiber metering system shall also provide a record of feed rate (weight or mass per time) and include a section of translucent pipe for visual confirmation of consistent flow rates. Care shall be taken to insure that the fibers are not entrained in the plant's exhaust system. If there is any evidence of fiber in the bag-house or wet-washer fines, the liquid asphalt binder line and/or the fiber line shall be relocated so that the fiber is captured by liquid asphalt binder spray and incorporated into the mix. If there is any evidence of clumps of fibers or pellets at the discharge chute, the contractor shall increase the mixing time and/or intensity. This may entail extending the liquid asphalt binder and fiber feeding lines further into the drum.

(g) SAMPLING AND INSPECTION.

Aggregates will be accepted in stockpiles in accordance with the Department's Testing Manual provided there is no segregation or contamination, but production of required gradation in the mix shall be the Contractor's responsibility.

Liquid asphalt binder will be accepted on the basis of ALDOT-243.

The right is reserved to take samples, including aggregates from stockpiles, plant mix from the hot elevator, plant mix from the spreader, liquid asphalt binder from storage tanks at the plant, etc., and to make further tests as needed as a basis for continued acceptance of the materials.

Samples of the mixture in use will be taken and tested in accordance with Subarticle 106.09(b).

When directed, the Contractor shall cut samples with mechanical equipment from the compacted pavement for testing. Samples not smaller than 4 inches {100 mm} square or 4 inches {100 mm} in diameter for the full depth of the course to be tested shall be taken at the locations directed by the Engineer. Furnishing of suitable approved cutting equipment, the cutting of the samples, and the immediate repair of the sample holes with similar type of material shall be performed by the Contractor without extra compensation.

A laboratory shall be furnished for the control of each hot and warm mix asphalt plant in accordance with the provisions of Section 601.

410.03 Construction Requirements.

(a) EQUIPMENT.

In general, choice of equipment will be left to the Contractor and it shall be his responsibility to provide proper sized and amounts of equipment that will produce, deliver to the roadbed, spread, and compact the plant mixed material in sufficient quantities for the continuous movement of the spreaders under normal operating conditions.

The mixing plant, hauling, spreading, and compaction equipment shall meet the requirements listed below; however, other equipment that will produce equally satisfactory results, such as electronically or automatically controlled devices of proven performance, will be considered for use in lieu thereof.

The Contractor shall secure approval of all equipment prior to beginning work and any equipment found unsatisfactory shall be promptly replaced or supplemented.

1. REQUIREMENTS FOR ALL PLANTS.

Mixing plants shall comply with the requirements of AASHTO M 156 as modified by ALDOT-324, Mixing Plant Requirements for Hot-Mixed, Hot-Laid Asphalt Paving Mixtures. In addition to the above, if a recycled/reclaimed mix is used, the mixing plant shall be modified as necessary to accommodate the use of the reclaimed material and necessary additives. Mixing plants shall be inspected at least annually to insure compliance with the requirements of AASHTO M 156 and ALDOT-324. The Contractor/Vendor will be charged a fee as specified by ALDOT-355, General Information Concerning Materials, Sources, and Devices with Special Acceptance Requirements. If the plant is relocated or substantially modified in any way within a year of the last inspection, an additional inspection and related fee will be required.

The plant shall be equipped with a dust collector constructed to waste or store and later return uniformly to the aggregate mixture all or any part of the material collected.

2. SCALES.

A digital recorder shall be installed as part of the platform truck scales. The recorder shall produce a printed digital record on a ticket of the gross and tare weights {masses} of the delivery trucks along with a time and date print for each ticket. Provisions shall be made so that scales may not be manually manipulated during the printing process, and so interlocked as to allow printing only when the scale has come to rest. The scales and recorder shall be of sufficient capacity and size to accurately determine the weight {mass} of the heaviest loaded truck or tractor trailers that are used for the delivery of the hot and warm mix asphalt from that plant.

In lieu of plant and truck scales, the Contractor may provide either (1) an approved automatic printer system which will print the weights {masses} of the material delivered (evidenced by a weight {mass} ticket for each load), provided the system is used in conjunction with an approved automatic batching and control system, or (2) an electronic load cell weight {mass} determination system with associated computer hardware and automated printing system.

The Contractor may provide a "weigh {mass} batcher" system utilizing a weigh {mass} hopper equipped with load cells that determine the net amount of mix delivered from the weight {mass} hopper. An automated weigh {mass} printing system shall be provided to accurately print the weight {mass} of material delivered, the time, and the date for each ticket.

All scales which determine the weight {mass} of the mix for pay purposes shall meet the requirements of Subarticle 109.01(h).

3. HAULING AND REMIXING EQUIPMENT.

a. Load Limitations.

Reference is made to Article 105.12 concerning load limitations on hauling equipment.

Wherever a Material Remixing Device is used, the following restrictions shall apply:

- The device shall be empty while on a bridge.
- The device shall be moved across a bridge without any other vehicles or equipment being on the bridge.
- The device shall be moved on a bridge only within the limits of a lane and shall not be moved on the shoulder of a bridge.

- The device shall move at a speed no greater than 5 miles {8 km} per hour without acceleration or deceleration.

b. Trucks.

Each truck shall have a hole in the side of the body, approximately 5/16 of an inch {8 mm} in diameter and suitably placed, to allow for temperature measurement of the asphalt mix.

Trucks used for hauling hot and warm mix asphalt mixtures shall have tight, clean, smooth metal beds that have been thinly coated with a minimum amount of approved asphalt release agent (List II-6, Hot Mix Asphalt Release Coating for Truck Beds, in the MSDSAR manual) to prevent the mixture from adhering to the beds. The use of gasoline, kerosene, diesel or other volatile material is prohibited.

Each truck shall be equipped with a tarpaulin that shall be used as needed to protect the mixture from adverse conditions. The tarpaulin shall be made of water repellent material, be of sufficient weight and strength to resist tearing and be in good condition with no holes or tears. The tarpaulin shall be large enough to cover the load.

Mixture shall not leave the plant unless the load is covered when the following conditions exist:

- when the air temperature is below 60 °F {15 °C};
- when hauling time exceeds 30 minutes;
- or when threatening weather exists.

c. Material Remixing Device.

When Pay Item 410-H is included in the contract, a material remixing device shall be used for the placement of all asphalt layers except the following:

- 327-E, Permeable Asphalt Treated Base (PATB);
- a layer placed directly on top of PATB if the placement must be accomplished

by operating the remixing device on the PATB.

If a pay item is not shown on the Plans, the Contractor may use a material remixing device without compensation.

A material remixing device shall not be placed on a Permeable Asphalt Treated Base.

The material remixing device shall be capable of remixing plant mix between the trucks and the finished mat. Plant mix shall be remixed in the device prior to being laid by the paver or spreader. The plant mix delivered by the material remixing device shall be a homogeneous, non-segregated mixture.

Equipment known to accomplish this remixing operation and currently approved by ALDOT are the ROADTEC Shuttlebuggy, Terex/Cedarapids CR 662 RM, BLAW-KNOX MC-330/TWIN PUG TUB, Weiler E1250, and the Weiler E2850.

A material remixing device will not be required for temporary work of short duration, bridge replacements having less than 1000 feet {300 m} of pavement at each end of a bridge, acceleration and deceleration lanes less than 1000 feet {300 m} in length, tapered sections, widening, patching, spot leveling, shoulders, crossovers, side street returns and other areas designated by the Engineer. A material remixing device will also not be required when placing a continuous leveling layer where the thickness of the layer is required to be transversely tapered (i.e. to correct cross slope) to a thickness less than twice the maximum aggregate size of the layer being placed.

4. HOT AND WARM MIX ASPHALT PAVERS OR SPREADERS.

Hot and warm mix asphalt pavers or spreaders shall be self-contained and of sufficient size, power, and stability to receive, distribute, and strike off the asphalt material at rates and widths consistent with the specified typical section requirements and details shown on the plans and noted in Item 410.03(f)2.

All asphalt pavers or spreaders used for mainline paving, including shoulders and interchange ramps, shall be equipped with a full width vibratory, or other compactive type, screed. The augers used to move the material across the width of the screed shall extend within 1.5 feet {450 mm} of the edge of the screed. It will be permissible to use a hydraulically extendable strikeoff for paving turnouts and short sections of pavement including variable width sections and crossovers.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture, providing a finished surface of the required evenness and texture without tearing, gouging, or shoving of the mixture.

All hot and warm mix asphalt paving machines shall be operated with automatic grade and slope controls unless otherwise directed by the Engineer. The automatic grade controls shall be a contact ski, a mobile stringline, or non-contact sonic averaging sensors. The effective length of these controls shall be a minimum of 24 feet {7.3 m}. In the event of a malfunction of the automatic control system, the spreading operation shall be discontinued after one hour until the equipment is repaired.

If shown to be required on the plans, special attachments to the pavers and spreaders will be required to shape and finish the pavement.

5. COMPACTION EQUIPMENT.

Compaction equipment shall be capable of compacting the mixture to the required density throughout the depth of the layer while it is still in a workable condition without damage to the material. The Contractor shall be responsible for the selection of the types and number of rollers to be used.

(b) DAYLIGHT, WET WEATHER AND TEMPERATURE LIMITATIONS.

1. OPERATIONS IN DAYLIGHT.

Placement and compaction operations shall be performed during daylight hours unless noted otherwise on the plans or directed otherwise by the Engineer. (The requirements for lighting for nighttime work are given in Article 104.04(a)).

2. WET WEATHER.

The mixture shall be laid only upon an approved underlying course, which is dry, and only when weather conditions are suitable. The Engineer may, however, permit work of this character to continue when overtaken by sudden rains, up to the amount which may be in transit from the plant at the time, provided the surface just ahead of the placing is swept clear of water and the mixture is within the allowable temperature tolerances. The layer placed under such conditions shall be at the Contractor's risk and shall be removed and replaced by the Contractor without extra compensation should it prove unsatisfactory.

3. COLD WEATHER RESTRICTIONS.

Hot mix asphalt (HMA) layers of 200 pounds per square yard {110 kg/m²} or less shall not be placed when the surface or air temperature is below 40 °F {4 °C}; air temperature shall be 40 °F {4 °C} before the spreading operation is started. Spreading operations shall be stopped when the air temperature is below 45 °F {7 °C} and falling. For HMA layers over 200 pounds per square yard {110 kg/m²}, the above temperature may be lowered 5 °F {2 °C}. Unless otherwise stated in the plans and specifications, polymer modified HMA layers of 200 pounds per square yard {110 kg/m²} or less shall not be placed when the surface or air temperature is below 60 °F {15 °C}; for layers over 200 pounds per square yard {110 kg/m²}, the above temperature may be lowered 10 °F {5 °C}.

Warm mix asphalt (WMA) layers of 200 pounds per square yard {110 kg/m²} or less shall not be placed when the surface or air temperature is below 32 °F {0 °C}; air temperature shall be 32 °F {0 °C} before the spreading operation is started. Spreading operations shall be stopped when the air temperature is below 35 °F {2 °C} and falling. For WMA layers over 200 pounds per square yard {110 kg/m²}, the above temperature may be lowered 5 °F {2 °C}. Unless otherwise stated in the plans and specifications, polymer modified WMA layers of 200 pounds per square yard {110 kg/m²} or less shall not be placed when the surface or air temperature is below 50 °F {10 °C}; for layers over 200 pounds per square yard {110 kg/m²}, the above temperature may be lowered 10 °F {5 °C}.

With the exception of Section 420 "Polymer Modified Open Graded Friction Course" layers, the Contractor may place HMA and WMA layers at temperatures lower than the cold weather limits. The Contractor is warned that other factors such as wind speed and percent humidity may increase the heat loss from the HMA and WMA layers. All other requirements for the installation and quality of the HMA and WMA layers shall be applicable to the work even when the restrictions against placement of the HMA and WMA during cold weather are not followed. The layers placed under such conditions shall be at the Contractor's risk and shall be removed and replaced without extra compensation if they are unacceptable. There will be no direct payment for additional costs associated with the placement of HMA and WMA during cold weather.

(c) PREPARATION OF UNDERLYING SURFACE.

1. GENERAL.

The underlying surface must be approved before the placing of a plant mix application will be allowed. The underlying surface, whether an old surface or a new surface, shall be thoroughly cleaned of all foreign or loose material and maintained in such condition in advance of the surfacing work.

Failures in existing pavement or base shall be corrected, as noted in Item 410.03(c)2, in advance of the placement of an overlying layer.

A prime coat, when required, shall be placed in accordance with Section 401. A tack coat, when required, shall be placed in accordance with Section 405.

2. PATCHING.

When patching of an existing surface is provided by the plans, the Engineer will examine the pavement surface and designate the area to be patched. The designated areas shall be trimmed to neat vertical lines for the depth of the unstable material as directed. The loose faulty material shall be picked up and removed from the area. The newly exposed patch area shall be cleaned and treated with prime or tack material as directed before placement of patching material. The hot and/or warm mix asphalt patching material shall be placed and compacted by methods approved by the Engineer until the patch area is filled to the elevation of the surrounding surface. Compaction of the patching material shall be to the degree that further consolidation of the patching material is not anticipated and is acceptable to the Engineer.

3. LEVELING.

When leveling of an existing pavement or base is provided by the plans, the surface shall be brought to required grade and cross section with plant mix material. The surface to be treated shall be prepared as noted herein and approved before placing the new material. The plant mix material shall be spread in accordance with the provisions of Item 410.03(f)2.

Leveling shall include superelevating when so directed.

4. WIDENING.

When widening is provided by the plans, the widening shall be placed at the locations designated by the plans and/or as directed by the Engineer. The requirements for placing the widening shall be the same, as far as practical, as for the placing of the normal roadway. Compaction of the widening material shall be to the degree that further consolidation of the widening material is not anticipated and is acceptable to the Engineer.

(d) PREPARATION OF MIXTURES.

1. LIQUID ASPHALT BINDER.

The liquid asphalt binder material shall be heated in a manner that insures the even heating of the entire mass under efficient and positive control at all times. Any liquid asphalt binder material which, in the opinion of the Engineer, has been damaged shall be rejected.

2. AGGREGATE.

a. Aggregate Used for Batch Mixing and Continuous Mixing Operations.

All aggregates shall be dried so that the moisture content of the hot and warm mix asphalt at the point of sampling is less than 0.20 % by weight {mass} in accordance with ALDOT-130. The temperature of the aggregate at the dryer shall not exceed 600 °F {315 °C}.

When more than two ingredients enter into the composition of the mineral aggregate, they shall be combined as directed.

The aggregate, immediately after being heated, shall be screened into three or more sizes and conveyed into separate bins, ready for batching and mixing with liquid asphalt binder material. However, for mixes using aggregate of 1/2 inch {12.5 mm} maximum size, the number of bins may be reduced to two.

b. Aggregates for Dryer Drum Mixing Operations.

Maintenance of a uniform aggregate gradation is essential for a dryer drum operation; hence, caution and care shall be exercised in stockpiling of materials to avoid segregation.

3. MIXING.

a. Mixing Temperature.

The mixing temperature of HMA and WMA shall be in accordance with the refineries' recommendations, based upon the temperature-viscosity curve, and shall be adequate to produce a mixture in accordance with the specification requirements. The mixing temperature shall not exceed 350 °F {177 °C}.

The mixing temperature for HMA and WMA shall be continuously recorded and delivered to the Engineer on the next working day.

b. Batch Mixing.

The dried mineral aggregate, and measured mineral filler when used, prepared as prescribed above, shall be combined in uniform batches by determining the weight {mass} of and conveying into the mixer the proportionate amounts of each aggregate required to meet the job-mix formula. The largest size aggregate shall be introduced first, then smaller sizes progressively, with mineral filler last, or all mineral components may be added simultaneously. The mineral components shall be thoroughly mixed. The required quantity of liquid asphalt binder material for each batch shall be measured by weight {mass} using scales or a liquid asphalt binder material metering device attached to the liquid asphalt binder material bucket.

After the mineral components have been mixed, the liquid asphalt binder material shall be added and the mixing continued for a period of at least 45 seconds, or longer if necessary to produce a homogeneous mixture. However, if a check by ASTM D 2489 (Ross Method) shows that 95% plus coating is obtained, a shorter mixing time will suffice. The Engineer may then give written permission for a change. Each batch must be kept separate throughout the weight {mass} determining and mixing operations.

The mixture shall be uniform in composition, free from lumps or balls of material containing an excess quantity of asphalt, or from pockets deficient in asphalt.

c. Continuous Mixing.

Components shall be introduced and proportioned volumetrically by continuous methods utilizing equipment specified herein for continuous plants. Amounts of aggregate and liquid asphalt binder material entering the mixer, and the rate of travel through the mixer, shall be so coordinated that a uniform mixture of specified gradation and liquid asphalt binder content will be produced.

d. Dryer-Drum Mixing.

Components shall be proportioned by weight {mass} as noted herein in Item 410.03(a)1 for this method of mixing. Amounts of aggregate and liquid asphalt binder material entering the mixer, and the rate of travel through the mixer, shall be so coordinated that a uniform mixture of specified gradation and liquid asphalt binder content will be produced. An anti-stripping agent may be required to insure adequate coating of the aggregates, if so directed by the Engineer.

4. RECYCLED MIXTURES.

a. New Aggregate Temperature.

The temperature of the new aggregate shall be super-heated to the point where, when combined with the reclaimed material, the specified discharge is produced; however, in no case shall the temperature of the new aggregate exceed 600 °F {315 °C}.

b. Mixing.

The plant shall be designed and operated so that heat transfer will take place in the mixing unit without damage to, or vaporization of, the liquid asphalt binder material. For batch type plants, a minimum dry mixing cycle of 15 seconds shall be required for the new aggregate and reclaimed material before introduction of the new liquid asphalt binder material. All environmental regulations shall be met as required by Article 107.22.

(e) TRANSPORTING MIXTURE.

The mixture shall be transported in approved equipment in accordance with Item 410.03(a)3. The equipment shall be in sufficient numbers to deliver the material to the roadbed without delay in the quantity required. Loads shall not be delivered too late in the day to be spread, compacted, and finished during daylight hours, unless nighttime work is allowed as shown on the plans or directed by the Engineer. Loads shall not be delivered at a temperature greater than 350 °F {177 °C} , or less than 220 °F {105 °C} without written permission of the State Materials and Tests Engineer.

(f) PLACING THE MIXTURE.

1. RATE OF PLACEMENT.

The rate of plant mix to be placed will be specified by the plans; however, this rate may require correction to adjust for the compacted mix unit weight {density} as determined in the job-mix formula design as outlined in Subarticle 410.02(b). The Engineer may direct in writing that the designated weight {mass} be increased or decreased in certain areas. It shall be the Contractor's responsibility to place and spread the material uniformly to such thickness as will produce the specified average rate, separately for each layer of base, binder, and surface, and to maintain a continuing check on tonnage {mass} and yardage {area} throughout the day's operation to insure uniform specified rate.

The unit for checking the average rate shall be approximately 5000 square yards {5000 m²} to the nearest even truck load. If the last check performed in any day or any section of roadway is between 2000 and 5000 square yards {2000 and 5000 m²}, this section shall be classified as a unit; if less than 2000 square yards {2000 m²}, this section shall be added to the previous unit and the revised unit rechecked. When the initial day's operation is less than 2000 square yards {2000 m²}, this initial section will be carried over to subsequent days' operations to make a unit of approximately 5000 square yards {5000 m²}.

In any unit checked, the average rate shall not vary from the specified rate by more than 10 pounds per square yard {5 kg/m²} for layers of 225 pounds per square yard {120 kg/m²} or less, and 15 pounds per square yard {8 kg/m²} for layers greater than 225 pounds per square yard {120 kg/m²}. On the first applied layer of resurfacing where there is no required milling or leveling, this tolerance is increased to 15 pounds per square yard {8 kg/m²} for layers of 225 pounds per square yard {120kg/m²} or less, and 25 pounds per square yard {13 kg/m²} for layers greater than 225 pounds per square yard {120 kg/m²}. This tolerance is for providing leeway in equipment adjustment only. A consistent and uncorrected variation from the specified rate, even within this tolerance, will not be allowed without the Engineer's written approval. This tolerance does not apply to patching, leveling, and widening.

If the average rate of any unit is found deficient by more than the above referenced tolerance, the Engineer will determine (1) whether the Contractor shall remove and replace the deficient unit without payment for the removal or the material removed, or (2) whether the Contractor may leave the deficient unit in place and cover it with a layer of the same mix of adjusted maximum size aggregate of not less than 80 pounds per square yard {45 kg/m²} average. In case (2), the surface layer shall not be feather-edged at the end of the overlay layer, but a sufficient amount of the surface beyond the ends of the deficient unit shall be removed, to a neat line across the pavement, to allow placing the full 80 pounds per square yard {45 kg/m²} and to make a joint that will meet the surface requirements. There will be no payment for any portion of the overlay needed to bring the total up to the designated average rate for that unit.

If the average rate of any unit is found to exceed the above referenced tolerance, the tonnage {metric tonnage} in the unit that is in excess of the specified rate will be paid for as specified in Subarticle 410.09(a).

Unless otherwise provided in the following sections of these specifications, or shown on the plans, the average rate placed and compacted in one layer shall not exceed 350 pounds per square yard {200 kg/m²} for base or binder layers, and 225 pounds per square yard {120 kg/m²} for surface layers. Where the amount to be placed exceeds these limits, it shall be placed and compacted in two or more approximately equal layers or as shown on the plans.

2. SPREADING.

a. General.

Spreading of the hot and warm mix asphalt mixture shall be performed by equipment meeting the requirements of Item 410.03(a)4, except as noted in this Item. Approved specialized equipment may be employed to spread the hot and warm mix asphalt material where standard full scale equipment is impractical due to size and irregularity of the area to be paved.

For hot and warm mix asphalt pavement wearing layers, spreading operations shall be so correlated with plant and hauling equipment that the spreading operation, once begun, shall proceed at a speed as uniform and continuous as practical. The continual forward movement of the spreader requires the use of hauling vehicles capable of supplying the spreader with hot and warm mix asphalt material while the spreader is in motion. Repetitive interruptions or stopping of the spreader

shall be cause for the Engineer to stop the work until the Contractor evaluates the cause of the stoppage and has provided a definite action plan for correction of the interruptions. Any interruption will require the thorough check of the area immediately under the spreader and any variances shall be corrected immediately or the material removed and replaced, as directed, without additional compensation.

Material placed in the spreader shall be immediately spread and screeded to such uniform depth that the average rate of the mixture required is secured. Alignment of the outside edges of the pavement shall be controlled by preset control lines, and shall be finished in conformity with these controls.

Any spreading operation, which cannot produce acceptable joints within the surface tolerances and density requirements, shall be cause for requiring the Contractor to modify his operations to include additional spreading equipment.

b. Spreading by Motor Grader.

For areas of a hot and warm mix asphalt plant mix surface inaccessible to the mechanical spreader, patching of pot holes and correcting failures in existing pavement, the plant mix may be dumped in low areas in the amounts directed, windrowed, spread, and compacted to bring the elevation and section to the desired level.

If shown on the plans, the Contractor shall use a motor grader or a motor grader equipped with a dragbox to perform the spreading for the leveling operation. The motor grader shall be equipped with smooth faced tires. The dragbox, when required, shall be of sufficient size and weight {mass} to effectively shape and level the plant mix and shall be approved by the Engineer prior to use.

c. Spreading by Hand.

For areas inaccessible to mechanical spreading equipment, and when patching potholes and minor pavement failures, hand spreading of the hot and warm mix asphalt mixture may be permitted. The mixture shall be distributed immediately into place by means of suitable tools and spread in a uniformly loose layer.

(g) COMPACTING.

As soon as the mixture has been spread and has set sufficiently to prevent undue cracking or shoving, rolling shall begin. A delay in the initial rolling will not be tolerated and the initial or breakdown rolling should in general be performed by rolling longitudinally, beginning at the sides and proceeding toward the center of the surface.

The Contractor as part of his QC plan shall establish a rolling pattern when initially constructing any leveling layers using the nondestructive testing devices approved in Section 306 of the Specifications. The device shall either be calibrated to roadway cores or gage counts and shall be used to determine the rolling pattern producing maximum density. Contractor QC personnel shall be on site throughout each day to perform periodic checks and verify that the rolling pattern continually produces the maximum density that is achievable.

When paving abuts a previously placed lane, the longitudinal joint shall be rolled in the first pass. On superelevated curves rolling shall begin at the low side and progress toward the high side.

If any displacement occurs during rolling, it shall be corrected at once. To prevent adhesion of surface mixture to the rollers, the wheels shall be kept adequately moistened with water and a non-foaming detergent, but an excess of water will not be permitted.

Adequate precaution shall be taken to prevent dropping of gasoline or oil on the pavement. In places inaccessible to a roller, compaction shall be obtained with hand or mechanical tampers that produce adequate pressure to obtain the required density.

When the roller is in contact with a bridge deck, vibratory mode shall be turned off and the roller shall operate in static mode only.

Throughout the process of compacting, tests for surface smoothness as required by Article 410.05 and density as required by Section 306 shall be made continuously.

(h) JOINTS.

1. GENERAL.

Placing of hot and warm mix asphalt paving layers shall be as continuous as possible. All joints shall be made in a careful manner in such a way as to provide a smooth, well-bonded, and sealed joint meeting the density and surface requirements of Articles 410.04 and 410.05. Failure to meet

requirements noted above shall be cause for ordering the removal and reconstruction of the joint without extra compensation.

The contact surface of concrete structures shall be treated with a thin coat of liquid asphalt binder material, tack material, or the liquid asphalt binder material used in the mix, prior to construction of the joint. When directed by the Engineer, the same treatment noted above shall be used on cold asphalt joints.

2. LONGITUDINAL.

Longitudinal joints in the wearing surface shall conform with the edges of proposed traffic lanes, insofar as practical. Any necessary longitudinal joints in underlying layers shall be offset so as to be at least 6 inches {150 mm} from the joint in the next overlying layer.

3. TRANSVERSE.

Transverse joints shall be carefully constructed. Rollers shall not pass over the unprotected edge of the freshly laid mixture unless laying operations are to be discontinued. To facilitate the expeditious removal of the plant mix joint when laying operations are resumed, the Contractor shall place a heavy wrapping paper on the underlying surface across the joint and place plant mix on top of the paper.

Upon resumption of the work, a neat vertical joint shall be formed into the previously laid material to expose the full depth of the layer. The fresh mixture shall be raked and tamped to provide a well-bonded and sealed joint meeting surface and density requirements.

410.04 Density Requirements.

Density requirements shall be as specified in Table IV, Subarticle 410.08(e).

410.05 Surface and Edge Requirements.

(a) SURFACE SMOOTHNESS REQUIREMENTS.

1. GENERAL.

Surface smoothness and roadway section will be checked by the use of string, Engineer's level, and straight edge.

The Contractor shall furnish string, straightedges, and the necessary personnel to handle them under the supervision of the Engineer.

Surface smoothness tests shall be made continuously during and immediately after rolling so that irregularities may be eliminated to the extent possible by rolling while the material is still workable; otherwise, deficiencies shall be corrected as provided in Article 410.06.

2. PERPENDICULAR TO CENTERLINE OF ROADWAY.

The finished surface of all base, binder, and wearing surface layers shall not vary more than 1/4 of an inch {6 mm} from a 10 foot {3.0 m} straightedge placed perpendicular (at a right angle) to the centerline of the roadway anywhere on the surface.

Unless shown otherwise in the contract, the slope shall not vary by more than 0.20 % from the required slope in any 10 foot {3.0 m} distance over which the slope is measured without the Engineer's written approval. (If, for example, a 2.0 % slope is required, the measured slope shall not be greater than 2.2 % or less than 1.8 %.)

3. PARALLEL TO CENTERLINE OF ROADWAY.

The surface shall not vary more than 1/4 of an inch {6 mm} from a 16 foot {4.8 m} straightedge placed parallel to the centerline anywhere on the surface. A 16 foot {4.8 m} rolling straightedge, equipped with marking capability, may be used in lieu of the fixed straightedge if approved by the Engineer.

The finished surface shall not vary more than 3/8 of an inch {9 mm} in any 25 foot {8 m} section from a taut string applied parallel to the surface at the following locations: 1 foot {300 mm} inside of the edges of pavement, at the centerline, and at other points designated by the Engineer. The variance from the designated grade shall not increase or decrease by more than 1/2 of an inch {12 mm} in 100 feet {30 m}.

(b) EDGE REQUIREMENTS.

Unless shown otherwise on the plans, surface, binder, and leveling pavement edges not confined by curbing or other structures may be lightly tamped, generally with a lute and immediately

behind the placement operation, to form an approximately 1:1 slope as a preventative measure against cracking and bulging during the rolling process. This procedure shall also be required on the initial edge of a longitudinal cold joint. These edges shall be neatly shaped to line behind the breakdown roller and shall be trimmed as necessary after final rolling, to an accurately lined string or wire providing a maximum tolerance of 2 inches {50 mm} outside the theoretical edge of pavement, with a maximum variation from a true line of 1/2 of an inch {12 mm} in 10 feet {3 m} and a slope not flatter than 1:1. Edges that are distorted by rolling shall be corrected promptly.

(c) RIDEABILITY REQUIREMENTS.

The rideability requirements covered in this Subarticle shall apply only when either Item 410-A, 410-B, or 410-C is included on the plans or in the proposal.

1. TESTING DEVICE.

a. Description.

The testing device shall be a longitudinal profilograph including all accessories and chart paper herein described. The chart paper containing the log of the smoothness index shall become the property of the Department at the time the measurements are taken. The following categories cover the furnishing and disposition of the profilograph:

Pay Item 410-A - The furnishing, by the Contractor, of a new profilograph, including chart paper, and its reconditioning, if deemed necessary by the Engineer, and title transfer to the Department upon completion of its use on the project.

Pay Item 410-B - The furnishing, by the Department, of a profilograph for use on the project. The Contractor shall furnish the chart paper.

Pay Item 410-C - The furnishing, by the Contractor, of a new or acceptable used profilograph, including chart paper, for use on the project with the Contractor retaining ownership of the profilograph.

b. Equipment Requirements.

The profilograph shall be a California type profilograph, completely equipped with all necessary accessories. The profilograph shall be hand-propelled and shall have multiple averaging wheels.

When the profilograph is required to be furnished by the Contractor, the Contractor shall calibrate the profilograph prior to delivery to the project and shall maintain the profilograph during the time its use is required on the project. When the profilograph is furnished by the State, the Department will calibrate and maintain the profilograph.

Chart paper for the profilograph shall be furnished in sufficient quantities for all calibration, test runs, and actual tests deemed necessary by the Engineer.

c. Equipment Delivery.

The profilograph shall be delivered to the project a minimum of two weeks before the beginning of the paving operation of the pavement layer to be tested to allow time for checking the profilograph.

2. TESTING PROCEDURE.

a. Description.

Unless shown otherwise by the plans, the following surfaces will be subject to the requirements of this Subarticle if one of the pay items listed in Subitem 410.05(c)1.a. is included in the proposal:

- Actual wearing surfaces including Polymer Modified Open Graded Friction Course (Section 420);
- The surface of the layer directly beneath the Polymer Modified Open Graded Friction Course.

The actual testing procedure shall be as outlined in ALDOT-335, a copy of which may be obtained from the Department's webpage. The Engineer reserves the right to make minor modifications to this procedure if he deems such will produce better results.

The profilograph test shall be performed as soon as practical after the pavement has been rolled and compacted sufficiently to prevent damage to the surface but no later than the next work day after placement of the pavement, unless otherwise authorized by the Engineer. The

Contractor shall furnish the necessary personnel to operate the profilograph under the direction of the Engineer.

The profilograph test is considered a part of the paving operation and will be performed immediately in the proper sequence, in a satisfactory manner, even to the exclusion of other work.

b. Rideability Requirements.

The results of the profilograph tests shall be evaluated by Department personnel as outlined in ALDOT-335.

If a Profile Index of 50.0 inches per mile {800.0 mm/km} is exceeded in any test section of any daily paving operation, the paving operation will be suspended as soon as possible after results of the unacceptable test section are obtained. The paving will not be allowed to resume until corrective action is taken by the Contractor.

When the Profile Index is more than 20.0 inches per mile {320.0 mm/km}, per section, a unit price reduction will be assessed. When the Profile Index is less than 10.0 inches per mile {160.0 mm/km} per section, a unit price increase will be added. The price adjustments are given in the following Table 1.

TABLE I	
Profile Index Inches/Mile/Section {Millimeters/Kilometer/Section}	Contract Price Adjustment Percent of Pavement Unit Bid Price
Under 10.0 {Under 160.0}	105 - (Profile Index/2.0) {105 - (Profile Index/32.0)}
10.0 to less than 20.0 {160.0 to less than 320.0}	100
20.0 thru 50.0 {320.0 thru 800.0}	100 - (Profile Index - 20.0)/1.5 {100 - (Profile Index - 320.0)/24.0}
Over 50.0 {Over 800.0}	Unacceptable

Any price adjustment for rideability considerations will be applied to the theoretical tonnage {metric tonnage}, calculated using the plan specified rate of placement, placed in those sections testing under 10.0, or more than 20.0, inches/mile {160.0, or more than 320.0, mm/km} per section.

c. Stringline and Straightedge Requirements.

On test sections where the Profile Index is 20.0 inches per mile {320.0 mm/km}, or less, the longitudinal stringline and straightedge requirements of Item 410.05(a)3 may be waived by the Engineer except at transverse construction joints and tie-ins. Within 50 feet {15 m} of all transverse construction joints and tie-ins, and on all test sections where the Profile Index is greater than 20.0 inches per mile or greater {320.0 mm/km}, all requirements of Item 410.05(a)3 will apply.

410.06 Correction of Deficiencies and Defects.

Deficiencies in surface smoothness shall be remedied to the extent practicable by rolling while the material is still workable. Otherwise the layer shall be removed and replaced as necessary to obtain required smoothness. "Skin patching" of a surface layer to correct low areas or heating and scraping to correct high areas will not be permitted. Overlays of not less than 80 pounds per square yard {45 kg/m²} may be authorized by the Engineer for surface smoothness deficiencies provided all material in the overlay is without additional cost to the Department.

Deficiencies in thickness shall be remedied as specified in Item 410.03(f)1.

All areas containing excessive or deficient amounts of liquid asphalt binder, all areas showing unacceptable segregation of materials, and all areas unbonded after rolling shall be removed and replaced at no cost to the Department. Unacceptable segregation of a hot and warm mix asphalt mat is defined as any area in which two six inch {150 mm} cores are taken and the average percent liquid asphalt binder content of the cores have an absolute difference greater than 0.50 percentage points of the design liquid asphalt binder content, or the combined gradation analysis of the two cores on selected sieves has an absolute difference greater than 10 percentage points from the job-mix formula. All testing shall be in accordance with ALDOT-389, "Evaluation of Segregated Areas in Hot Mix

Asphalt Pavement." The location of all cores taken for segregation evaluation will be determined by the Department. All coring and traffic control required by ALDOT-389 shall be conducted/supplied by the Contractor at no cost to the Department; however, the Contractor will be reimbursed \$500.00 per core when core results are within tolerances and the coring operations require additional traffic control.

At any time that segregation is determined to be unacceptable, work shall be automatically suspended if positive corrective action is not taken by the Contractor to prevent further segregation in the mat. Upon suspension, the Contractor shall place a test section not to exceed 500 tons {500 metric tons} of the affected mixture for evaluation by the Engineer. However, if after a few loads it is apparent that the corrective actions were not adequate, work shall again be suspended and the segregated areas evaluated in accordance with ALDOT-389. Likewise, if after 500 tons {500 metric tons} it is apparent that the problem has been solved, work will be allowed to continue.

When correcting subsurface mixtures (base and binder layers), the removal and replacement may be limited to the actual defective areas or the full mat width within the limits of individual defective areas as directed by the Engineer. Removal and replacement of hot and warm mix asphalt wearing surface layers shall be a minimum of the full mat width and 10 feet {3 m} in length. All surface tolerance requirements shall apply to the corrected areas for both subsurface and surface mixes.

Areas found deficient in density shall be removed and replaced or immediately re-rolled until density is acceptable.

All work specified in this Article shall be performed without additional compensation.

410.07 Maintenance and Protection.

Sections of newly finished work shall be protected from all traffic until they become properly hardened. Maintenance shall include immediate repairs of any defects that may occur on the work; such repairs shall be repeated as often as necessary to maintain the work in a continuously satisfactory condition. The Contractor shall be responsible for the protection of the work and protection of any traffic using the work. No extra compensation will be paid for maintenance and protection.

410.08 Method of Measurement.

(a) GENERAL.

The accepted quantity of hot and warm mix asphalt plant mix used as directed will be measured in tons of 2000 pounds {metric tons} in accordance with the following:

When the laboratory compacted density as determined in the job-mix formula design exceeds 158 pounds per cubic foot {2530 kg/m³}, the actual total tonnage {metric tonnage} of mix placed will be adjusted for pay purposes in accordance with the following formula (this shall not apply to Section 327 PATB and Section 420 OGFC):

$$y = 158 c / a \quad \{ y = 2530 c / a \}, \text{ where}$$

y = total tonnage {metric tonnage} of plant mix for pay purposes;

c = actual tonnage {metric tonnage} of plant mix measured and placed, except items subject to pay factor adjustment under the QC/QA provisions. On items subject to pay factor adjustment, the adjusted tonnage {metric tonnage} (after pay factor adjustment) will be used;

a = laboratory compacted mix unit weight in pounds per cubic foot {density in kilograms per cubic meter} as shown in the job-mix formula.

No adjustments to the actual total tonnage {metric tonnage} placed will be made where the laboratory compacted mix density is below 158 pounds per cubic foot {2530 kg/m³}.

No adjustments to the actual tonnage {metric tonnage} placed will be made when the use of lightweight aggregate (expanded clay or shale) is designated.

For determining weight {mass}, each load of hot and warm mix asphalt mixture shall have its weight {mass} determined on approved certified scales, as specified in Article 109.01, furnished by the Contractor without direct compensation.

The weight {mass} measurement shall include all components of the mixture. No deductions will be made for any of the components, including the liquid asphalt binder material, contained in the mixture.

The laboratory compacted density requirements for OGFC are given in Section 420. Section 327 PATB does not have a laboratory compacted density requirement because a layer thickness (typically 4 inches {100 mm}) is required instead of a rate of placement.

(b) ACCEPTANCE OF THE MIXTURE.

The hot and warm mix asphalt mixture will be evaluated at the plant on a LOT to LOT basis. The material will be tested for acceptance in accordance with the provisions of Section 106 and the following requirements. However, any load or loads of mixture, which, in the opinion of the Engineer, are obviously unacceptable, will be rejected for use in the work.

The Contractor shall control all operations in the handling, preparation, and mixing of the hot and warm mix asphalt plant mix so that the percent liquid asphalt binder and voids in laboratory compacted samples or gradation will meet the approved job-mix formula within the tolerances shown in Tables II, III, and VI for the 1.00 pay factor. In recognition of the fact that the drying and screening operations may generate additional dust over that shown in the approved mix design, the Contractor's attention is drawn to the realization that the dust must be controlled in order to control VMA and voids in the total mix.

Acceptance of the mixture will be in accordance with Subarticle 106.09(c).

LOT pay factors for asphalt content and air voids will be determined from Table II for Section 423 mixes and from Table III for a Section 424 mix after the requirements of Item 106.09(c)3 are satisfied. LOT pay factors for asphalt content will be determined from the top half of Table II for Section 327 and 420 mixes after the requirements of Item 106.09(c)3 are satisfied. Air voids are not a pay factor for Section 327 and 420 mixes. Gradation is shown as a pay factor for Section 420 mixes in Table VI. The pay factor values determined for each sieve noted in Table VI will be averaged. This average will then be compared to the asphalt content pay factor. The lowest of these two pay factors will be applied to the mix.

Calculations for the acceptance test results for asphalt content and voids in total mix shall be carried to the thousandths (0.001) and rounded to the nearest hundredth (0.01). Calculations for averages shall be carried to the thousandths (0.001) and rounded to the nearest hundredth (0.01) in accordance with AASHTO R 11 rules of rounding. LOT pay factors will be calculated to the nearest hundredth (0.01).

Payment for Section 327 and 423 mixes will be on the basis of Table II Acceptance Schedule for Payment. Payment for a Section 424 mix will be on the basis of Table III Acceptance Schedule for Payment. Payment for Section 420 mixes will be on the basis of Table II and Table VI.

(c) SUSPENSION AND VOLUNTARY TERMINATION OF LOTS.

The production process will be considered out of control when any individual test result (asphalt content, gradation, or air voids) from a LOT has a pay factor equal to 0.80 computed from the "1 Test" row in Table II, Table III, or Table VI, whichever is appropriate. When gradation is a pay factor, a 0.80 result for an individual screen (before averaging) is considered out of control. If any single gradation for the 327 mixes falls outside of the gradation band shown in Section 327 the process is considered out of control. When this happens, production shall be suspended. If mix from the suspended LOT is contained in storage/surge bins, that mix will be considered part of the suspended LOT, and shall not be placed on any State project.

When production is suspended as described above, or when the contractor voluntarily terminates a lot, production shall not be re-started until after all of the following has been accomplished:

- (1) the Contractor shall notify the Project Manager immediately that the process is out of control, or that the LOT has been terminated voluntarily, and that production has been suspended;
- (2) the Contractor shall determine what adjustments to make in order to bring the process under control and inform the Project Manager in writing of these adjustments;
- (3) after adjustments, the Contractor shall produce sufficient mix (approximately 25 to 35 tons {25 to 35 metric tons}) as a trial batch and test for control parameters (asphalt content, gradation, and air voids);
- (4) adjustments, trial batches, and tests shall be repeated as many times as necessary until pay factors for asphalt content, gradation, and air voids equal 1.00, minimum, at which time production may be re-started. Mix utilized as a trial batch shall not be used on the project.

(d) ACCEPTANCE SCHEDULE OF PAYMENT FOR ASPHALT PLANT MIX CHARACTERISTICS.

TABLE II						
SECTION 327 MIXES**						
SECTION 420 MIXES (OPEN GRADED FRICTION COURSE)**						
SECTION 423 MIXES (STONE MATRIX ASPHALT)						
ACCEPTANCE SCHEDULE OF PAYMENT FOR ASPHALT PLANT MIX CHARACTERISTICS						
Arithmetic Average of the Absolute Values of Deviations of the LOT Acceptance Tests From Job Mix Formula Values						
Asphalt Content						
LOT Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	-	0.00-0.48	0.49-0.51	0.52-0.57	0.58-0.66	Over 0.66
2 Tests	-	0.00-0.34	0.35-0.36	0.37-0.40	0.41-0.47	Over 0.47
3 Tests	-	0.00-0.28	0.29-0.29	0.30-0.33	0.34-0.38	Over 0.38
4 Tests	0.00-0.14	0.15-0.24	0.25-0.26	0.27-0.28	0.29-0.33	Over 0.33
Voids in Total Mix (Lab. Compacted Samples)						
LOT Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	-	0.00-1.50	1.51-1.62	1.63-1.80	1.81-2.10	Over 2.10
2 Tests	-	0.00-1.06	1.07-1.15	1.16-1.27	1.28-1.48	Over 1.48
3 Tests	-	0.00-0.87	0.88-0.94	0.95-1.04	1.05-1.21	Over 1.21
4 Tests	0.00-0.45	0.46-0.75	0.76-0.81	0.82-0.90	0.91-1.05	Over 1.05
* If approved by the Department, the Contractor may accept the indicated LOT partial pay. The Department may require removal and replacement. If the LOT pay factor is greater than 0.80, the Contractor has the option to remove at no cost to the Department and to replace at contract unit bid price rather than accepting the reduced LOT payment.						
** The Acceptance Schedule of Payment for "Voids in Total Mix" will not apply to the 327 and 420 mixes						

TABLE III						
SECTION 424 MIXES (SUPERPAVE)						
ACCEPTANCE SCHEDULE OF PAYMENT FOR ASPHALT PLANT MIX CHARACTERISTICS						
Arithmetic Average of the Absolute Values of Deviations of the LOT Acceptance Tests From Job Mix Formula Values						
Asphalt Content						
LOT Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	-	0.00-0.62	0.63-0.68	0.69-0.75	0.76-0.88	Over 0.88
2 Tests	-	0.00-0.44	0.45-0.48	0.49-0.53	0.54-0.62	Over 0.62
3 Tests	-	0.00-0.36	0.37-0.39	0.40-0.43	0.44-0.51	Over 0.51
4 Tests	0.00-0.19	0.20-0.31	0.32-0.34	0.35-0.38	0.39-0.44	Over 0.44
Voids in Total Mix (Lab. Compacted Samples)						
LOT Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	-	0.00-2.50	2.51-2.70	2.71-3.00	3.01-3.50	Over 3.50
2 Tests	-	0.00-1.77	1.78-1.91	1.92-2.12	2.13-2.47	Over 2.47
3 Tests	-	0.00-1.44	1.45-1.56	1.57-1.73	1.74-2.02	Over 2.02
4 Tests	0.00-0.75	0.76-1.25	1.26-1.35	1.36-1.50	1.51-1.75	Over 1.75
* If approved by the Department, the Contractor may accept the indicated LOT partial pay. The Department may require removal and replacement. If the LOT pay factor is greater than 0.80, the Contractor has the option to remove at no cost to the Department and to replace at contract unit bid price rather than accepting the reduced LOT payment.						

TABLE VI				
SECTION 420 MIXES (OPEN GRADED FRICTION COURSE)				
ACCEPTANCE SCHEDULE OF PAYMENT FOR ASPHALT PLANT MIX CHARACTERISTICS				
Arithmetic Average of the Absolute Values of Deviations of the LOT Acceptance Tests From Job Mix Formula Values				
Gradation 3/8" {9.5 mm} Sieve				
LOT Pay Factor	1 Test	2 Tests	3 Tests	4 Tests
1.02	-	-	-	0.00 - 3.60
1.00	0.00 - 12.00	0.00 - 8.48	0.00 - 6.93	3.61 - 6.00
0.98	12.01 - 12.96	8.49 - 9.16	6.94 - 7.48	6.01 - 6.48
0.95	12.97 - 14.40	9.17 - 10.18	7.49 - 8.31	6.49 - 7.20
0.90	14.41 - 16.80	10.19 - 11.88	8.32 - 9.70	7.21 - 8.40
0.80*	Over 16.80	Over 11.88	Over 9.70	Over 8.40
Gradation No. 8 {2.36 mm} Sieve				
LOT Pay Factor	1 Test	2 Tests	3 Tests	4 Tests
1.02	-	-	-	0.00 - 2.40
1.00	0.00 - 8.00	0.00 - 5.66	0.00 - 4.62	2.41 - 4.00
0.98	8.01 - 8.64	5.67 - 6.11	4.63 - 4.99	4.01 - 4.32
0.95	8.65 - 9.60	6.12 - 6.79	5.00 - 5.54	4.33 - 4.80
0.90	9.61 - 11.20	6.80 - 7.92	5.55 - 6.47	4.81 - 5.60
0.80*	Over 11.20	Over 7.92	Over 6.47	Over 5.60
The comparison value for ALDOT and Contractor testing for the 3/8" {9.5 mm} and No. 8 {2.36 mm} sieves is +/- 2.0%.				
* If approved by the Department, the Contractor may accept the indicated LOT partial pay. The Department may require removal and replacement. If the LOT pay factor is greater than 0.80, the Contractor has the option to remove at no cost to the Department and to replace at contract unit bid price rather than accepting the reduced LOT payment.				

(e) ACCEPTANCE OF THE ROADWAY DENSITY.

For paving that is not mainline paving (paving for patching, widening, and crossovers and leveling), in-place density pay factors will not be applied. For mainline paving (including shoulders, ramps, and acceleration/deceleration lanes), in-place density pay factors will be applied as specified herein unless otherwise noted on the plans or in the specifications.

After the hot and/or warm mix asphalt mixture has been placed and compacted, it shall be evaluated for density. A core for mat density determination shall be taken by the Contractor on each 3000 foot {900 m} segment of roadway lane of asphalt mixture placed. The location of each test will be designated by the Department. The core shall meet a minimum thickness for use in determining the roadway density. If the core's average thickness in inches {millimeters} is not at least 0.008 times the rate in pounds per square yard {0.375 times the rate in kilograms per square meter}, another core shall be taken (as close a practical to the original location) where the Engineer believes the pavement is thick enough for roadway density determination. The core's average thickness shall be determined by measuring the core's thickness at six equidistant locations around the circumference of the core. The Department will take immediate possession of the core and will make a density determination of the core in accordance with AASHTO T 166, Method A. The density values of the cores will be used to compute the pay factor for that subplot. Testing locations will be selected with the random number method outlined in ALDOT-210. Contractors are allowed, but not required, to take cores anywhere, anytime for quality control. This includes taking cores from the wearing layer. The contractor must have the permission of the Engineer to take cores from a PATB (327) or OGFC (420) mix. All core holes shall be promptly repaired at the contractor's expense. For purposes of evaluation, a LOT will be as defined in Item 106.09(c)1. A SUBLOT for evaluation of density will be equal to 12,000 feet {3600 m} (4 test results) or fraction of a 12,000 foot {3600 m} length as applicable. For instance, a 27,000 foot

{8100 m} LOT would be divided into two 12,000 foot {3600 m} SUBLOTS and one 3000 foot {900 m} SUBLOT.

The in-place density will be expressed as a percentage of the theoretical maximum mix density with the following relationship:

$$\% \text{ TMD} = \frac{\text{In-place Density}}{\text{Maximum Mix Density}} \times 100$$

Maximum mix density is equated to maximum mix specific gravity as measured with AASHTO T 209, Flask determination with dry back. The maximum mix specific gravity used will be the average of the values from the four most recent determinations using Contractor data.

The appropriate pay factor for each SUBLOT will be determined from Table IV for the appropriate number of test results. The pay factor for the LOT will be determined by computing the weighted average of the SUBLOTS:

$$\text{LOT Pay Factor (PF)} = \frac{\text{PF SUBLOT 1 (Length SUBLOT 1)} + \text{PF SUBLOT 2 (Length SUBLOT 2)} + \dots}{\text{Length SUBLOT 1} + \text{Length SUBLOT 2} + \dots}$$

Calculations for the acceptance test results for in-place density will be carried to the hundredths (0.01) and rounded to the nearest tenth (0.1). LOT and SUBLOT pay factor calculations will be carried to the thousandths (0.001) and rounded to the nearest hundredth (0.01) in accordance with AASHTO R 11 rules of rounding.

The low rates of placement at which minimum density does not apply are given in Section 306. Density pay factors will not be applied to pavement layers placed at these rates.

TABLE IV ACCEPTANCE SCHEDULE OF PAYMENT FOR IN-PLACE DENSITY					
SECTION 423 MIXES (STONE MATRIX ASPHALT)					
Characteristic	SUBLOT PAY FACTOR	Arithmetic Average of the Absolute Values of Deviations of SUBLOT Acceptance Tests From Target**			
		1 Test	2 Tests	3 Tests	4 Tests
In-Place Density	1.02	0.00 - 2.00	0.00 - 1.41	0.00 - 1.15	0.00 - 1.00
	1.00	2.01 - 3.33	1.42 - 2.36	1.16 - 1.92	1.01 - 1.67
	0.98	3.34 - 3.60	2.37 - 2.55	1.93 - 2.08	1.68 - 1.80
	0.95	3.61 - 4.00	2.56 - 2.83	2.09 - 2.31	1.81 - 2.00
	0.90	4.01 - 4.67	2.84 - 3.30	2.32 - 2.69	2.01 - 2.33
	0.80*	Over 4.67	Over 3.30	Over 2.69	Over 2.33
SECTION 424 MIXES (SUPERPAVE)					
Characteristic	SUBLOT PAY FACTOR	Arithmetic Average of the Absolute Values of Deviations of SUBLOT Acceptance Tests From Target**			
		1 Test	2 Tests	3 Tests	4 Tests
In-Place Density	1.02	0.0-2.25	0.0-1.59	0.0-1.30	0.0-1.12
	1.00	2.26-3.75	1.60-2.65	1.31-2.17	1.13-1.88
	0.98	3.76-4.05	2.66-2.86	2.18-2.34	1.89-2.02
	0.95	4.06-4.50	2.87-3.18	2.35-2.60	2.03-2.25
	0.90	4.51-5.25	3.19-3.71	2.61-3.03	2.26-2.62
	0.80*	Over 5.25	over 3.71	over 3.03	Over 2.62
<p>* If approved by the Department, the Contractor may accept the indicated partial SUBLOT pay. The Department may require removal and replacement. The Contractor has the option to remove at no cost to the Department and replace at contract unit bid price rather than accepting the reduced SUBLOT payment.</p> <p>** Target density shall be 94.0 % of the theoretical maximum density for all mixes except for: - the range of placement rates given in Item 306.03(g)3 (140 pounds per square yard or greater {76 kg per square meter or greater} and less than 200 pounds per square yard {109 kg per square meter} over surface treatments) the target density shall be 92.0 % and; - ESAL Range A and B mixes where the Contractor demonstrates and explains in writing why 94 % of the theoretical maximum density cannot be achieved and the Engineer informs the Contractor by written notification that the target density can be reduced to 93 % or 92 %.</p>					

TABLE V COMPARISON OF ALDOT AND CONTRACTOR TESTING	
TEST	ACCEPTABLE
ASPHALT CONTENT	± 0.30 %
AIR VOIDS	± 0.50 %
GRADATION *	See Table VI
* Gradations given in Articles 327.02 and 420.02.	

(f) TACK COAT.

Tack coat liquid asphalt material used as directed will be measured and paid for as specified in Section 405.

(g) WASTED AND EXCESS MATERIALS APPLIED.

Deductions in measurement will be made for all material wasted or lost due to negligence of the Contractor or applied beyond the limits of the work.

(h) PROFILOGRAPH.

The number of profilographs measured for payment will be the actual number of units ordered and accepted.

(i) MATERIAL REMIXING DEVICE.

The number of material remixing devices measured for payment will be the number of units approved by the Engineer for use. These devices will be measured per each device.

410.09 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Compensation for plant mix material, measured as provided above, will be made on a tonnage {metric tonnage} basis and the contract unit price per ton {metric ton} for each individual item shall be full compensation for construction of the hot and warm mix asphalt plant mix layer complete in place on the roadbed as indicated or directed, including all materials, procurement, handling, hauling, and processing cost, and includes all equipment, tools, labor, and incidentals required to complete the work.

Unless otherwise covered by a separate pay item, the cost of excavation for patching and widening, compacting the subgrade, backfilling, spreading, or disposing of excess excavated material, removal and disposal of old pavement, removal and resetting of roadway signs and mailboxes, and removal and disposal of pavement markers shall be subsidiary obligations of the associated plant mix pay item, and no additional payment will be made for performing the work.

No payment will be made for unacceptable material; for material needed to overlay layers deficient in thickness; for material used in replacing defective or condemned construction; for material wasted in handling, hauling, or otherwise; or for maintaining the work.

When the average rate of placement is found to exceed the tolerance given in Item 410.03(f)1., the tonnage {metric tonnage} placed above the specified rate in that unit will be paid for at 50 percent of the contract unit price. This reduction will not be applied to patching, leveling, and widening.

The ordered and accepted profilographs, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing the unit and includes all equipment, tools, labor, calibration, maintenance, services, supplies, chart paper, and incidentals necessary to complete these items of work.

The number of approved remixing devices, measured as noted above, will be paid for at the contract unit bid price. This price shall be full compensation for furnishing the vehicles and shall include all equipment, tools, labor, calibration, maintenance, services, operator, and all other items necessary to furnish and operate the vehicles.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

See Appropriate Section for Type of Plant Mix Involved.

410-A Profilograph - per Each

410-B State Furnished Profilograph - per Each

410-C Contractor Retained Profilograph - per Each

410-H Material Remixing Device - per Each

SECTION 420 POLYMER MODIFIED OPEN GRADED FRICTION COURSE

420.01 Description.

The work covered by this Section shall consist of constructing a hot mixed, hot laid polymer modified open graded friction course wearing layer generally placed on an existing pavement. The typical cross section and the average weight per square yard will be shown on the plans. Requirements for all hot mix asphalt pavements as specified in Section 410 are applicable to this Section, subject to any exceptions contained herein. Quality Control/Quality Assurance (QC/QA) requirements as specified in Section 106 are applicable to this Section, subject to any exceptions contained herein.

420.02 Materials.

The materials furnished for use shall comply with the requirements of Section 410 and the following:

(a) AGGREGATES.

The aggregate shall be limited to 100% crushed, aggregates of the following: granite, quarried quartzite, slag, sandstone or manufactured lightweight aggregate, all of which shall be from approved sources and meet the appropriate requirements of Sections 801 and 802. However, if additional dust (- 200 {- 75 μm} material) is needed, mineral filler (meeting the requirements of Section 805) or agricultural limestone may be used. If agricultural limestone is used, it shall meet the requirements of ASTM C 602, Standard Specification for Agricultural Liming Materials, for Class E agricultural limestone, so that a minimum of 80.0 % of the material will pass the No. 8 {2.35 mm} sieve and 25.0 % will pass the No. 60 {0.250 mm} sieve. In addition, a minimum of 5.0 % will pass the No. 200 {75 μm} sieve. No more than 10.0 % agricultural limestone shall be used.

The aggregate shall be combined into a total blend that will produce an acceptable job mix within the gradation limits shown below in the following table. The blend shall be made from at least two stockpiles of different gradations. At least 10% of the blend shall be taken from each stockpile.

AGGREGATE GRADATION FOR OPEN GRADED FRICTION COURSE	
Sieve (Square Mesh Type)	Percent Passing By Weight {Mass}
3/4 inch {19.0 mm}	100
1/2 inch {12.5 mm}	85 - 100
3/8 inch {9.5 mm}	55 - 65
No. 4 {4.75 mm}	10 - 25
No. 8 {2.36 mm}	5 - 10
No. 200 {75 μm}	2 - 4

The requirements for allowing the use of RAP and RAS are given in Article 410.02.

(b) LIQUID ASPHALT BINDER.

The liquid binder shall be a polymer modified PG 76-22 meeting the requirements of Section 804. The proportion of liquid asphalt binder to total sample by weight {mass} shall be 4.7 % to 9.0 %. The exact proportion shall be fixed by the job mix formula.

Additives or modifiers shall be used to prevent stripping of liquid asphalt binder if stripping is observed during design, production or laydown. These additives or modifiers shall be furnished and used at no additional cost to the State.

(c) POLYMER.

The polymer additive shall meet the requirements of Section 811.

(d) LIQUID ASPHALT BINDER DRAINDOWN.

A fiber stabilizer meeting the requirements given in Section 410 shall be incorporated into the mix to reduce draindown. The fiber shall be blended into the mix in accordance with the requirements given in Section 410.

(e) TACK COAT MATERIALS

Tack coat materials shall either be a CQS-1hp asphalt emulsion used in conjunction with the spray paver equipment as required in Subarticle 420.04 (d) or "PG Asphalt for Trackless Tack" with conventional paving equipment. The CQS-1hp shall be smooth and homogeneous and shall meet the requirements shown in the following table:

CQS-1hp MODIFIED ASPHALT EMULSION			
TEST OF EMULSION			
Parameter	Test Method	Value	
Viscosity @ 77° F, SF	AASHTO T 59	20 Min.	150 Max.
Sieve Test, %	AASHTO T 59	-	0.1 Max. ¹
24-Hour Storage Stability, %	AASHTO T 59	-	1.0 Max. ²
Residue By Distillation	AASHTO T 59	60 Min.	-
Oil Distillate, by Volume of Emulsion, %	AASHTO T 59	-	-
Particle Charge	AASHTO T 59	Positive ³	
TEST OF RESIDUE FROM EMULSION			
Solubility in TCE, %	AASHTO T 44 ⁴	97.5 Min.	-
Elastic Recovery @ 50 °F	AASHTO T 301	60.0 Min.	-
Penetration @ 77 °F	AASHTO T 49	60 Min.	110 Max.
Ductility @ 77.0 °F	AASHTO T 51	40 Min.	-
1. Sieve test may be waived based on successful application in the field. 2. After standing undisturbed for 24 hours, the surface shall show no white, milky-colored substance, but shall be a smooth homogeneous color throughout the sample. 3. If the Particle Charge Test is inconclusive, a pH test (AASHTO T 200) shall be used with a maximum of 6.7 allowable. 4. ASTM D 5546 may be used when polymers block the filter during the test.			

The original "PG Asphalt for Trackless Tack" (no RTFO or PAV testing) shall conform to the physical requirements shown in the following table:

SPECIFICATIONS FOR PG ASPHALT FOR TRACKLESS TACK		
Parameter	Specification	Test Method
Rotational Viscosity	Maximum 3 Pa•s @ 135 °C	AASHTO T 316
Penetration	Maximum 25 @ 77 °F {25 °C}, 100 g, 5s	AASHTO T 49
Softening Point (°C)	Minimum 70	AASHTO T 53
Dynamic Shear, G*/sin δ	Minimum 1.0 kPa @ 82 °C	AASHTO T 315

420.03 Design

The Open Graded Friction Course shall be designed with a minimum air void content of 12% according to ALDOT-259, OPEN GRADED ASPHALT CONCRETE FRICTION COURSE DESIGN METHOD. The contractor shall have the responsibility for the design of Section 420 mixes. The laboratory compacted density as determined in the job-mix formula design shall not exceed 150 pounds per cubic foot (2400 kg/m³); this corresponds with a maximum specific gravity value of 2.837 or a bulk specific gravity of 2.411.

The work will be accepted on a LOT by LOT basis in accordance with the applicable requirements. Pay factors for air voids and density shall not apply.

420.04 Construction Requirements.

(a) GENERAL.

The requirements of Articles 410.03 through 410.07 shall apply except as modified hereinafter in this Article.

(b) RATE OF PLACEMENT OF TACK COAT.

The rate of application of the tack coat on the asphalt surface shall be 0.13 to 0.18 gallons per square yard within a tolerance of -0.02 and +0.02 gallons per square yard for the PG Asphalt for Trackless Tack. CQS-1hp asphalt emulsion shall be applied at a rate of 0.18 - 0.23 gallons per square yard within a tolerance of -0.02 and +0.02 gallons per square yard. A uniform distribution of tack coat across the mat shall be enforced and streaked tack shots shall not be accepted.

(c) CONVENTIONAL PAVING EQUIPMENT WITH THE USE OF "PG ASPHALT FOR TRACKLESS TACK"

The use of conventional paving equipment shall be allowed when the tack coat material used is "PG Asphalt for Trackless Tack" meeting the requirements given in Subarticle 420.02. "PG Asphalt for Trackless Tack" shall be applied at a temperature of 300 °F to 375 °F, on a clean dry surface.

(d) SPRAY PAVER PAVING EQUIPMENT WITH THE USE OF CQS-1HP ASPHALT EMULSION

The requirements given in Article 410.03 shall be applicable to the construction of the open graded friction course except for the following:

- The paving machine shall incorporate a tack distribution system, receiving hopper, feed conveyor, and a variable width, heated, ironing or vibratory type screed.

- The tack distribution system shall include metered mechanical pressure sprayer to accurately apply and monitor the rate of application of the emulsion for the tack. The rate shall be uniform across the entire paving width. It shall be applied at a temperature of 140 - 180 °F. Application shall be immediately in front of the screed unit. No wheel or other part of the paving machine shall come in contact with the tack before the paving mix is applied.

- Extensions added to the screed shall be provided with the same heating capability as the main screed unit, except for use on variable width tapered areas as approved by the Engineer.

(e) COMPACTION EQUIPMENT.

Item 410.03(a)5 is amended to require that steel wheel tandem (7 ton {6 metric ton} minimum size) rollers shall be furnished in sufficient numbers based on the quantity of material being placed to provide effective compaction coverage within the workable time period of the mix as designated by the Engineer. Rubber-tire rollers shall not be used.

(f) WEATHER AND TEMPERATURE LIMITATIONS.

The weather, air, and surface temperature limitations for (polymerized) HMA mixes are found in Subarticle 410.03(b).

(g) COMPACTING.

Subarticle 410.03(g) is amended to require that rolling shall be as approved by the Engineer; no density tests will be required.

420.05 Method of Measurement.

The accepted quantities of polymer modified open graded friction course will be measured as provided in Article 410.08.

The CQS-1hp emulsion or "PG Asphalt for Trackless Tack" for the tack coat will be measured in gallons in accordance with the requirements given in Article 109.02.

420.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Polymer Modified Open Graded Friction Course, measured as noted above, will be paid for at the contract unit price bid in accordance with Article 410.09.

The unit price of the Open Graded Friction Course Tack Coat shall be full compensation for all materials, equipment, and labor required to furnish and place the tack.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

420 - A Polymer Modified Open Graded Friction Course - per ton {metric ton}

420 - B Open Graded Friction Course Tack Coat - per gallon

SECTION 423 STONE MATRIX ASPHALT (SMA)(FIBER STABILIZED ASPHALT CONCRETE)

423.01 Description.

The work covered by this Section shall consist of constructing a hot mix asphalt layer of fiber stabilized stone matrix asphalt pavement on a prepared surface in accordance with these specifications and in conformity with the lines, grades, typical cross section, and the placement rate shown on the plans or as directed. The plant, equipment, and construction requirements for this pavement are specified in Sections 106 and 410, subject to any exceptions herein. All 423 mixes shall be designed and produced in accordance with the requirements given in this Section and ALDOT-395, SMA Mix Design.

423.02 Materials.

(a) AGGREGATES.

1. PROCEDURE FOR ACCEPTANCE OF COARSE AND FINE AGGREGATES.

All fine and coarse aggregate furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, *Procedure for Acceptance of Coarse and Fine Aggregates*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices with Special Acceptance Requirements Manual*, List I-1. The Department has established a list of qualified producers of fine and coarse aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

2. TYPES OF ACCEPTABLE COARSE AGGREGATES FOR SMA.

Coarse aggregate shall be aggregate retained on the No. 4 {4.75 mm} sieve. The virgin coarse aggregate shall be 100% crushed granite, quarried quartzite, limestone, sandstone, slag, or other 100% crushed manufactured stone meeting the requirements given in Section 801.

3. FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATES FOR SMA.

The maximum amount of flat and elongated particles in coarse aggregate for SMA is given in the following table.

PERCENT OF FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE FOR SMA		
Test Method		Maximum
Flat & Elongated % by Count 3:1 (max to min)	ASTM D 4791 Section 8.4	20 %
Flat & Elongated % by Count 5:1 (max to min)	ASTM D 4791 Section 8.4	5 %

4. COARSE AGGREGATE SOUNDNESS FOR SMA.

The percent degradation of the source aggregate by the sodium sulfate soundness test (AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate) after five cycles of testing shall not exceed 10 %.

5. DELETERIOUS MATERIALS AND ABSORPTION IN COARSE AGGREGATE FOR SMA.

The amount of deleterious substances and absorption in the coarse aggregate shall not exceed the limits given in the following table.

DELETERIOUS MATERIALS AND ABSORPTION IN COARSE AGGREGATE FOR SMA	
Coal and Lignite (Visual)	0.25 %
Clay Lumps and Friable Particles (AASHTO T 112)	0.25 %
Other local deleterious substances (Shale, Mica, Marcasite, etc.) (Visual)	2.0 %
Absorption (Absorption on the material passing the 3/4 inch {19.0 mm} sieve and retained on the No. 4 {4.75 mm} sieve) (AASHTO T 85 *). Applies to gravel aggregates only.	2.0 %
* Section 8.1 of AASHTO T 85 modified to require a 15 minute vacuum saturation period as per Section 6.3 of AASHTO T 209 prior to the required 15-19 hour soaking period.	

6. LOS ANGELES ABRASION CRITERIA FOR COARSE AGGREGATE FOR SMA.

The percent loss of the coarse aggregate by the LA Abrasion test (AASHTO T 96, Resistance to Abrasion of Small Size Aggregate by use of the Los Angeles Machine) shall not exceed 48 % except that, for Sandstone and Blast Furnace Slag, the LA Abrasion shall not exceed 55 %.

7. FINE AGGREGATE FOR SMA.

Fine aggregate shall be 100% crushed granite, limestone, sandstone, slag, or other 100% crushed manufactured stone meeting the requirements of Section 802 and the following table. The parent material shall meet the requirements given in Section 801.

FINE AGGREGATE QUALITY REQUIREMENTS FOR SMA		
Test Method	Minimum	Maximum
Uncompacted Voids %, AASHTO T 304*	45 %	100 %
Sand Equivalent %, AASHTO T 176*	50 %	100 %
Liquid Limit %, AASHTO T 89	0 %	25 %
Plasticity Index, AASHTO T 90	Non-plastic	
*The Sand Equivalent and Uncompacted Voids may be run on the blend of the aggregates.		

The fine aggregate shall be non-plastic when tested in accordance with AASHTO T 89, as modified by ALDOT-232, and AASHTO T 90 and shall have a maximum of 1.0 % clay lumps and friable particles as determined by AASHTO T 112. It shall consist of hard, tough grain, free of injurious amounts of clay, loam, or other deleterious substances.

8. MINERAL FILLER FOR SMA.

The mineral filler shall meet the requirements of Section 805.

(b) RECYCLED ASPHALT PAVEMENT (RAP) & RECLAIMED ASPHALT SHINGLES (RAS).

The requirements for allowing the use of RAP and RAS are given in Article 410.02.

(c) BLEND OF AGGREGATES.

The combined aggregates shall conform to the percent passing by volume requirements given in the following table.

PERCENT PASSING BY VOLUME OF AGGREGATE FOR SMA										
Sieve Size	1.5 inch {37.5 mm} Maximum Aggregate Size		1 inch {25.0 mm} Maximum Aggregate Size		3/4 inch {19.0 mm} Maximum Aggregate Size		1/2 inch {12.5 mm} Maximum Aggregate Size		3/8 inch {9.5 mm} Maximum Aggregate Size	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
1.5 inch {37.5 mm}	100	100								
1 inch {25.0 mm}	90	100	100	100						
3/4 inch {19.0 mm}	30	86	90	100	100	100				
1/2 inch {12.5 mm}	26	63	50	74	90	100	100	100		
3/8 inch {9.5 mm}	24	52	25	60	26	78	90	100	100	100
# 4 {4.75 mm}	20	28	20	28	20	28	26	60	90	100
# 8 {2.36 mm}	16	24	16	24	16	24	20	28	28	65
# 16 {1.18 mm}	13	21	13	21	13	21	13	21	22	36
# 30 {600 μm}	12	18	12	18	12	18	12	18	18	28
# 50 {300 μm}	12	15	12	15	12	15	12	15	15	22
# 200 {75 μm}	8	10	8	10	8	10	8	10	12	15

An example of how to blend aggregate based upon volume can be found in ALDOT-395, SMA Mix Design. The production tolerances for the above gradation bands are as specified in Item 410.02(d)7, except that the tolerance for the No. 4 {4.75 mm} sieve is +/- 4% and for the 3/8 inch {9.5 mm} sieve is +/- 6%.

Aggregates that tend to polish under traffic, such as limestone, dolomite, or marble, shall be permitted only in widening as defined by Article 410.01, shoulder paving, underlying layers, and layers that are to be covered by Polymer Modified Open Graded Friction Course (Section 420) mix in this contract, except as noted in the following table.

ALLOWABLE CARBONATE STONE CRITERIA FOR SMA	
BPN 9 Value Of Aggregate Source *	Maximum Allowable Percentage Of Carbonate Stone
≤ 25	30
26 through 28	35
29 through 31	40
32 through 34	45
≥ 35	50
* This value, BPN 9, is made using the British Pendulum Tester on aggregate source specimen polished for 9 hours on an accelerated polishing machine known as the British Wheel as per ASTM D 3319, ASTM E 303 and BMTP-382.	

In no case shall the total amount of virgin carbonate stone in the combined mixture used as actual wearing surface layers exceed the percentage shown in Table 4. When parts of the carbonate stone used in the mix are from differing strata of material or coming from multiple sources that are represented by different BPN 9 values, the lowest BPN 9 value will be used.

(d) LIQUID ASPHALT BINDER.

1. REQUIRED TYPE OF LIQUID ASPHALT BINDER FOR SMA.

Unless otherwise shown on the plans, for pavement layers in the top 2 inches the liquid asphalt binder shall meet the requirements of Section 804 and shall be polymer-modified to meet a PG 76-22 as given in Section 811. For pavement layers below the top 2 inches the liquid asphalt binder shall be PG 67-22 and shall meet the requirements of Section 804. If Open Graded Friction Course (Section 420) layers are required, the top 2 inches shall be measured from the bottom of the Open Graded Friction Course layer.

2. REQUIRED MINIMUM AMOUNT OF LIQUID ASPHALT BINDER FOR SMA.

The minimum liquid asphalt binder content shall be as given in the following table (by weight {mass} of total mix).

MINIMUM LIQUID ASPHALT BINDER CONTENT FOR SMA			
Maximum Aggregate Size (inches) {mm}	Nominal Aggregate Size (inches) {mm}	Minimum Liquid Asphalt Binder Content (% by weight) {% by mass}	Minimum Liquid Asphalt Binder Content for mixes containing RAS (% by weight) {% by mass}
1.5 {37.5}	1.0 {25}	5.3	5.5
1.0 {25.0}	3/4 {19.0}	5.5	5.7
3/4 {19.0}	1/2 {12.5}	5.7	5.9
1/2 {12.5}	3/8 {9.5}	5.9	6.1
3/8 {9.5}	No. 4 {4.75}	6.1	6.3

3. LIQUID ASPHALT BINDER DRAINDOWN.

A fiber stabilizer meeting the requirements given in Section 410 shall be incorporated into the mix to reduce draindown. The fiber shall be blended into the mix in accordance with the requirements given in Section 410. RAS may be allowed as a fiber stabilizer provided it meets the requirements in Section 410.

423.03 Design.

All SMA mixes shall be designed according to ALDOT-395, SMA Mix Design. SMA mixes shall be designed using a 50 blow Marshall design or a 60 gyration gyratory compactor design. The SMA shall have a minimum VMA of 17, a VCA_{MIX} less than the VCA_{DRC} (calculating Voids in the Coarse Aggregate is explained in ALDOT-395 SMA Mix Design) and air voids of 3.5% for SMA mixes containing RAS or 4.0 % for all other SMA mixes. The SMA mix shall be designed with a minimum tensile strength ratio of 0.80 according to ALDOT-361. The mix shall exhibit 4.50 mm or less rutting when tested in accordance with ALDOT-401, Rutting Susceptibility Determination of Asphalt Paving Mixtures Using the Asphalt Pavement Analyzer.

423.04 Hot Mix Asphalt Plant Requirements.

(a) MINERAL FILLER.

To ensure accurate metering and proportioning, the introduction of the mineral filler shall be in accordance with Section 4.3 of AASHTO M 156 as specified in ALDOT-324. Adequate dry storage shall be provided for the mineral filler. In a batch plant, mineral filler shall be added directly into the weigh hopper. In a drum plant, mineral filler shall be added directly into the drum mixer near enough to the liquid asphalt binder line so that the mineral filler is captured by the liquid asphalt binder. Note: For most SMA projects, the flow rate of the mineral filler governs the plant production rate.

(b) HOT-MIXTURE STORAGE.

SMA shall be stored according to the requirements as given in ALDOT 324, "Plant Requirements for Plants Producing Hot-Mixed, Hot-Laid Asphalt Mixtures". SMA shall not be heated above 350 °F {177 °C} without the approval of the Engineer.

423.05 Construction Requirements.

(a) GENERAL.

Construction requirements shall be the same as specified in Articles 410.03 through 410.07 except as noted in this Article.

(b) WEATHER AND TEMPERATURE LIMITATIONS.

The weather, air and surface temperature limitations for (polymerized) HMA mixes are found in Subarticle 410.03(b).

(c) SURFACE PREPARATION.

A thin tack coat meeting the requirements of Section 405 shall be applied to ensure uniform and complete adherence of the overlay.

(d) COMPACTION.

Due to the nature of stone matrix asphalt mixture, the surface shall be rolled immediately. Rollers shall move at a uniform speed, not to exceed 3 miles per hour {5 km/hr}, with the drive roller nearest the paver. Rolling shall be continued until all roller marks are eliminated and the required density has been obtained. The Contractor shall monitor density during the compaction process using the nondestructive testing devices approved in Section 306 of the Specifications to ensure that the required density is being obtained. The device shall either be calibrated to roadway cores or gage counts and shall be used to determine the rolling pattern producing maximum density. If vibratory compaction causes aggregate breakdown or forces liquid asphalt binder to the surface, the vibratory mode shall be turned off and the roller shall operate in static mode only.

To prevent adhesion of the mixture to the rollers, it shall be necessary to keep the wheels properly moistened with water mixed with very small quantities of detergent or other approved material.

423.06 Method of Measurement.

The accepted quantities of stone matrix asphalt binder layer and stone matrix asphalt wearing layer will be measured as provided in Article 410.08. The SMA mix shall be evaluated for liquid asphalt binder content, laboratory compacted air voids, and in-place density; pay factors will be applied.

423.07 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Stone Matrix Asphalt Binder Layer and Stone Matrix Asphalt Wearing Layer, measured as noted above, will be paid for at the contract unit price bid in accordance with Article 410.09.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

423-A Stone Matrix Asphalt Wearing Layer, ___ Maximum Aggregate Size
- per ton {metric ton}

423-B Stone Matrix Asphalt Binder Layer, ___ Maximum Aggregate Size
- per ton {metric ton}

* Specify Maximum Aggregate Size, either 1.5, 1, 3/4, 1/2 or 3/8 inches
{37.5 mm, 25 mm, 19 mm, 12.5 mm, or 9.5 mm}

SECTION 424 SUPERPAVE BITUMINOUS CONCRETE BASE, BINDER, AND WEARING SURFACE LAYERS

424.01 Description

The work covered by this Section shall consist of a hot or warm bituminous plant mixed pavement layer placed on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, typical cross section, and the approximate placement rate shown on the plans or as directed.

The Contractor may use either hot mix or warm mix for all Superpave ESAL Range mixes in Section 424.

General requirements for all bituminous concrete pavements as specified in Section 410 are applicable to this Section, subject to any exceptions contained herein. Quality Control/Quality Assurance (QC/QA) requirements as specified in Section 106 are applicable to this section, subject to any exceptions contained herein.

The work will be accepted on a LOT by LOT basis in accordance with the applicable requirements.

424.02 Materials.

The materials furnished for use shall conform to the requirements of Section 410 and the following:

(a) AGGREGATES.

1. PROCEDURE FOR ACCEPTANCE OF COARSE AND FINE AGGREGATES.

All fine and coarse aggregate furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, *Procedure for Acceptance of Coarse and Fine Aggregates*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices with Special Acceptance Requirements Manual*, List I-1. The Department has established a list of qualified producers of fine and coarse aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

2. TYPES OF ACCEPTABLE COARSE AGGREGATES FOR SUPERPAVE.

Coarse aggregate shall be aggregate retained on the No. 4 {4.75 mm} sieve.

Coarse aggregate shall consist of crushed (or uncrushed) gravel with a bulk specific gravity greater than 2.550 (AASHTO T 85), crushed stone, or crushed slag, or a combination thereof having hard, strong, durable pieces, free from adherent coatings, and meeting all requirements of these specifications.

3. FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATES FOR SUPERPAVE.

The maximum amount of flat and elongated particles in coarse aggregate for Superpave is given in the following table.

PERCENT OF FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE FOR SUPERPAVE	
Test Method	Maximum
Flat & Elongated % by Count 5:1 (max to min) ASTM D 4791 Section 8.4	10 % *
* Shall not apply to the 3/8 inch {9.5 mm} mix or to ESAL Range A/B	

4. COARSE AGGREGATE SOUNDNESS FOR SUPERPAVE.

The percent degradation of the source aggregate by the sodium sulfate soundness test (AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate) after five cycles of testing shall not exceed 10 %.

5. DELETERIOUS MATERIALS AND ABSORPTION IN COARSE AGGREGATE FOR SUPERPAVE.

The amount of deleterious substances and absorption in the coarse aggregate shall not exceed the following limits:

RESTRICTION OF DELETERIOUS MATERIALS AND ABSORPTION IN COARSE AGGREGATE FOR SUPERPAVE	
Coal and Lignite (Visual)	0.25 %
Clay Lumps and Friable Particles (AASHTO T 112)	0.25 %
Other local deleterious substances (Shale, Mica, Marcasite, etc.) (Visual)	2.0 %
Absorption (Absorption on the material passing the 3/4 inch {19.0 mm} sieve and retained on the No. 4 {4.75 mm sieve}) (AASHTO T 85 *). Applies to gravel aggregates only.	2.0 %
* Section 8.1 of AASHTO T 85 modified to require a 15 minute vacuum saturation period as per Section 6.3 of AASHTO T 209 prior to the required 15-19 hour soaking period.	

6. LOS ANGELES ABRASION CRITERIA FOR COARSE AGGREGATE FOR SUPERPAVE.

The percent loss of the coarse aggregate by the LA Abrasion test (AASHTO T 96, Resistance to Abrasion of Small Size Aggregate by use of the Los Angeles Machine) shall not exceed 48 % except that, for Sandstone and Blast Furnace Slag, the LA Abrasion shall not exceed 55 %.

7. FINE AGGREGATE FOR SUPERPAVE.

Fine aggregate shall be aggregate passing the No. 4 {4.75 mm} sieve. Gravel used to manufacture fine aggregate shall have a bulk specific gravity greater than 2.550 (AASHTO T 85).

The fine aggregate shall be non-plastic when tested in accordance with AASHTO T 89, as modified by ALDOT-232, and AASHTO T 90 and shall have a maximum of 1.0 % clay lumps and friable particles as determined by AASHTO T 112. It shall consist of hard, tough grain, free of injurious amounts of clay, loam, or other deleterious substances.

8. CLAY CONTENT FOR SUPERPAVE.

The amount of clay material, as indicated by the sand equivalent, measured on the aggregate passing the No. 4 {4.75 mm} sieve as determined by AASHTO T 176, Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test, shall be no less than the values defined in the following table according to the total design traffic in equivalent single axle loads (ESALs).

CLAY CONTENT CRITERIA FOR SUPERPAVE		
ESAL Range	Traffic (ESALs)	Sand Equivalent
A/B	ESALs < 1.0x10 ⁶	≥ 40.0
C/D	1.0x10 ⁶ ≤ ESALs < 1.0x10 ⁷	≥ 45.0
E	1.0x10 ⁷ ≤ ESALs < 3.0x10 ⁷	≥ 45.0

9. MINERAL FILLER FOR SUPERPAVE.

Mineral filler shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, or fly ash meeting the requirements of Section 805.

The introduction of mineral filler shall be in accordance with AASHTO M 156, Section 3.3, as specified in ALDOT-324, with the additional requirement that accurate proportioning shall be accomplished by means of pneumatic or mechanical metering.

(b) RECYCLED ASPHALT PAVEMENT (RAP) & RECLAIMED ASPHALT SHINGLES (RAS).

The requirements for allowing the use of RAP and RAS are given in Article 410.02.

(c) BLEND OF AGGREGATES.

1. GRADATIONS FOR BLEND OF AGGREGATES.

The coarse and fine aggregates, mineral filler, and recycled material shall be combined in a total blend that will produce an acceptable job mix within the gradation limits determined by the maximum and minimum control points as shown in the following tables. Maximum particle size is defined as the sieve size that is two sizes larger than the first sieve to retain more than 10 % of the material. The sequence of sieve sizes to be used in determining maximum particle size is given in the following tables. Gradation charts illustrating gradation requirements are given in Article 424.03.

The required mix will be shown on the plans. Also, all ESAL range "E" mixes shall exhibit 4.50 mm or less rutting when tested according to ALDOT-401, Rutting Susceptibility Determination of Asphalt Paving Mixtures Using the Asphalt Pavement Analyzer.

AGGREGATE GRADATION CONTROL POINTS FOR SUPERPAVE 1 1/2 inch {37.5 mm} Maximum Aggregate Size Mix		
Sieve Size	Control Point (Percent Passing)	
	Minimum	Maximum
No. 200 {75 μm}	1	7
No. 8 {2.36 mm}	19	45
3/4" {19 mm}	19	90
1" {25 mm} Nominal	90	100
1.5" {37.5 mm} Maximum	100	-

AGGREGATE GRADATION CONTROL POINTS FOR SUPERPAVE 1 inch {25.0 mm} Maximum Aggregate Size Mix		
Sieve Size	Control Point (Percent Passing)	
	Minimum	Maximum
No. 200 {75 μm}	2	8
No. 8 {2.36 mm}	23	49
1/2" {12.5 mm}	23	90
3/4" {19 mm} Nominal	90	100
1" {25 mm} Maximum	100	-

AGGREGATE GRADATION CONTROL POINTS FOR SUPERPAVE 3/4 inch {19.0 mm} Maximum Aggregate Size Mix		
Sieve Size	Control Point (Percent Passing)	
	Minimum	Maximum
No. 200 {75 μm}	2	10
No. 8 {2.36 mm}	28	58
3/8" {9.5 mm}	28	90
1/2" {12.5 mm} Nominal	90	100
3/4" {19.0 mm} Maximum	100	-

AGGREGATE GRADATION CONTROL POINTS FOR SUPERPAVE 1/2 inch {12.5 mm} Maximum Aggregate Size Mix		
Sieve Size	Control Point (Percent Passing)	
	Minimum	Maximum
No. 200 {75 μm}	2	10
No. 8 {2.36 mm}	32	67
No. 4 {4.75 mm}	32	90
3/8" {9.5 mm} Nominal	90	100
1/2" {12.5 mm} Maximum	100	-

AGGREGATE GRADATION CONTROL POINTS FOR SUPERPAVE 3/8 inch {9.5 mm} Maximum Aggregate Size Mix		
Sieve Size	Control Point (Percent Passing)	
	Minimum	Maximum
No. 200 {75 μm}	6	12
No. 16 {1.18 mm}	30	60
No. 4 {4.75 mm} Nominal	75	100
3/8" {9.5 mm} Maximum	95	100
Note: Up to 5% may be retained on the maximum size sieve (3/8 inch {9.5 mm}) and up to 25% may be retained on the nominal size sieve (#4 {4.75 mm}).		

2. COARSE AGGREGATE ANGULARITY FOR BLEND OF AGGREGATES.

The coarse aggregate angularity shall be measured on the total blended aggregate retained on the No. 4 {4.75 mm} sieve in accordance with ASTM D 5821.

A fractured face is defined as an angular, rough, or broken surface of an aggregate particle created by crushing, by other artificial means, or by nature. A face is considered fractured only if it has a projected area at least as large as one-quarter of the maximum projected area (maximum cross-sectional area) of the particle and has sharp, well-defined edges.

The percent by weight {mass} of the coarse particles of the blended aggregate retained on the No. 4 {4.75 mm} sieve with one fractured face and with two or more fractured faces shall be no less than the values in the following table.

COARSE AGGREGATE ANGULARITY REQUIREMENTS FOR SUPERPAVE			
ESAL Range	Traffic (ESALs)	Wearing Surface & Binder Layers	Base Layers
A/B	ESALs < 1.0x10 ⁶	75 / -	50 / -
C/D	1.0x10 ⁶ ≤ ESALs < 1.0x10 ⁷	85 / 80	60 / -
E	1.0x10 ⁷ ≤ ESALs < 3.0x10 ⁷	95 / 90	80 / 75
Note: "85 / 80" denotes that 85 % of the coarse aggregate has at least one fractured face and 80 % has two or more fractured faces.			

3. FINE AGGREGATE ANGULARITY FOR BLEND OF AGGREGATES.

The percent air voids in loosely compacted fine aggregate, measured according to AASHTO T 304, Method "A", or ASTM C 1252, Method "A", *Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)* shall be no less than the values in the following table.

FINE AGGREGATE ANGULARITY REQUIREMENTS FOR SUPERPAVE			
ESAL Range	Traffic (ESALs)	Minimum % Air Void	
		Base	Binder & Surface
A/B	ESALs < 1.0x10 ⁶	43	43
C/D	1.0x10 ⁶ ≤ ESALs < 1.0x10 ⁷	43	45
E	1.0x10 ⁷ ≤ ESALs < 3.0x10 ⁷	43	45

4. RESTRICTIONS IN THE USE OF CARBONATE STONE FOR BLEND OF AGGREGATES.

The restrictions for the use of carbonate stone are given in the following table. These restrictions do not apply to widening as defined in Article 410. 01, shoulder paving, underlying layers, and layers that are to be covered by Polymer Modified Open Graded Friction Course (Section 420) mix in this contract.

CRITERIA FOR THE USE OF CARBONATE STONE IN SUPERPAVE	
BPN 9 Value Of Aggregate Source *	Maximum Allowable Percentage Of Carbonate Stone
≤ 25	30
26 through 28	35
29 through 31	40
32 through 34	45
≥ 35	50
* This value, BPN 9, is made using the British Pendulum Tester on aggregate source specimen polished for 9 hours on an accelerated polishing machine known as the British Wheel as per ASTM D 3319, ASTM E 303 and ALDOT-382.	

In no case shall the total amount of virgin carbonate stone in the combined mixture used as actual wearing surface layers that are exposed to traffic exceed the percentage shown in the above table. When parts of the carbonate stone used in the mix are from differing strata of material or coming from multiple sources that are represented by different BPN 9 values, the lowest BPN 9 value will be used.

(d) LIQUID ASPHALT BINDER.

Liquid asphalt binders shall come from an approved producer who is participating in and meeting the requirements of ALDOT-243, *Acceptance Program For Asphalt Materials*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices With Special Acceptance Requirements Manual*, List I-4. The Department has established a list of qualified producers of asphalt materials. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list. Unless shown otherwise on the plans or in the proposal, liquid asphalt binder for use in all mixes shall meet the requirements of AASHTO M 320, *Standard Specification For Performance Graded Asphalt Binder*, as modified by the requirements given in the following table and Section 804.

ALLOWABLE ASPHALT BINDER GRADES FOR SUPERPAVE			
ESAL Range	Traffic (ESALs)	Base, Lower, & Upper Binder Layers	Wearing Surface Layers
A/B	ESALs < 1.0x10 ⁶	PG 67-22	PG 67-22
C/D	1.0x10 ⁶ ≤ ESALs < 1.0x10 ⁷	PG 67-22	PG 67-22
E	1.0x10 ⁷ ≤ ESALs < 3.0x10 ⁷	PG 67-22	PG 76-22

The asphalt binder shall be PG 76-22 for leveling when the top of the leveling is within 2 inches {50 mm} of the final pavement surface. The asphalt binder may be PG 67-22 for leveling that is not within 2 inches {50 mm} of the final pavement surface and for all patching and widening;. If Open Graded Friction Course (Section 420) layers are required, the final pavement surface shall be the surface of the layer below these layers.

Asphalt Binders shall meet the requirements of Section 804.

Polymer modifiers shall be blended at an approved refinery and meet the requirements of Section 811. Approved Warm Mix additives or processes are given in List II-27, "Warm Mix Asphalt Products and Processes" of the Materials, Sources, and Devices with Special Acceptance Requirements manual.

(e) MIX PROPERTIES.

1. AIR VOIDS (Va).

The design air voids for all levels of traffic is 3.5 % for mixes containing RAS and 4.0 % for all other mixes.

2. VOIDS IN MINERAL AGGREGATE (VMA).

The job mix shall be designed at a minimum VMA given in the following table.

VOIDS IN MINERAL AGGREGATE DESIGN VMA FOR SUPERPAVE ***		
Maximum Aggregate Size * (inches) {mm}	Nominal Aggregate Size (inches) {mm}	Minimum VMA (%)
3/8 {9.5 }	No. 4 {4.75}	16.5 **
1/2 {12.5 }	3/8 {9.5}	15.5
3/4 {19.0 }	1/2 {12.5}	14.5
1 {25.0 }	3/4 {19.0}	13.5
1.5 {37.5 }	1 {25.0}	12.5

* As defined in Subarticle 424.02(c)
** All 3/8" (9.5 mm) mixes where the ESAL range is greater than A/B shall have a maximum VMA of 18.0.
*** Production VMA may be 0.5 lower than design VMA.

3. LIQUID ASPHALT BINDER CONTENT (Pb).

The job mix shall be designed at a minimum Liquid Asphalt Binder Content (Pb) given in the following table. Production tolerances shall be governed by the pay factors in Table III, Section 410.08.

LIQUID ASPHALT BINDER CONTENT (Pb) CRITERIA FOR SUPERPAVE			
Maximum Aggregate Size* (inches) {mm}	Nominal Aggregate Size (inches) {mm}	Minimum Liquid Asphalt Binder Content (Pb) by Percent of Total Mix**	Minimum Liquid Asphalt Binder Content (Pb) for mixes containing RAS by Percent of Total Mix**
3/8 {9.5 }	No. 4 {4.75}	5.90	6.1
1/2 {12.5 }	3/8 {9.5}	5.50	5.7
3/4 {19.0 }	1/2 {12.5}	5.10	5.3
1 {25.0 }	3/4 {19.0}	4.40	4.6
1.5 {37.5 }	1 {25.0}	4.20	4.4
* As defined in Subarticle 424.02(d)			
** Nd = 60			

4. DUST PROPORTION (D/Pbe).

The ratio of the percent by weight {mass} of aggregate passing the 75 µm sieve to the effective asphalt content expressed as percent by weight {mass} of the total mix shall be between 0.60 and 1.4. All 3/8 inch {9.5 mm} mixes shall have a dust to effective asphalt ratio range of 0.90 to 2.00. These ratio limits apply to both the design and production phases. Effective asphalt content is that liquid asphalt binder not absorbed into the aggregate pore structure and is determined in accordance with Section 4.09 of the Asphalt Institute's, MS-2, *Mix Design Methods for Asphalt Concrete*.

5. LIQUID ASPHALT BINDER DRAINDOWN.

A fiber stabilizer meeting the requirements given in Section 410 may be incorporated into the mix to reduce draindown. The fiber shall be blended into the mix in accordance with the requirements given in Section 410.

6. RESISTANCE TO MOISTURE-INDUCED DAMAGE.

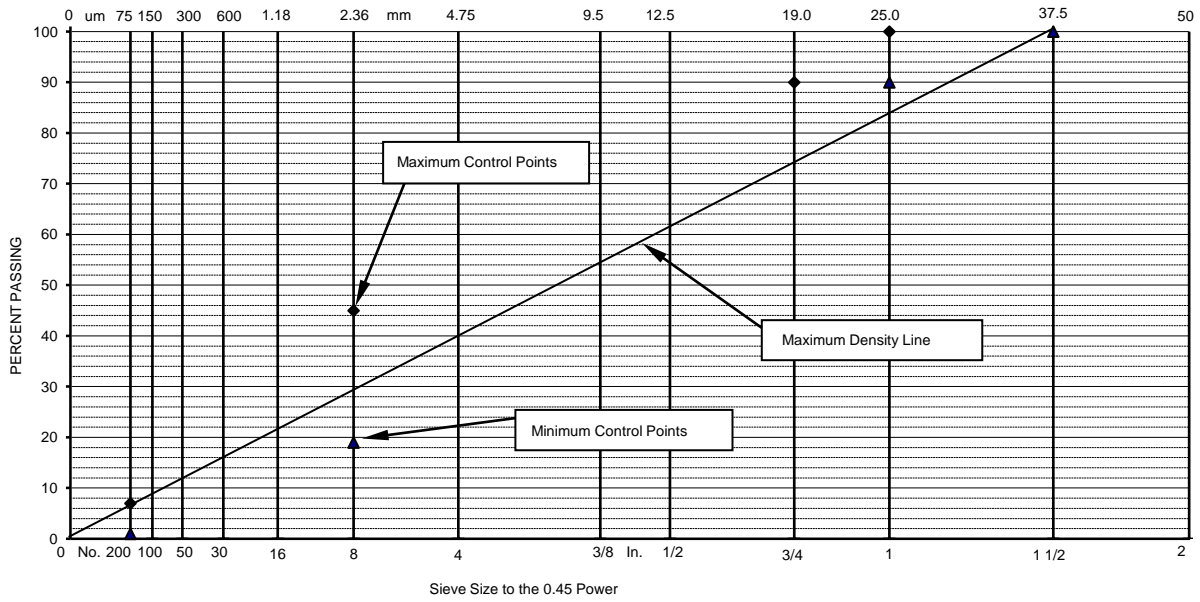
All mixes shall be designed and produced to have a tensile strength ratio (TSR) of at least 0.80 when compacted according to ALDOT-384 at 7.0 % air voids and tested in accordance with AASHTO T 283 as modified by ALDOT-361, except the specimen shall be 6.00" {150 mm} in diameter and 3.75" {95 mm} in height.

(f) DESIGN PROCEDURE.

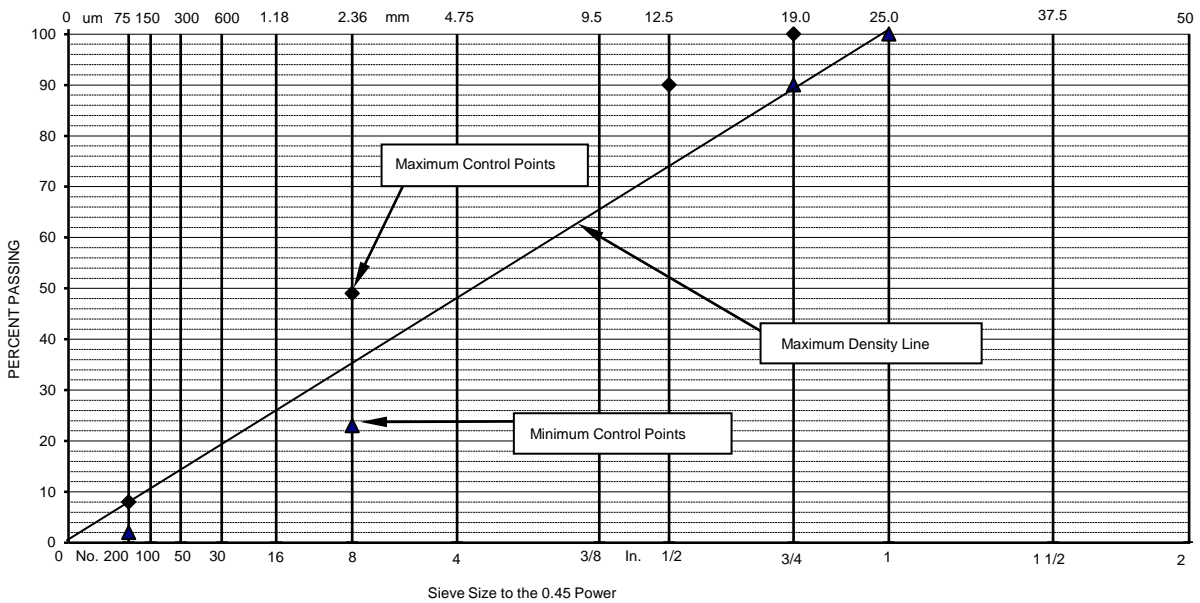
All Superpave mixes with 100 % virgin aggregate shall be designed in accordance with ALDOT-384, *Mix Design Procedure for Superpave Level I*. All other Superpave mixes containing RAP shall be designed in accordance with ALDOT-388, *Superpave Volumetric Mix Design Procedure Using Recycled Asphalt Pavement*. All Superpave Gyratory Compactors shall have their angle of gyration verified by the Engineer following the procedure in AASHTO T 344, Standard Method of Test for Evaluation of Superpave Gyratory Compactor (SGC) Internal Angle of Gyration Using Simulated Loading. This includes all design, quality control, and quality assurance SGCs. The compactors shall tilt the specimen molds at an average internal angle of 20.2 ± 0.35 mrad (1.16 ± 0.02 degrees).

424.03 Gradation Requirements.

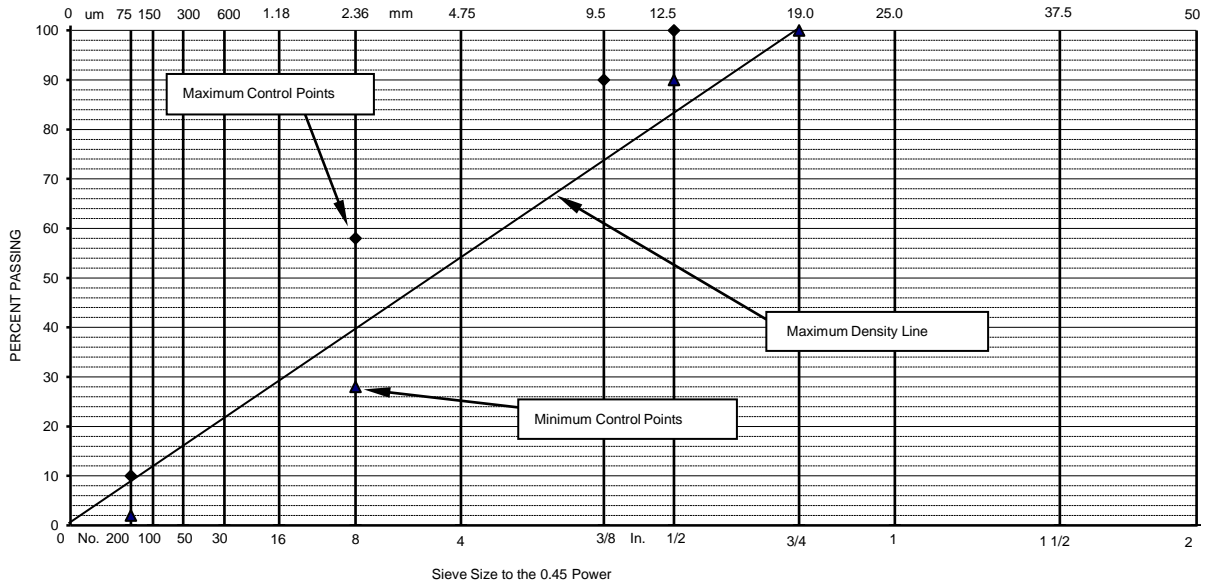
GRADATION CHART FOR 1 1/2 inch (37.5 mm) MAXIMUM SIZE AGGREGATE



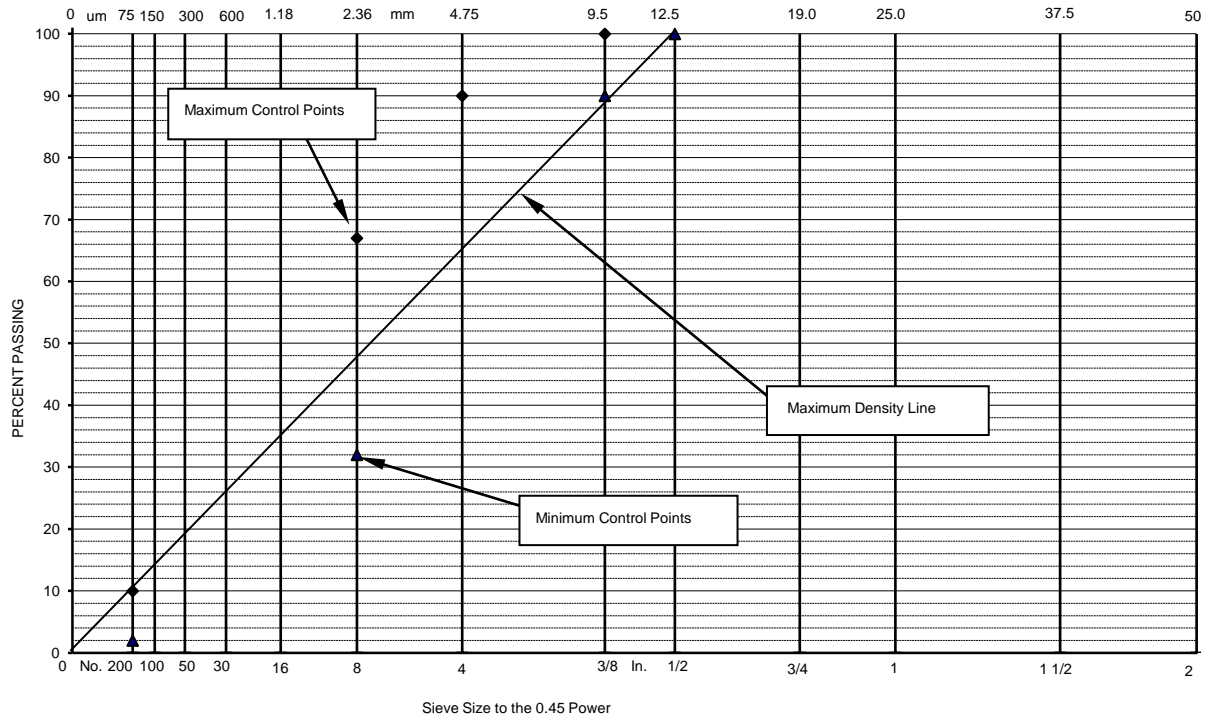
GRADATION CHART FOR 1 inch (25 mm) MAXIMUM SIZE AGGREGATE

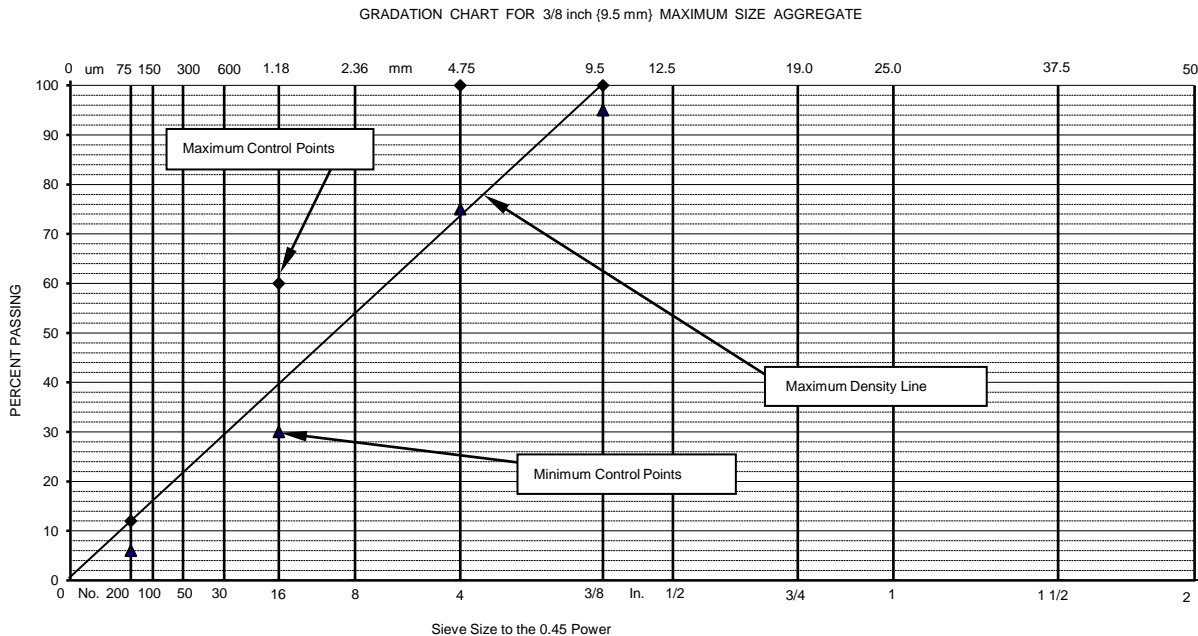


GRADATION CHART FOR 3/4 inch (19 mm) MAXIMUM SIZE AGGREGATE



GRADATION CHART FOR 1/2 inch (12.5 mm) MAXIMUM SIZE AGGREGATE





424.04 Construction Requirements.

(a) GENERAL.

The mixing temperature shall not exceed 350 °F {177 °C}.

(b) BINDER LAYER AND WEARING SURFACE LAYER.

Construction requirements shall be as specified in Articles 410.03 through 410.07.

(c) BASE LAYER.

The construction requirements for base layers shall be as specified in Articles 410.03 through 410.07, except as follows:

The edges shall be trimmed immediately after final rolling, using an accurately aligned string or wire, to a tolerance of 2 inches {50 mm} outside the theoretical edge of the layer and to a slope not flatter than 1:1.

Any edge distorted by rolling shall be promptly corrected.

(d) PREPARATION OF MIXTURES - MOISTURE CONTENT.

Each time an asphalt content measurement is made (ALDOT-354 or AASHTO T 308), the amount of moisture in the mixture shall be determined, regardless of aggregate type, as specified in ALDOT-130 and reported on Form BMT-20. The moisture determination shall be used in computing the corrected asphalt content. Moisture samples shall be taken with the asphalt content samples from the loaded truck. Moisture in the mixture shall not exceed 0.20% by weight {mass}.

(e) PRODUCTION TOLERANCES.

All mixtures furnished for use shall conform to the approved job mix formula (JMF) within the tolerances set in Article 410.02. Mixture gradations may be produced provided the gradations are within the tolerances.

424.05 Method of Measurement.

The accepted quantities of Superpave Bituminous Concrete Wearing Surface Layer, Superpave Bituminous Concrete Binder Layer, and Superpave Bituminous Concrete Base Layer will be measured as provided in Article 410.08, subject to any exceptions contained herein.

424.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Superpave Bituminous Concrete Wearing Surface Layer, Superpave Bituminous Concrete Binder Layer, and Superpave Bituminous Concrete Base Layer will be paid for at the contract unit price bid in accordance with Article 410.09, subject to any exceptions contained herein.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

424-A Superpave Bituminous Concrete Wearing Surface Layer, ^{**} ,
 ^{***} Maximum Aggregate Size Mix, ESAL Range ^{****} - per ton {metric ton}

424-B Superpave Bituminous Concrete ^{*} Binder Layer, ^{**} ,
 ^{***} Maximum Aggregate Size Mix, ESAL Range ^{****} - per ton {metric ton}

424-C Superpave Bituminous Concrete Base Layer, ^{**} ,
 ^{***} Maximum Aggregate Size Mix, ESAL Range ^{****} - per ton {metric ton}

* Specify either "Upper" or "Lower".

** Specify "Patching", "Leveling", "Widening", etc. only when required.

*** Specify Maximum Aggregate Size: 3/8", 1/2", 3/4", 1", or 1.5" {9.5 mm, 12.5 mm, 19.0 mm, 25.0 mm, or 37.5 mm}.

**** Specify "A/B", "C/D", or "E".