

**PROJECT SPECIAL PROVISIONS**  
ROADWAY

1-15-02

RR01

**PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX:** 11-21-00

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the Standard Specifications as modified herein.

The base price index for asphalt binder for plant mix is \$301.43 per ton.

This base price index represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals on April 1, 2006.

RR19

**ASPHALT PAVEMENTS - SUPERPAVE**

05-17-05  
Rev 04-18-06

Revise the 2002 *Standard Specifications* as follows:

PRIME COAT

Page 6-2, **Article 600-9**

Delete the first paragraph and substitute the following:

The quantity of prime coat to be paid will be the number of gallons (liters) of prime coat material that has been satisfactorily placed on the roadway. Each distributor load of prime coat material delivered and utilized on the project will be measured. Deductions will be made from each measured tank of material for all material placed on the roadway that exceeds the application rate established by the Engineer by more than 0.03 gallons per square yard (0.14 liters per square meter).

ASPHALT TACK COAT

Page 6-4, **Article 605-8**

Insert the following after paragraph one.

Take necessary precautions to limit the tracking and/or accumulation of tack coat material on either existing or newly constructed pavements. Excessive accumulation of tack may require corrective measures.

FIELD VERIFICATION AND JOB MIX FORMULA ADJUSTMENTS

Page 6-7, **Article 609-4**

Delete the first paragraph and substitute the following:

Conduct field verification of the mix at each plant within 30 calendar days prior to initial production of each mix design, when required by the Allowable Mix Adjustment Policy and when directed as deemed necessary.

Page 6-7, **Article 609-4**

Add the following sentence after the first sentence of the second paragraph in this Article:

Mix obtained from NCDOT or non-NCDOT work may be used for this purpose provided it is sampled, tested, and the test data handled in accordance with current procedures in the Department's *HMA/QMS Manual* and the following provisions.

Page 6-8, **Article 609-4**

Delete the first paragraph and substitute the following:

Retain records of these calibrations and mix verification tests, including Superpave Gyratory Compactor (SGC) printouts, at the QC laboratory. In addition, furnish copies, including SGC printouts, to the Engineer for review and approval within one working day after beginning production of the mix.

Page 6-8, **Article 609-4**

Add the following sentence at the end of the last paragraph:

Any mix produced that is not verified may be assessed a price reduction at the Engineer's discretion in addition to any reduction in pay due to mix and/or density deficiencies.

Page 6-8, **Subarticle 609-5(A)**

Delete the second sentence in the fourth paragraph and substitute the following:

This person is responsible for monitoring all roadway paving operations and all quality control processes and activities, to include stopping production or implementing corrective measures when warranted.

**Page 6-9, Subarticle 609-5(C)1**

Add the following sentences at the end of the first paragraph of this Article:

Identify any additional quality control samples taken and tested at times other than the regularly scheduled random samples or directed samples which take the place of regularly scheduled as process control (PC) samples on the appropriate forms. Process Control test results should not be plotted on control charts nor reported to Quality Assurance Laboratory.

**Page 6-9, Subarticle 609-5(C)1**

Delete the second sentence in the second paragraph and substitute the following:

Retain the QC compacted volumetric test specimens for 5 calendar days, commencing the day the specimens are prepared.

**Page 6-10, Subarticle 609-5(C)2**

In the first full paragraph on this page, add to the reference AASHTO T 168 “Modified”

Revise Items B, C, D and E on this page as follows:

- B. Gradation on Recovered Blended Aggregate from Mix Sample (AASHTO T 30 Modified) Grade on all sieves specified on JMF
- C. Maximum Specific Gravity (AASHTO T 209 or ASTM D 2041), optional (ASTM D 6857)
- D. Bulk Specific Gravity of Compacted Specimens (AASHTO T166), optional (ASTM D 6752), Average of 3 specimens at  $N_{des}$  gyrations (AASHTO T 312)
- E. Air Voids (VTM) (AASHTO T 269), Average of 3 specimens at  $N_{des}$  gyrations

**Page 6-11, Subarticle 609-5(C)2**

At the top of this page, delete Item B.,” Reclaimed Asphalt Pavement...” and substitute the following:

- B. Reclaimed Asphalt Pavement (RAP) Binder Content and Gradation (AASHTO T 308 Modified or T 164 and AASHTO T 30 Modified) (sampled from stockpiles or cold feed system at beginning of production and weekly thereafter). Have RAP approved for use in accordance with Article 1012-1(G). (Split Sample Required)

Page 6-11, **Subarticle 609-5(C)2**

Delete Item E at the end of this Subarticle and Substitute the following:

- E. Reclaimed Asphalt Shingle Material (RAS) Binder Content and Gradation (AASHTO T 308 Modified or T 164 and AASHTO T 30 Modified) (sampled from stockpiles or cold feed system at beginning of production and weekly thereafter). Have RAS approved for use in accordance with Article 1012-1(F). (Split Sample Required)

Page 6-11, **Subarticle 609-5(C)3**

Delete the first paragraph and substitute the following:

Maintain standardized control charts furnished by the Department at the field laboratory. For mix incorporated into the project, record full test series data from all regularly scheduled random samples or directed samples which replace regularly scheduled random samples, on control charts the same day the tests are obtained.

In addition, partial test series results obtained due to reasons outlined in Subarticle 609-5(C)2 will be reported to Quality Assurance personnel on the proper forms, but will not be plotted on the control charts.

Page 6-12, **Subarticle 609-5(C)3**

Delete item 3 in the list below the second full paragraph and substitute the following:

3. If failure to stop production after two consecutive moving averages exceed the warning limits occurs, but production does stop at a subsequent time, re-establish a new moving average beginning at the actual production stop point.

Page 6-12, **Subarticle 609-5(C)3**

Delete the first and second sentence in the third full paragraph and substitute the following:

In addition, re-establish the moving averages for all mix properties.

**CONTROL LIMITS**

**Page 6-12, Subarticle 609-5(C) 4**

At the bottom of this page, delete the table and substitute the following:

**CONTROL LIMITS**

Mix Control Criteria	Target Source	Warning Limit	Moving Average Limit	Individual Limit
2.36mm Sieve	JMF	±4.0 %	±5.0 %	±8.0 %
0.075mm Sieve	JMF	±1.5 %	±2.0 %	±2.5 %
Binder Content	JMF	±0.3 %	±0.5 %	±0.7 %
VTM @ N <sub>des</sub>	JMF	±1.0 %	±1.5 %	±2.0 %
VMA @ N <sub>des</sub>	Min. Spec. Limit	-0.5%	-0.8%	-1.0%
P <sub>0.075</sub> / P <sub>be</sub> Ratio	Max. Spec. Limit	0.0	N/A	+0.4%
%G <sub>mm</sub> @ N <sub>ini</sub>	Max. Spec. Limit	N/A	N/A	+2.0%
TSR	Min. Spec. Limit	N/A	N/A	-15.0%

**Page 6-13, Subarticle 609-5(C)6**

Delete the second paragraph of this Subarticle and substitute the following:

Immediately cease production and immediately notify the Engineer when any of the following occur:

1. When an individual test result for a mix control criteria (including results for required partial test series on mix) exceeds both the individual test control limits and the applicable specification design criteria, or,
2. When two consecutive field TSR values fail to meet the minimum specification requirement, or,
3. When two consecutive binder content test results exceed the individual limits.

Do not resume normal plant production until one of the following has occurred.

Option 1: Approval has been granted by the appropriate QA Supervisor.

Option 2: The mix in question has been satisfactorily verified in accordance with Article 609-4. Normal production may resume based on the approval of the contractor’s Level II technician, provided notification and the verification test results have been furnished to the QA Laboratory.

Failure to fully comply with one of the above provisions will result in immediate production stoppage by the Engineer. Normal production shall not then resume until a complete verification process has been performed and approved by the Engineer.

Page 6-13, **Subarticle 609-5(C)6**

Delete the last sentence of the seventh paragraph of this Subarticle and add the following:

Do not resume normal plant production until one of the following has occurred.

Option 1: Approval has been granted by the appropriate QA Supervisor.

Option 2: The mix in question has been satisfactorily verified in accordance with Article 609-4. Normal production may resume based on the approval of the contractor’s Level II technician, provided notification and the verification test results have been furnished to the QA Laboratory.

Failure to fully comply with one of the above provisions will result in immediate production stoppage by the Engineer. Normal production shall not then resume until a complete verification process has been performed and approved by the Engineer.

Allowable Retesting for Mix Deficiencies:

Page 6-14, **Subarticle 609-5C(7)**

In the first paragraph, insert the following as the fourth sentence:

The Contractor under the supervision of the Department’s QA personnel will perform these retests.

**FIELD COMPACTION QUALITY CONTROL**

Page 6-15, **Subarticle 609-5(D)1**

In the last sentence of the third paragraph of this subarticle, insert the wording “and wedging as shown in the HMA/QMS Manual, “ after the wording “temporary pavements”

Delete the first and second sentences in the fourth paragraph and substitute the following:

Base and intermediate mix types (surface mixes not included) utilized for pavement widening of less than 4.0 feet and all mix types used in tapers, irregular areas and intersections (excluding full width travel lanes of uniform thickness), will not be subject to the sampling and testing frequency specified above provided the pavement is compacted using approved equipment and procedures. However, the Engineer may require occasional density sampling and testing to evaluate the compaction process.

Page 6-16, **Subarticle 609-5(D)1**

Delete item number 2 at the top of this page. Item number 3 should be re-numbered as 2 after the specified deletion.

Pavement Samples (Cores)

Page 6-16, **Subarticle 609-5(D)(2)**

In the first paragraph, delete the second sentence and insert the following as the last sentence in that paragraph:

The use of a separator medium beneath the layer to be tested is prohibited.

Page 6-16, **Subarticle 609-5(D)2**

Delete the last paragraph in this Subarticle and substitute the following:

Where samples have been taken, clean the inside surfaces of the sample hole, dry, properly apply tack coat, place and compact new mix of the same type to conform with the surrounding area within one working day of the sample being taken. Use a circular tamp or other approved device to achieve compaction.

LIMITED PRODUCTION PROCEDURE

Page 6-17, **Subarticle 609-5(D) 5**

Delete the first paragraph and substitute the following:

Proceed on limited production when, for the same mix type, one of the following items occur:

- (1) Two consecutive failing lots, excluding lots representing an individual resurfacing map or portion thereof.
- (2) Three consecutive failing lots, with each lot representing an individual resurfacing map or portion thereof.
- (3) Two consecutive failing nuclear control strips.

Pavement within each construction category (New and Other), as defined in Article 610-13, and pavement placed simultaneously by multiple paving crews will be evaluated independently for limited production purposes.

Delete the first sentence in the last paragraph and substitute the following:

If the Contractor does not operate by the limited production procedures as specified above, the two consecutive failing density lots, three consecutive failing lots with each lot representing an individual resurfacing map or portion thereof, or two consecutive failing nuclear control strips, whichever is applicable, and all mix produced thereafter will be considered unacceptable. Remove this material and replace with material that complies with the Specifications, unless otherwise approved.

DOCUMENTATION (RECORDS)

Page 6-18, **Subarticle 609-5(E)**

Delete the third and fourth sentence in the first full paragraph and substitute the following:

Maintain all QC records, forms and equipment calibrations for a minimum of 3 years from their completion date.

Delete the second full paragraph and substitute the following:

Falsification of test results, documentation of observations, records of inspection, adjustments to the process, discarding of samples and/or test results, or any other deliberate misrepresentation of the facts will result in the revocation of the applicable person’s QMS certification. The Engineer will determine acceptability of the mix and/or pavement represented by the falsified results or documentation. If the mix and/or pavement in question is determined to be acceptable, the Engineer may allow the mix to remain in place at no pay for the mix, asphalt binder and other mix components. If the mix and/or pavement represented by the falsified results is determined not to be acceptable, remove and replace with mix, which complies with the Specifications. Payment will be made for the actual quantities of materials required to replace the falsified quantities, not to exceed the original amounts.

QUALITY ASSURANCE

Page 6-18, **Article 609-6**

In Item 1 under Plant Mix Quality Assurance, substitute “5 percent” for “10 percent”.

In Item 2 under Plant Mix Quality Assurance, substitute “sampling and testing procedures” for “tests”.

In Item 4 under Plant Mix Quality Assurance, add “for that increment” after the word “sample”.

In Item 5 under Plant Mix Quality Assurance, add “at a frequency equal to or greater than 10 percent of the QC sample frequency”; or

Insert the following after Item 5 under Plant Mix Quality Assurance:

- 6. By any combination of the above.

Delete the paragraph below Plant Mix Quality Assurance, and replace with the following:

The Engineer will conduct assurance tests on both split QC samples taken by the Contractor and verification samples taken by the Department. These samples may be the regular quality control samples or a sample selected by the Engineer from any location in the process or verification samples taken at random by the Department. The frequency will be equal to or greater than 5 percent of that required of the Contractor as stated in Subarticle 609-5(C)2. The Engineer may select any or all samples for assurance testing.



In Item 1 under Density Quality Assurance, delete the wording at the end of the sentence “at a frequency equal to or greater than 10 percent of the frequency required of the Contractor”.

In Item 3 under Density Quality Assurance, substitute 5 percent for 10 percent.

Page 6-19, **Article 609-6**

In Item 4 under Density Quality Assurance, add “at a frequency equal to or greater than 10 percent of the QC sample frequency.”

Insert the following after Item 4 under Density Quality Assurance:

- 5. By periodically directing the recalculation of random numbers for the Quality Control core or nuclear density test locations. The original QC test locations may be tested by QA and evaluated as verification tests.

LIMITS OF PRECISION

Page 6-19, **Article 609-6**

In the limits of precision table, delete the last three rows and substitute the following:

QA retest of prepared QC Gyrotory Compacted

Volumetric Specimens	± 0.015
Retest of QC Core Sample	± 1.2% (% Compaction)
Comparison of QA Core Sample	± 2.0% (% Compaction)
QA Verification Core Sample	± 2.0% (% Compaction)
Nuclear Comparison of QC Test	± 2.0% (% Compaction)
QA Nuclear Verification Test	± 2.0% (% Compaction)

Delete the first paragraph below the Limits of Precision table and insert the following two paragraphs.

The Engineer will immediately investigate the reason for differences if any of the following occur:

- 1. QA test results of QC split sample does not meet above limits of precision, or
- 2. QA test results of QC split sample does not meet the individual test control limits or the specification requirements, or
- 3. QA verification sample test results exceed the allowable retesting tolerances.

If the potential for a pavement failure exists, the Engineer may suspend production, wholly or in part, in accordance with the requirements of Article 108-7 while the investigation is in progress. The Engineer’s investigation may include, but not be limited to the following:

- 1. Joint testing of any remaining split samples

- 2. Review and observation of the QC technician’s sampling and testing procedures,
- 3. Evaluation and calibration of QC testing equipment, and/or
- 4. Comparison testing of other retained qualify control samples, and/or additional density core samples.

In the third sentence of the second paragraph below the limits of precision table, insert “or verification test results” after “quality assurance test results”.

ASPHALT CONCRETE PLANT MIX PAVEMENTS – DESCRIPTION

Page 6-20, **Article 610-1**

Insert the following after the last paragraph:

A high frequency of asphalt plant mix, density, or mix and density deficiencies occurring over an extended duration of time may result in future asphalt, which is represented by mix and/or density test results not in compliance with minimum specification requirements, being excluded from acceptance at an adjusted contract unit price in accordance with Article 105-3. This acceptance process may apply to all asphalt produced and /or placed and may continue until the Engineer determines a history of quality asphalt production and placement is reestablished.

MATERIALS

Page 6-21, **Article 610-2**

Delete reference of Anti-strip additive (chemical) to **Article 1020-2** and substitute **Article 1020-8**.

COMPOSITION OF MIXTURES (MIX DESIGN AND JOB MIX FORMULA)

Page 6-21, **Subarticle 610-3(A)**

At the end of the second paragraph, add the following sentence:

In addition, submit Superpave gyratory compactor printouts for all specimens compacted at  $N_{des}$  during the mix design process.

Insert the following paragraph after the second paragraph:

For the final surface layer of the specified mix type, use a mix design with an aggregate blend gradation above the maximum density line on the 2.36 mm and larger sieves.

Insert the following at the end of the third paragraph:

When the percent of binder contributed from RAS or a combination of RAS and RAP exceeds 20 percent of the total binder in the completed mix, the virgin binder PG grade shall be one grade below (both high and low temperature grade) the binder grade specified in Table 610-2 for the mix type.

Delete the fourth paragraph and substitute the following:

For Type S 9.5D and Type S 12.5D mixes, the maximum percentage of reclaimed asphalt material is limited to 15% and shall be produced using virgin asphalt binder grade PG 76-22. For all other recycled mix types, when the percentage of RAP is 15 percent or less of the total mixture, the virgin binder PG grade shall be as specified in Table 610-2 for the specified mix type. When the percentage of RAP is greater than 15 but not more than 25 percent of the total mixture, the virgin binder PG grade shall be one grade below (both high and low temperature grade) the specified grade for the mix type. When the percentage of RAP is greater than 25 percent of the total mixture, the Engineer will establish and approve the asphalt binder grade.

Page 6-23, **Subarticle 610-3(A)**

After Item 12 at the top of the page, add Item 13 as follows:

- 13. TSR data in accordance with AASHTO T 283(Modified).

Page 6-23, **Subarticle 610-3(A)**

Under the quantities of mix components insert the following paragraph:

In addition to the required mix design submittal forms, the Contractor shall deliver six (6) Superpave Gyratory Compactor specimens to the Department’s Central Asphalt Laboratory for the following surface mix types: SF 9.5A, S 9.5B, S 9.5C, S 9.5D, S 12.5C and S 12.5D. The Contractor will prepare these specimens using lab produced mix in accordance with AASHTO T 312 (Modified). These specimens shall be compacted to a height of 75mm and to a void content (VTM) of 4.0% +/- 0.5%. These specimens will be tested for rutting susceptibility using the Asphalt Pavement Analyzer in the Materials and Test Central facility or other approved facility.

Page 6-23, **Subarticle 610-3(A)**

In the last sentence of the second paragraph on this page, change “10 days” to “20 days”.

Page 6-23, **Subarticle 610-3(B)**

Add the following paragraph after the first paragraph of this Subarticle:

Surface mix designs will be tested by the Department for rutting susceptibility. Rut depth requirements for each surface mix type and traffic level are specified in Table 610-2. Mix designs that fail to meet these requirements will be considered unacceptable and must be redesigned by the Contractor such that rut depths are acceptable.

OB MIX FORMULA

Page 6-24, **Subarticle 610-3(C)**

Delete Table 610-1 and associated notes. Substitute the following:

**TABLE 610-1  
SUPERPAVE AGGREGATE GRADATION DESIGN CRITERIA**

Standard	Percent Passing Criteria (Control Points)											
	Sieves											
(mm)	Mix Type (Nominal Maximum Aggregate Size)											
	4.75 mm (a)		9.5 mm (c)		12.5 mm (c)		19.0 mm		25.0 mm		37.5 mm	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
50.0											100.0	
37.5									100.0		90.0	100.0
25.0							100.0		90.0	100.0		90.0
19.0					100.0		90.0	100.0		90.0		
12.5			100.0		90.0	100.0		90.0				
9.5	100.0		90.0	100.0		90.0						
4.75	90.0	100.0		90.0								
2.36	65.0	90.0	32.0(b)	67.0(b)	28.0	58.0	23.0	49.0	19.0	45.0	15.0	41.0
1.18												
0.600												
0.300												
0.150												
0.075	4.0	8.0	4.0	8.0	4.0	8.0	3.0	8.0	3.0	7.0	3.0	6.0

- (a) For Type S 4.75A, a minimum of 50% of the aggregate components shall be manufactured material from the crushing of stone.
- (b) For Type SF 9.5A, the percent passing the 2.36 mm sieve shall be a minimum of 60% and a maximum of 70%.
- (c) For the final surface layer of the specified mix type, use a mix design with an aggregate blend gradation above the maximum density line on the 2.36 mm and larger sieves.

Delete Table 610-2 and associated notes. Substitute the following:

**TABLE 610-2  
SUPERPAVE MIX DESIGN CRITERIA**

	Design	Binder	Compaction Levels		Volumetric Properties (c)				
Mix Type	ESALs millions	PG Grade	No. Gyration @		Max. Rut Depth (mm)	VMA % Min.	VTM %	VFA Min. - Max.	%Gmm @ N <sub>ini</sub>
(e)	(a)	(b)	N <sub>ini</sub>	N <sub>des</sub>	(mm)	% Min.	%	Min. - Max.	@ N <sub>ini</sub>
S-4.75A	<0.3	64 -22	6	50	-----	20.0	7.0-15.0		
SF-9.5A	<0.3	64 -22	6	50	11.5	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S-9.5B	0.3 - 3	64 -22	7	75	9.5	15.0	3.0 - 5.0	65 - 80	≤ 90.5
S-9.5C	3 - 30	70 -22	8	100	6.5	15.0	3.0 - 5.0	65 - 76	≤ 90.0
S 9.5D	> 30	76 -22	9	125	4.5	15.0	3.0 - 5.0	65 - 76	≤ 90.0
S-12.5C	3 - 30	70 -22	8	100	6.5	14.0	3.0 - 5.0	65 - 75	≤ 90.0
S-12.5D	> 30	76 -22	9	125	4.5	14.0	3.0 - 5.0	65 - 75	≤ 90.0
I-19.0B	< 3	64 -22	7	75	-----	13.0	3.0 - 5.0	65 - 78	≤90.5
I-19.0C	3 - 30	64 -22	8	100	-----	13.0	3.0 - 5.0	65 - 75	≤ 90.0
I-19.0D	> 30	70 -22	9	125	-----	13.0	3.0 - 5.0	65 - 75	≤ 90.0
B-25.0B	< 3	64 -22	7	75	-----	12.0	3.0 - 5.0	65 - 78	≤ 90.5
B-25.0C	> 3	64 -22	8	100	-----	12.0	3.0 - 5.0	65 - 75	≤ 90.0
B-37.5C	> 3	64 -22	8	100	-----	11.0	3.0 - 5.0	63 - 75	≤ 90.0
	<b>Design Parameter</b>				<b>Design Criteria</b>				
All Mix Types	1. Dust to Binder Ratio (P <sub>0.075</sub> / P <sub>be</sub> )				0.6 - 1.4				
	2. Retained Tensile Strength (TSR)(AASHTO T 283 Modified)				85 % Min. (e)				

- Notes:**
- (a) Based on 20 year design traffic.
  - (b) When Recycled Mixes are used, select the binder grade to be added in accordance with Subarticle 610-3(A).
  - (c) Volumetric Properties based on specimens compacted to N<sub>des</sub> as modified by the Department.
  - (d) AASHTO T 283 Modified (No Freeze-Thaw cycle required). TSR for Type S 4.75A, Type B 25.0 and Type B 37.5 mixes is 80% minimum.
  - (e) Mix Design Criteria for Type S 4.75A may be modified subject to the approval of the Engineer

**WEATHER, TEMPERATURE, AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES**

Page 6-26, **Article 610-4, Table 610-3**

Delete the title of **Table 610-3** and substitute the following title:

**ASPHALT PLACEMENT- MINIMUM TEMPERATURE REQUIREMENTS**

In the first column, third row; delete reference to the ACSC Types S 9.5A and S 12.5B mix.

Add the following minimum placing temperatures for mix types S 4.75A and SF 9.5A.

<b>Asphalt Concrete Mix Type</b>	<b>Minimum Air Temperature</b>	<b>Minimum Road Surface Temperature</b>
ACSC, Type S 4.75A, SF 9.5A	40°F (5°C)	50°F (10°C)

**SPREADING AND FINISHING**

Page 6-32, **Article 610-8**

Insert the following after the second sentence within the sixth paragraph.

Take necessary precautions during production, loading of trucks, transportation, truck exchanges with paver, folding of the paver hopper wings, and conveying material in front of the screed to prevent segregation of the asphalt mixtures.

Page 6-32, **Article 610-8**

Delete the last paragraph beginning on this page and continuing on the next page and substitute the following:

Use pavers equipped with an electronic screed control that will automatically control the longitudinal profile and cross slope of the pavement. Control the longitudinal profile through the use of either a mobile grade reference(s), including mechanical, sonic and laser grade sensing and averaging devices, an erected string line(s) when specified, joint matching shoe(s), slope control devices or the approved methods or combination of methods. Unless otherwise specified, use a mobile grade reference system capable of averaging the existing grade or pavement over a minimum 30 foot (9.1 meter) distance or by non-contacting laser or sonar type ski with at least four referencing stations mounted on the paver at a minimum length of 24 feet. Establish the position of the reference system such that the average profile grade is established at the approximate midpoint of the system. The transverse cross-slope shall be controlled as directed by the Engineer.

Page 6-33, **Article 610-8**

Delete the second full paragraph on this page and substitute the following:

Use the 30 foot (9.1 meter) minimum length mobile grade reference system or the non-contacting laser or sonar type ski with at least four referencing stations mounted on the paver at a minimum length of 24 feet to control the longitudinal profile when placing the initial lanes and all adjacent lanes of all courses, including resurfacing and asphalt in-lays, unless other specified or approved. A joint matching device short (6 inch [152.4 mm] shoes) may be used only when approved.

At the end of the third full paragraph, add the following sentence:

Waiver of the use of automatic screed controls does not relieve the Contractor of achieving plan grades and cross-slopes.

Insert the following at the end of this Article:

Repair any damage caused by hauling equipment across structures at no additional cost to the Department.

Use a Material Transfer Vehicle (MTV) when placing all asphalt concrete plant mix pavements, including open-graded asphalt friction course, which require the use of asphalt binder grade PG 76-22, unless otherwise approved. Utilize the MTV when placing all full width travel lanes, including shoulders, collector lanes, ramps, and loops which require PG 76-22.

Provide an MTV that receives mixture from the hauling equipment and independently delivers the mixture from the hauling equipment to the paving equipment. Provide an MTV capable of transferring the material from the haul vehicle to the paver hopper at a uniform and continuous rate to allow the continuous movement of the paver. Install a paver hopper insert with a minimum capacity of 7 tons in the hopper of conventional paving equipment when utilizing a MTV. Perform remixing of the material prior to discharge into the paver conveyor system by utilizing either a MTV with a remixing system contained within a minimum 7 ton capacity storage bin or a dual pugmill system with two full length transversely mounted paddle mixers located in the paver hopper insert.

Use an MTV that provides to the paver a homogeneous, non-segregated mixture that is of uniform temperature such that there is no more than 20°F difference between the highest and lowest temperatures when measured transversely across the width of the mat in a straight line at a distance of one foot to three feet from the screed while the paver is operating. Obtain the temperature measurements approximately one foot from each edge and at least once in the middle of the mat.

Empty the MTV when crossing a bridge and move across without any other Contractor vehicles or equipment being on the bridge. Move the MTV across a bridge in a travel lane and not on the shoulder. While crossing a bridge move the MTV at a speed no greater than five miles per hour without any abrupt acceleration or deceleration.

In the event the MTV malfunctions during paving operations, immediately discontinue plant operations and do not resume operations until the MTV malfunctions have been remedied, unless otherwise directed due to safety concerns. The Contractor may continue placement of the mix until any additional mix in transit has been placed, provided satisfactory results are achieved. This procedure in no way alleviates the Contractor from meeting contract requirements.

DENSITY REQUIREMENTS

Page 6-34, **Article 610-10**,

Delete **Table 610-4** and substitute the following table and associated notes:

**Table 610-4**  
**MINIMUM DENSITY REQUIREMENTS**

MIX TYPE	MINIMUM % of $G_{mm}$
SUPERPAVE MIXES	(Maximum Specific Gravity)
S 4.75A	85.0 <sup>(a,b)</sup>
SF 9.5A	90.0
S 9.5X, S 12.5X, I 19.0X, B 25.0X, B 37.5X	92.0

- (a) All S 4.75A pavement will be accepted for density in accordance with Article 105-3
- (b) Compaction to the above specified density will be required when the S 4.75 A mix is applied at a rate of 100 lbs/sy (55 kg/m<sup>2</sup>)

Page 6-34, **Article 610-10**

Delete the second paragraph and substitute the following:

Compact base and intermediate mix types (surface mixes not included) utilized for pavement widening of less than 4.0 feet (1.2 meters) and all mix types used in tapers, irregular areas and intersections (excluding full width travel lanes of uniform thickness), using equipment and procedures appropriate for the pavement area width and/or shape. Compaction with equipment other than conventional steel drum rollers may be necessary to achieve adequate compaction. Occasional density sampling and testing to evaluate the compaction process may be required. Densities lower than that specified in Table 610-4 will be accepted, in accordance with Article 105-3, for the specific mix types and areas listed directly above.



## SURFACE REQUIREMENTS AND ACCEPTANCE

Page 6-35, **Article 610-12**

Delete the first paragraph and substitute the following:

Construct pavements using quality paving practices as detailed herein. Construct the pavement surface smooth and true to the plan grade and cross slope. Immediately correct any defective areas with satisfactory material compacted to conform with the surrounding area. Pavement imperfections resulting from unsatisfactory workmanship such as segregation, improper longitudinal joint placement or alignment, non-uniform edge alignment and excessive pavement repairs will be considered unsatisfactory and if allowed to remain in place will be accepted in accordance with Article 105-3.

When directed due to unsatisfactory laydown or workmanship, operate under the limited production procedures. Limited production for unsatisfactory laydown is defined as being restricted to the production, placement, compaction, and final surface testing (if applicable) of a sufficient quantity of mix necessary to construct only 2500 feet (750 meter) of pavement at the laydown width.

Remain on limited production until such time as satisfactory laydown results are obtained or until three consecutive 2500 foot (750 meter) sections have been attempted without achieving satisfactory laydown results. If the Contractor fails to achieve satisfactory laydown results after three consecutive 2500 foot (750 meter) sections have been attempted, cease production of that mix type until such time as the cause of the unsatisfactory laydown results can be determined. As an exception, the Engineer may grant approval to produce a different mix design of the same mix type if the cause is related to mix problem(s) rather than laydown procedures.

Mix placed under the limited production procedures for unsatisfactory laydown or workmanship will be evaluated for acceptance in accordance with Article 105-3.

## DENSITY ACCEPTANCE

Page 6-36, **Article 610-13**

Delete the second paragraph and substitute the following:

The pavement will be accepted for density on a lot by lot basis. A lot will consist of one day's production of a given job mix formula on a contract. As an exception, separate lots will be established when the one of the following occurs:

- (1) Portions of pavement are placed in both "New" and "Other" construction categories as defined below. A lot will be established for the portion of the pavement in the "New" construction category and a separate lot for the portion of pavement in the "Other" construction category.

- (2) Pavement is placed on multiple resurfacing maps, unless otherwise approved prior to paving. A lot will be established for each individual resurfacing map or portion thereof.
- (3) Pavement is placed by multiple paving crews. A lot will be established for the pavement placed by each paving crew.
- (4) Pavement is placed in different layers. A lot will be established for each layer.
- (5) Control strips are placed during limited production.

The Engineer will determine the final category and quantity of each lot for acceptance purposes.

Page 6-36, **Article 610-13**

Delete the first sentence in the third paragraph and insert the following:

The “New” construction category will be defined as pavements of uniform thickness, exclusive of irregular areas, meeting all three of the following criteria:

Delete the sixth paragraph and substitute the following:

A failing lot for density acceptance purposes is defined as a lot for which the average of all test sections, and portions thereof, fails to meet the minimum specification requirement. If additional density sampling and testing, beyond the minimum requirement, is performed and additional test sections are thereby created, then all test results shall be included in the lot average. In addition, any lot or portion of a lot that is obviously unacceptable will be rejected for use in the work.

Page 6-36, **Article 610-13**

Delete the last paragraph and substitute the following:

Any density lot not meeting minimum density requirements detailed in Table 610-4 will be evaluated for acceptance by the Engineer. If the lot is determined to be reasonably acceptable, the mix will be paid at an adjusted contract price in accordance with Article 105-3. If the lot is determined not to be acceptable, the mix will be removed and replaced with mix meeting and compacted to the requirement of these specifications.

**BASIS OF PAYMENT, ASPHALT PAVEMENTS**

Page 6-37, **Article 610-16**

Add the following to the second paragraph:

The quantity of hot mix asphalt pavement, measured as provided in Article 610-15, will be paid for at the contract unit prices per ton (metric ton) for “Asphalt Concrete Surface Course, Type S 4.75A, and SF 9.5A”.

Add the following to the payment item description:

Asphalt Concrete Surface Course, Type S 4.75A..... Ton (Metric Ton)  
Asphalt Concrete Surface Course, Type SF 9.5A..... Ton (Metric Ton)

Delete reference to the Asphalt Concrete Surface Course, Types S 9.5A and S 12.5B in both the second paragraph and in the payment description.

**ASPHALT BINDER FOR PLANT MIX - METHOD OF MEASUREMENT**

Page 6-39, **Article 620-4**

Delete the first sentence of the second paragraph and substitute the following:

Where recycled plant mix is being produced, the grade of asphalt binder to be paid for will be the grade for the specified mix type as required in Table 610-2 unless otherwise approved.

**OPEN-GRADED ASPHALT FRICTION COURSE CONSTRUCTION REQUIREMENTS**

Page 6-43, **Article 650-5**

Add the following paragraph after the first paragraph:

Do not place open-graded asphalt friction course between October 31 and April 1 of the next year, unless otherwise approved. Place friction course, Type FC-1 mixes, only when the road surface temperature is 50°F (10°C) or higher and the air temperature is 50°F (10°C) or higher. The minimum air temperature for Type FC-1 Modified and FC-2 Modified mixes will be 60°F (15°C).

Add the following paragraph after the fifth paragraph of this Article.

Use a Materials Transfer Vehicle in accordance with Article 610-8 of the Standard Specifications as amended herein.

**AGGREGATES FOR ASPHALT PLANT MIXES**

Page 10-34, **Subarticle 1012-1(B)4**

Delete and substitute the following:

- (4) Flat and Elongated Pieces:

Use coarse aggregate meeting the requirements of Table 1012-1 for flat and elongated pieces when tested in accordance with ASTM D 4791 (Section 8.4) on the No. 4 (4.75 mm) sieve and larger with a 5:1 aspect ratio (maximum to minimum) for all pavement types, except there is no requirement for Types S 4.75A, SF 9.5A, and S 9.5B.

Page 10-35, **Table 1012-1**

Delete **Table 1012-1** and substitute the following:

**Table 1012-1**  
**AGGREGATE CONSENSUS PROPERTIES<sup>(a)</sup>**

Mix Type	Course	Fine	Sand	Flat &
	Aggregate	Aggregate	Equivalent	Elongated
	Angularity <sup>(b)</sup>	Angularity		5 : 1 Ratio
		% Minimum	% Minimum	% Maximum
	ASTM D 5821	AASHTO T 304 Method A	AASHTO T 176	ASTM D 4791 Section 8.4
S 4.75 A		40	40	
SF 9.5 A S 9.5 B I 19.0 B B 25.0 B	75 / -	40	40	10 <sup>(c)</sup>
S 9.5 C S 12.5 C I 19.0 C B 25.0 C B 37.5 C	95 / 90	45	45	10
S 12.5 D I 19.0 D	100 / 100	45	50	10
S 12.5 D S 9.5 D I 19.0 D	100 / 100	45	50	10
OGAFC	100 / 100	N/A	N/A	10

- (a) Requirements apply to the course aggregate blend and/or fine aggregate blend
- (b) 95/90 denotes that 95% of the course aggregate (+No.4 or + 4.75mm sieve) has one fractured face and 90% has two or more fractured faces.
- (c) Does not apply to Mix Types SF 9.5 A or S

**FINE AGGREGATE ANGULARITY**

Page 10-36, **Subarticle 1012-1(C)6**

Delete reference to AASHTO TP 33 Method A and substitute AASHTO T 304, Method A.

Page 10-37, **Subarticle 1012-1(H)**

Delete this Subarticle. It is a duplicate of Subarticle 1012-1(F) located on Page 10-36.

ASPHALT BINDER

Page 10-46, **Article 1020-2**

Delete the first paragraph and substitute the following:

Use Performance Graded Asphalt Binder meeting the requirements of AASHTO M 320. See Article 610-3 for the specified grades. Submit a Quality Control Plan for asphalt binder production in conformance with the requirements of AASHTO R 26 to the Materials and Tests Unit.

RR31

**HOT IN-PLACE RECYCLED ASPHALT CONCRETE:**  
(SUPERPAVE VERSION)

**08-12-02<sub>R</sub>**

**1.0 DESCRIPTION:**

This work shall consist of hot in-place recycling of the existing asphalt concrete surface by heating and softening the existing asphalt pavement with indirect heat, loosening the heated pavement by hot milling to the depth specified in the plans, adding a plant produced hot mix asphalt admixture, if required, applying an emulsified rejuvenating agent, thoroughly remixing the material in a pugmill, leveling, relaying and compaction of the hot-in-place (HIP) recycled asphalt mixture. A continuous, single train, single pass, multi-step process shall accomplish this work.

Hot In-Place Recycled Asphalt Concrete production and placement, including all materials and equipment shall be in accordance with applicable provisions of Division 6 of the Standard Specifications except as specifically noted or modified herein.

Provide and conduct the quality control and required testing for acceptance of the asphalt mixture in accordance with the Project Special Provisions titled "Quality Management System For Asphalt Pavements" (Hot In-Place Recycled Asphalt Concrete – Superpave Version), included herein.

**2.0 MATERIALS:**

**2.1 Hot Mix Asphalt Admixture:**

If required, the type and amount of plant produced hot mix asphalt admixture to be added to the recycled mixture shall be determined by the Contractor subject to the approval of the Engineer. The HMA admixture shall be a plant mixture of asphalt binder and aggregate(s) meeting the applicable requirements of Division 10 of the Standard Specifications as shown below. The aggregate in the admixture may be a single standard size aggregate or a combination of aggregate sizes as needed. The binder content of the admixture shall be such that the aggregate particles are fully coated. The gradation and binder content of the admixture shall be such that when blended with the other mix components, the hot in-place recycled mix properties will meet the mix design criteria for the applicable mix type specified in the plans, unless approved

otherwise by the Engineer. The HMA admixture shall be produced in accordance with applicable requirements of Division 6 of the Standard Specifications.

Coarse Aggregate.....	Article 1012-1
Fine Aggregate.....	Article 1012-1
Stone Screenings.....	Article 1012-1
Asphalt Binder.....	Article 1020-2
Anti-strip Additive.....	Article 1020-8

**2.2 Emulsified asphalt rejuvenating agent:**

Type CSS-1RP meeting the following requirements:	Minimum	Maximum
Viscosity, 77° F, SSF, ASTM D-244	20	125
Sieve, %, ASTM D-244	-----	0.10
Storage Stability, 24 hr, %, ASTM D-244	-----	1
Residue from distillation, % (1)	60	-----
Oil Distillate, Volume %	-----	5
Tests on Residue and Rolling Thin-film Oven Tests: (2)		
Penetration @ 77° F, 5 sec.	300	-----
Torsional Recovery 39.7° F, %	20	-----

- Notes: (1) ASTM D244 except that the maximum temperature shall be 350°F held for 20 minutes.  
 (2) The residue from distillation shall be subject to the standard rolling thin film oven test.

**3.0 Composition of Mixture (Mix Design /Job Mix Formula).**

**3.1 Mix Design-General:**

Prepare and submit a proposed HIP mix design and job mix formula to the Engineer at least 14 days prior to beginning work in accordance with all applicable requirements of Article 610-3 of the Standard Specifications, except as modified herein.

The Contractor shall sample the existing pavement by coring or other methods approved by the Engineer to determine representative characteristics and properties of the existing pavement for use in mix design preparation. These samples shall be taken in the presence of the Engineer and at locations approved by the Engineer.

The mix design shall be performed and documented in accordance with the Department’s most current accepted policies and procedures for the design of asphalt mixes. The Department’s Asphalt Design Engineer at the Materials and Tests Unit may be contacted for these procedures. The proposed mix design shall be established such that the hot in-place recycled mix properties will be within the design criteria for the type mix specified, unless otherwise approved by the Engineer. The mix design shall be submitted on forms and in the format approved by the

Department. Once the proposed mix design is approved, the Engineer will provide a Job Mix Formula for the hot in-place recycled asphalt mix. The job mix formula will be established within the design criteria below, unless otherwise approved by the Engineer.

In addition to applicable mix design data required in Sub-article 610-3 (A), the data shall include but not be limited to the proposed percent admixture, if needed, admixture components, gradation, binder grade, binder content, percent anti-strip additive in admixture, percent existing pavement (RAP), gradation and binder content of existing pavement, percent emulsified rejuvenating agent, penetration of recovered binder from total mix, and all mix design properties and calculations.

### **3.2 Mix Design Criteria:**

The finished asphalt pavement shall be a uniform mixture composed of the existing in-place asphalt pavement, emulsified asphalt rejuvenating agent, and new hot mix asphalt admixture, if required. The hot in-place recycled asphalt mix shall meet applicable requirements of Section 610-3 of the Standard Specifications (excluding maximum percentage of allowable RAP) for the mix type specified, except as modified herein.

The proposed mix design shall be established such that the hot in-place recycled mix properties will meet applicable gradation and mix design requirements of Table 1 and Table 2 for the mix type specified, except as modified herein, unless otherwise approved by the Engineer

Emulsified asphalt rejuvenating agent shall be added at a rate which yields a completed mixture with a minimum/maximum penetration value as specified in TABLE 2 below, unless otherwise approved by the Engineer.

**AGGREGATE GRADATION DESIGN CRITERIA—TABLE 1**

Standard Sieves	Percent Passing Criteria (Control Points)					
	Mix Type (Nominal Maximum Aggregate Size)					
	9.5 mm		12.5 mm		19.0 mm	
(mm)	Min.	Max.	Min.	Max.	Min.	Max.
50.0						
37.5						
25.0						100.0
19.0				100.0	90.0	100.0
12.5		100.0	90.0	100.0		90.0
9.5	90.0	100.0		90.0		
4.75		90.0				
2.36**	32.0**	67.0**	28.0	58.0	23.0	49.0
1.18						
0.600						
0.300						
0.150						
0.075	4.0	8.0	4.0	8.0	3.0	8.0

\*\*NOTE: For Type SF 9.5A the percentage Passing the 2.36 mm sieve is 60% Minimum and a Maximum of 70%.

Aggregate Nominal Maximum Size is defined as one standard sieve size larger than the first sieve to retain more than 10 percent aggregate. Maximum Size is defined as one standard sieve size larger than the nominal maximum size.



**MIX DESIGN CRITERIA—TABLE 2(d)**

Mix Type	Design ESALs (millions) (a)	Target Binder PG Grade	Compaction Levels			Volumetric Properties (b)			
			No. Gyration @			(AASHTO PP 28)			
			N <sub>ini</sub>	N <sub>des</sub>	N <sub>max</sub>	VMA % Min.	VTM %	VFA Min.-Max.	%G <sub>mm</sub> @ N <sub>ini</sub>
SF-9.5A	< 0.3	64 - 22	6	50	75	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S-9.5A	< 0.3	64 - 22	6	50	75	15.0	3.0 - 5.0	70 - 80	≤ 91.5
S-9.5B	0.3 - 3	64 - 22	7	75	115	15.0	3.0 - 5.0	65 - 80	≤ 90.5
S-9.5C	3 - 30	70 - 22	8	100	160	15.0	3.0 - 5.0	65 - 76	≤ 89.0
S-12.5B	< 3	64 - 22	7	75	115	14.0	3.0 - 5.0	65 - 78	≤ 90.5
S-12.5C	3 - 30	70 - 22	8	100	160	14.0	3.0 - 5.0	65 - 75	≤ 89.0
I-19.0B	< 3	64 - 22	7	75	115	13.0	3.0 - 5.0	65 - 78	≤ 90.5
I-19.0C	3 - 30	64 - 22	8	100	160	13.0	3.0 - 5.0	65 - 75	≤ 89.0
All Mix	<b>Design Parameter</b>					<b>Design Criteria</b>			
	1. %G <sub>mm</sub> @ N <sub>max</sub> 2. Penetration(AASHTO T 49) from Abson Recovery (AASHTO T 170)					≤ 98.0% (c) 40 Min. 90 Max.			

- Notes: (a) Based on 20 year design traffic.  
 (b) Volumetric Properties based on specimens compacted to N<sub>des</sub> as modified by the Department.  
 (c) Based on specimens compacted to N<sub>max</sub> at selected optimum asphalt content.  
 (d) Mix Design Criteria may be modified, subject to approval by the Engineer.

**3.3 Job Mix Formula:**

Once the proposed mix design is approved, the Engineer will provide a Job Mix Formula for the hot in-place recycled asphalt mix. The job mix formula will be established within the design criteria below, unless otherwise approved by the Engineer.

Once the HIP mix design is approved, the Engineer will provide a Job Mix Formula for the admixture if utilized. The completed admixture shall be produced in accordance with the Job Mix Formula requirements for gradation and binder content as prescribed in the project special provision titled “Quality Management System for Asphalt Pavements” (Hot In-Place Recycled Asphalt Concrete – Superpave Version), included herein.

Samples of the completed recycled mixture may be taken by the Department on a random basis to determine if the PG grading on the recovered asphalt binder is in accordance with AASHTO MP 1 for the grade specified. If the grading is determined to be a value other than required for the specified mix type, the Engineer may require the Contractor to adjust the grade and/or percentage of additional asphalt binder, asphalt rejuvenator, and/or the blend of reclaimed material and admixture to bring the grade to the specified value.

#### **4.0 EQUIPMENT:**

##### **4.1 General:**

Equipment used to recycle the existing asphalt surface shall be designed and built for this specific purpose. The equipment shall be capable of a single pass, multi-step operation that includes; multi-step heating, milling, introducing recycling agent, introducing hot mix asphalt, if required, mixing the new material with the reclaimed material in a separate on-board chamber, redistributing the recycled material, leveling, and compacting the mixture.

##### **4.2 Heating Unit:**

Preheating mechanism(s) consisting of clusters of heaters capable of uniformly heating the asphalt pavement to a temperature high enough to remove excess moisture, to allow milling of the existing pavement material to the designated plan depth without excessive fracturing of aggregate particles, without charring the existing asphalt and without producing undesirable pollutants. The heating mechanism shall be so equipped that the heat application shall be completely under an enclosed or shielded hood. The unit shall be adjustable in width. The Contractor shall protect adjacent landscape from heat damage and shall be responsible for any damage that may occur.

##### **4.3 Milling/Blending Unit:**

A self propelled processing unit containing the following:

1. A recycling machine equipped with additional heaters conforming to the same requirements as the preheaters.
2. A unit capable of uniformly loosening the existing asphalt pavement to the depth specified. Care must be taken to ensure that milling or pavement reclaiming does not degrade the aggregates but only loosens the heated existing pavement.
3. A controlled system for adding and uniformly blending a rejuvenating agent at a predetermined rate with the reclaimed mix during the remixing and leveling operation. The metering equipment shall be capable of measuring in gallons. The application rate in gallons, for the added material, shall be synchronized with the machine ground speed to provide a uniform application. The actual rate used may be adjusted as determined by the Engineer.
4. A blending unit consisting of a twin shafted pugmill capable of uniformly adding new hot mix asphalt admixture at a rate of at least 50 lbs. per square yard. The unit shall be capable of thoroughly mixing the loosened asphalt pavement, emulsified asphalt rejuvenating agent, and new hot mix asphalt admixture if required, at the pugmill to produce a uniform mixture.
5. A unit capable of auguring the heated and loosened material into a windrow at the center of the machine prior to entry into the blending unit.
6. A paving machine meeting the requirements of Article 610-8 of the Standard Specifications, except as modified herein, shall be utilized to redistribute the remixed material over the width being processed and finished, so as to produce a uniform cross section and surface. The paving machine must be capable of screeding the full width of the remixed material. Automatic screed controls meeting the requirements of this Article shall be provided and used unless otherwise approved by the Engineer.

7. The recycling train shall be capable of maintaining an average production rate of a minimum of 1 lane mile per day.
8. The reheating and remixing units shall meet all state and local air quality emission standards for mobile sources.

#### **4.4 Compaction Equipment:**

Rollers meeting the requirements of Section 610-9 of the Standard Specifications and capable of achieving the specified density and surface requirements shall be utilized.

#### **5.0 CONSTRUCTION REQUIREMENTS:**

Hot In-place recycled mixtures shall not be produced or placed during rainy weather or when the air temperature measured in the shade away from artificial heat at the location of the paving operations is less than 50°F. Do not place surface course material which is to be the final layer of pavement between December 15 and March 16 of the next year.

Prior to heating and remixing operations, the pavement shall be cleaned of all loose material. Power brooms shall be used and supplemented when necessary by hand brooming or other cleaning operations, as required, to bring the surface to a clean, suitable condition free of deleterious material.

The pavement surface shall be evenly heated, loosened, and remixed to the lines, grades and depths shown on the plans. Heating shall be controlled to ensure uniform heat penetration without overheating, coking, or sooting of the asphalt pavement. The milled material shall be picked up, mixed with an emulsified asphalt rejuvenator and asphalt admixture, if needed, in a pugmill and then distributed and leveled by a conventional paving machine. The temperature of the milled material shall not be more than 325°F when measured immediately behind the milling unit. The temperature of the remixed material shall not be less than 235°F directly behind the screed.

The heating operation shall extend at least 4 inches beyond the width of remixing on both sides. When a pass is made adjacent to a previously placed mat, the longitudinal joint shall extend at least 2" into the previously placed mat.

The layer thickness specified in the Plans or Contract Proposal shall be the compacted in-place thickness of the rejuvenated and recycled mixture layer, not to exceed the original elevation by more than 1/2 inch. The depth of milling of the existing surface shall be such that the depth as specified on the plans is within  $\pm 1/4$  inch, unless otherwise approved by the Engineer.

The emulsified asphalt rejuvenator shall be applied uniformly to the mixed material prior to remixing in the pugmill. The rate of application of rejuvenator will be as specified on the Job Mix Formula approved by the Engineer based upon the Contractor's proposed mix design.

The remixed asphalt pavement shall be compacted immediately after it has been spread and leveled, while it is still in a workable condition.

Density control may be by either core samples or nuclear density control in accordance with the Department's most current procedures. Density shall be a minimum of 92.0 percent of Maximum Specific Gravity (AASHTO T 209) as determined by procedures specified in the Department's most current edition of the HMA/QMS Manual.

The compacted surface of the completed and accepted pavement structure shall meet the requirements of Article 610-12 of the Standard Specifications.

The Contractor shall take precautions needed to protect the adjacent landscape from heat damage. Damaged landscape shall be repaired or replaced at no cost to the Department.

#### **6.0 METHOD OF MEASUREMENT:**

The quantity of Hot In-Place Recycled Asphalt Concrete, Type\_\_\_ to be paid for will be measured by the square yard and shall include all completed and accepted work.

The quantity of emulsified asphalt rejuvenating agent to be paid for will be measured by the metered quantity in gallons used in all completed and accepted work.

The quantity of admixture to be paid for, when required, will be measured by being weighed in trucks on a certified weighing device and documented on load tickets.

The quantity of asphalt binder to be paid for will be measured in accordance with Article 620-4 of the *Standard Specifications*.

#### **7.0 BASIS OF PAYMENT:**

The quantity of hot in-place recycled asphalt concrete pavement measured as provided above will be paid for at the contract unit price per square yard for "Hot In-Place Recycled Asphalt Concrete, Type\_\_\_" for the mix type specified.

The quantity of emulsified asphalt rejuvenating agent measured as provided above will be paid for at the contract price per gallon for "Emulsified Asphalt Rejuvenating Agent."

The quantity of hot mix asphalt for admixture measured as provided above will be paid for at the contract unit price per ton for "Hot Mix Asphalt Admixture."

Furnishing asphalt binder for hot mix asphalt admixture will be paid for as provided in Article 620-5 for "Asphalt Binder for Plant Mix."

The above prices and payments will be full compensation for all work covered by this section including but not limited to furnishing all materials, producing, weighing, transporting, placing, and compacting the recycled pavement; maintaining the finished course until final acceptance of the project, performing quality control as specified in the project special provisions and making any repairs or corrections to the surface of the pavement that may become necessary.

Payment will be made under:

Hot In-Place Recycled Asphalt Concrete, Type _____	.....Square Yard
Emulsified Asphalt Rejuvenating Agent.....	Gallons
Hot Mix Asphalt Admixture.....	Tons
Asphalt Binder for Plant Mix, Grade PG _____	Tons

**QUALITY MANAGEMENT SYSTEM FOR ASPHALT PAVEMENTS: 08-12-02**  
 (Hot In-Place Recycled Asphalt Concrete-SUPERPAVE)

**1.0 DESCRIPTION:**

The work covered by this provision consists of the production and placement of hot in-place asphalt recycled mixtures in accordance with a quality management system as described in these specifications. All provisions of Division 6 of the Standard Specifications, except as modified herein, shall apply.

**2.0 DESCRIPTION OF RESPONSIBILITIES:**

**2.1 Quality Control:**

The Contractor shall provide and conduct a quality control program. A quality control program is defined as all activities, including mix design, process control inspection, sampling and testing, and necessary adjustments in the process that are related to production of a pavement which meets all requirements of the Specifications.

**2.2 Quality Assurance:**

The Department will conduct a quality assurance program. A quality assurance program is defined as all activities, including inspection, sampling, and testing related to determining that the quality of the completed pavement conforms to specification requirements.

**3.0 MIX DESIGN/JOB MIX FORMULA REQUIREMENTS:**

All mix design and job mix formula requirements of the Project Special Provision titled "Hot In-Place Recycled Asphalt Concrete" shall apply.

**4.0 FIELD VERIFICATION OF MIXTURE AND JOB MIX FORMULA ADJUSTMENTS:**

The Contractor shall conduct field verification of the hot in-place mix at the beginning of production of each new mix design. Beginning production shall be limited to a maximum of 2500 linear feet of laydown width for performing the field verification tests. In addition to the required sampling and testing, all preliminary checks and equipment calibrations shall be performed. Records of these checks and calibrations shall be maintained by the Contractor for the Engineer's review and approval.

Field verification testing shall consist of a minimum of one (1) set of samples tested according to "Required Sampling and Testing" specified in Section 5.4. The field verification mix sample shall be obtained from the completed hot in-place recycled mix prior to laydown and compaction and split in accordance with current procedures in the HMA/QMS Manual. Normal production shall not begin until all field verification test results have been completed and approved by the Engineer. Verification is considered satisfactory when all volumetric properties except %Gmm@Nini are within the applicable mix design criteria and the gradation, binder content, and %Gmm@Nini are within the individual limits for the mix type being produced, unless otherwise approved by the Engineer.

Retain records of these calibrations and mix verification tests at the QC laboratory. In addition, furnish copies to the Engineer for review and approval within one working day after beginning production of the mix.

If the Contractor and/or the Engineer determine from results of quality control tests conducted during mix verification that adjustments to the JMF are necessary to achieve specified mix properties, adjustments to the JMF may be made within tolerances permitted by specifications for the mix type being produced. All JMF adjustments will be approved by the Engineer and documented in writing.

Failure by the Contractor to fully comply with the above mix verification requirements shall result in immediate production stoppage by the Engineer. Normal production shall not resume until all mix verification sampling and testing, and calibrations have been performed and approved by the Engineer.

## **5.0 CONTRACTOR'S QUALITY CONTROL SYSTEM:**

### **5.1 Personnel Requirements:**

The Contractor shall provide a certified Hot-In-Place Asphalt Recycling Plant Technician Level I to perform quality control operations and activities at all times during production of hot in-place recycled mix on the project.

In addition, a certified Plant Technician Level I shall be provided at the asphalt plant during production of the hot mix asphalt admixture, if required. A plant operator who is a certified Asphalt Plant Technician Level I may be utilized to meet this requirement when daily production for the admixture is less than 100 tons, provided the randomly scheduled increment sample as defined in Section 5.4 herein, is not due. When performing in this capacity, the plant operator will be responsible for all quality control activities which are necessary and required. Any absence of either Level I Technician, other than those for normal breaks and emergencies must be pre-approved by the appropriate QA Supervisor or his designated representative. Any extended absence of the Technician that has not been approved will result in immediate suspension of production by the Engineer. The Contractor shall also have a certified Asphalt Plant Technician Level II readily available to supervise, coordinate, and make any necessary process adjustments. A plant technician may serve in more than one of the above capacities; however, all specification requirements shall still apply.

The Contractor shall provide a certified QMS Roadway Technician with each hot in-place recycling operation at all times during production and placement of asphalt. This person shall be responsible for and directly supervise all roadway paving operations and roadway quality control processes.

Provide a certified nuclear gauge operator when nuclear density control is being utilized.

All certifications shall be in accordance with the Department's current asphalt technician certification program.

## **5.2 Field Laboratory Requirements:**

The Contractor shall furnish and maintain a Department certified laboratory for quality control testing of the hot in-place recycled mix. The laboratory shall be located either at or near the project site. In either case, all other requirements of these specifications shall apply. The laboratory may be either stationary or portable and shall include all necessary equipment and supplies for performing required Contractor quality control testing. The Contractor shall also furnish a certified laboratory for the quality control testing of the hot mix asphalt admixture. This laboratory may be located at the plant site or may be the laboratory provided at the project site for testing of the hot in-place recycled mix. Convenient telephone and fax machine access for QMS personnel shall be provided by the Contractor at the plant laboratory site producing the admixture and the laboratory site testing the completed mix from the roadway.

## **5.3 Field Laboratory Equipment:**

The laboratory testing equipment shall meet the requirements of the test methods herein identified in Section 5.4 - "Required Sampling and Testing."

Laboratory equipment furnished by the Contractor or his representative shall be properly calibrated and maintained. The Engineer shall be allowed to inspect measuring and testing devices to confirm both calibration and condition. If at any time the Engineer determines that the equipment is not operating properly or is not within the limits of dimensions or calibration described in the applicable test method, the Engineer may stop production until corrective action is taken. The Contractor shall maintain a record of calibration results at the laboratory.

## **5.4 Required Sampling and Testing (Mixtures):**

All mix sampling, testing, data analysis and data posting shall be performed or directly supervised by a certified HIP QMS Asphalt Plant Technician.

The Contractor's quality control process shall include, at a minimum but not limited to, the sampling and testing of all parameters outlined in these provisions using test methods and frequencies as specified herein. The Contractor shall obtain randomly selected samples of hot in-place recycled mix prior to the laydown and compaction processes. A minimum of one random mix sample of 180 pounds shall be taken from each 5000 linear foot test section. The Contractor shall also obtain a minimum of one randomly selected 25 pound sample of the hot mix asphalt admixture, when required, from each 200 ton increment of admixture production. The admixture samples shall be taken from the truck at either the plant site or project site. The random samples

shall be obtained and at location(s) determined in accordance with procedures specified in AASHTO T 168. All samples shall be split in accordance with the procedures in the most current edition of the Department's "HMA/QMS Manual" and shall be logged on forms provided by the Engineer. All samples taken shall be split and retained in accordance with these procedures.

The untested split portion of the hot in-place recycled mix sample and hot mix asphalt admixture sample shall be retained for 5 calendar days at the appropriate laboratory site by the Contractor commencing the day the samples are tested. The QC SUPERPAVE Gyratory Compactor (SGC) specimens shall be retained for 2 calendar days commencing the day the specimens are prepared. Disposal permission may be given by Quality Assurance personnel prior to these maximum storage periods. The split portion of the Contractor's mix verification sample shall be retained until disposal permission is given by QA personnel. All retained samples shall be stored in a dry and protected location.

The Contractor shall maintain minimum test frequencies as established above. All tests shall be completed within 24 hours of the time the sample was taken, unless specified otherwise in these provisions. Should the specified tests not be completed within the required time frame, production will cease at that point until such time the tests are completed.

The Contractor may utilize innovative equipment or techniques not addressed by these specifications to produce and/or monitor the production of the mix, subject to approval by the Engineer.

Should the Contractor's testing frequency for hot in-place recycled mix fail to meet the minimum frequency requirement, all mix without the specified test representation shall be considered unsatisfactory. If the Engineer allows the mix to remain in place, payment will be made at 50 percent of the contract unit bid price for the hot in-place recycling.

Should the Contractor's testing frequency for the hot mix asphalt admixture fail to meet the minimum requirements, all admixture without test representation shall be considered unsatisfactory, and will be paid for at 50 percent of the contract unit bid price for the admixture.

### **QUALITY CONTROL SAMPLING AND TESTING SCHEDULE (MIXTURES)**

#### **A. Hot In-Place Recycled Mix:**

1. Blended aggregate recovered from hot in-place recycled mix sample (AASHTO T-30 and T-11) (Shall be graded on all sieves specified on the job mix formula.)
2. Binder Content, % (Contractor may select any option below)
  - a. Extraction (AASHTO T-164)
  - b. Ignition Furnace (AASHTO T 308 Modified)
  - c. OTHER: Contractor may request to use other means of checking Binder Content subject to approval by the Engineer.
3. Maximum Specific Gravity (AASHTO T 209)
4. Bulk Specific Gravity of Compacted Specimens (AASHTO T 166, Average of 3 specimens at  $N_{des}$  gyrations (AASHTO PP 28 and AASHTO TP 4))
5. Air Voids (VTM), Average of 3 specimens at  $N_{des}$  gyrations
6. Voids in Mineral Aggregate (VMA) (calculation)



7. Voids Filled with Asphalt (VFA) (calculation)
  8.  $P_{0.075}/P_{be}$  Ratio
  9. % Maximum Specific Gravity at  $N_{ini}$  (calculation)
- B. Hot Mix Asphalt Admixture (if required):
1. Binder Content, % (Contractor may select any option below)
    - a. Extraction (AASHTO T-164)
    - b. Ignition Furnace (AASHTO T 308 Modified)
    - c. OTHER: Contractor may request to use other means of checking AC Content subject to approval by the Engineer
  2. Blended aggregate recovered from admixture sample (AASHTO T-30 and T-11) (Shall be graded on all sieves specified on the job mix formula.)

In addition to the above sampling and testing program, the following test shall be conducted as indicated:

Penetration Test (AASHTO T 49) from Abson Recovery (AASHTO T 170).  
Test performed on hot in-place mix sampled from roadway during field verification and at a minimum of weekly thereafter; however, penetration results are not required for approval of the field verification. Recovery and Penetration Test may be performed at an off-site laboratory. Results must be furnished to the Engineer within 3 working days of obtaining the sample.

### **5.5 Documentation (Records):**

The Contractor shall document all observations, records of inspection, samples taken, adjustments to the mix, and test results on a daily basis. Results of observations and records of inspection shall be noted as they occur in a permanent field record. Adjustment to mix production and test results shall be recorded on forms provided by the Engineer.

All such records shall be made available to the Engineer, upon request, at any time during project construction. All QC records and forms shall be completed and distributed in accordance with the most current edition of the Department's "HMA/QMS Manual". At the completion of the project, a copy of the control charts (with the moving average shown in red) shall be provided to the Engineer in a neat and orderly manner. The QC testing forms shall be maintained by the Contractor for 1 year after completion of the form.

Failure to maintain QC records and forms as required, or to provide these records and forms to the Engineer upon request, may result in production stoppage until the problem is resolved.

Falsification of test results, documentation of observations, records of inspection, adjustments to the process, discarding of samples and/or test results, or any other deliberate misrepresentation of the facts will result in the revocation of the applicable person's QMS certification. The Engineer will determine acceptability of the mix and/or pavement represented by the falsified results or documentation. If the mix and/or pavement in question is determined to be acceptable, the Engineer may allow the mix to remain in place at no pay for mix processing, admixture, asphalt binder, rejuvenating agent and/or other mix components. If the mix and/or pavement represented by the falsified results are determined not to be acceptable, reprocess or remove and replace with

mix which complies with the Specifications as approved by the Engineer. Payment will be made for the actual quantities of materials required to reprocess or replace the falsified quantities, not to exceed the original amounts.

### 5.6 Documentation (Control Charts):

Standardized control charts furnished by the Department shall be maintained by the Contractor at the appropriate field laboratory. All test results obtained by the Contractor shall be recorded on control charts the same day tests are conducted.

Results of quality assurance tests performed by the Engineer will be posted on the Contractor's control charts as data becomes available.

The following data shall be recorded on standardized control charts:

Hot In-Place Recycled Mix:

1. Aggregate Gradation Test Results:
  - a. For each mix type: one sieve size smaller than the mix nominal maximum size.
  - b. For all mix types: 2.36 mm and 0.075 mm sieves
2. Binder Content, %,  $P_b$
3. Bulk Specific Gravity of Compacted Specimens at  $N_{des}$  (measured)
4. Maximum Specific Gravity Determined by AASHTO T 209
5. Percent Voids in Total Mix at  $N_{des}$  Gyrations
6. Percent Voids in Mineral Aggregate at  $N_{des}$  Gyrations

Hot Mix Asphalt Admixture, if required:

1. Binder Content, %,  $P_b$
2. 0.075 mm sieve

Both the individual test value and the moving average of the last four (4) data points will be plotted on each chart. The Contractor's test data will be shown in black and the moving average in red. The Engineer's assurance data will be plotted in blue. The warning control limits shall be drawn with a dash green line, the JMF control limits with a dash blue line, and individual test limits with a dash red line.

Once a moving average has been established for a given JMF, the moving average shall be continuous with the following exceptions. A new moving average shall be re-established when a change in the asphalt cement percentage or aggregate blend is made in the JMF or when the Contractor elects or is required to stop production after one or two moving average values, respectively, fall outside the warning limits as outlined in Section 5.9. In addition, if the Contractor fails to stop production after two consecutive moving averages exceed the warning limits, but does stop production at a subsequent time, a new moving average shall be re-established beginning at the actual production stop point. The moving averages for all other mix properties shall also be re-established. Moving averages will not be re-established when

production stoppage occurs due to an individual test result exceeding the Specification requirements.

All individual test results shall be part of the quality control record and shall be included in moving average calculations with the following exception. When the Contractor’s testing data has been proven incorrect, the correct data as determined by the Engineer shall be used in lieu of the Contractor’s data to determine acceptance of the mix in question. In this case, only the data in question shall be replaced.

**5.7 Control Limits:**

The following shall be considered control limits for mix production. For each criteria, the warning and moving average control limits are based on a moving average of the last four (4) data points. All control limits will be applied to target data given on the current JMF except VMA limits. VMA control limits will be based against the minimum specification requirement for that mix type.

Hot In-Place Recycled Mix (Control Criteria)	Warning	Control Limits	
		Moving Average	Individual Test
2.36 mm Sieve	± 4.0	± 5.0	± 8.0
0.075 mm Sieve	± 1.5	± 2.0	± 2.5
Binder Content, %	± 0.3	± 0.5	± 0.7
Air Voids(VTM)% @ N <sub>des</sub>	± 1.0	± 1.5	± 2.0
VMA, %@ N <sub>des</sub>	- 0.5	-0.8	- 1.0

Hot Mix Asphalt Admixture, if required:

Binder Content, %	± 0.3	± 0.5	± 0.7
0.075 mm sieve	± 1.5	± 2.0	± 2.5

**5.8 Warning Bands:**

Warning bands are defined as the area between the Warning limits and Moving Average Limits.

**5.9 Corrective Action:**

All required corrective actions are based upon initial test results and should be taken immediately upon obtaining those results.

When an individual test result for a mix control criteria exceeds both the individual test control limits and the applicable specification mix design limits, production of that mix shall cease immediately. Normal production of the mix in question shall not resume until approval is given by the Engineer.

Acceptance of all mix failing to meet the individual test control limits as described above will be determined in accordance with Article 105-3. In addition, any mix that is obviously unacceptable will be rejected for use in the work.

Failure to stop production and make adjustments when required due to an individual test not meeting the specified requirements shall subject all mix from the stop point tonnage to the point when the next individual test is back on or within the warning limits, or to the tonnage point when production is actually stopped, whichever occurs first, to be considered unacceptable. This material shall be remilled and reprocessed to comply with the specifications, unless otherwise approved by the Engineer.

If two consecutive moving average values for any one of the mix control criteria fall outside the warning limits, the Contractor shall cease production of that mix and make adjustments. The Contractor may elect to stop production after only one moving average value falls outside the warning limits. In either case, a new moving average shall not be determined until the fourth test after the elective or mandatory stop in production. Normal production of the mix in question shall not be resumed until approved by the Engineer.

If the process adjustment improves the property in question such that the moving average after four additional tests is on or within the warning limits, the Contractor may continue production with no reduction in payment.

If the adjustment does not improve the property in question such that the moving average after four additional tests is not on or within the warning limits, the applicable mix shall be accepted in accordance with Article 105-3. The quantity of mix in question will be determined by the Engineer. Any mix which is obviously unacceptable will be rejected for use in the work.

Failure to stop production and make adjustments as described above due to two consecutive moving average values falling outside the warning limits shall subject all mix produced from the stop point tonnage to the tonnage point when the moving average is back on or within the warning limits, or to the tonnage point when production is actually stopped, whichever occurs first, to be considered unacceptable. This material shall be remilled and reprocessed to comply with the specifications, unless otherwise approved by the Engineer.

#### **5.10 Allowable Retesting for Mix Deficiencies:**

The Contractor may elect to resample and retest for hot in-place recycled mix deficiencies when individual QC test(s) exceed one or more of the mix property target(s) by more than the tolerances indicated below. The retesting shall be performed within 10 days of the initial test results. Retesting shall be approved by the Engineer prior to being performed and shall be in accordance with the Department's "Guidelines For Retests Of Plant Mix Deficiencies" as outlined in the HMA/QMS Manual except will based on equivalent linear feet in lieu of tonnage . Retests for any mix deficiency other than as listed below will not be allowed unless otherwise permitted by the Engineer. Acceptance of the mix in question will be based on the retest data in accordance with Article 105-3. The Department reserves the right to direct the Contractor to resample and retest at any time or location as directed by the Engineer.

Air Voids (VTM)	-- by more than +/- 2.5%
Binder Content	-- by more than +/- 1.0%
VMA	-- by more than - 2.0%
0.075 mm sieve	-- by more than +/- 3.0%
2.36 mm sieve	-- exceeds Specification Mix Design Limits and one or more of the above tolerances are also exceeded.

**6.0 QUALITY ASSURANCE OF MIX:**

Quality assurance will be accomplished in the following ways:

1. By conducting assurance testing of split samples obtained by the Contractor at a frequency equal to or greater than 10% of the frequency required of the Contractor;
2. By periodically observing tests performed by the Contractor;
3. By monitoring required control charts exhibiting test results of control parameters;
4. By directing the Contractor to take additional samples at any time and any location during production (in lieu of the next scheduled random sample) and;
5. By conducting verification sampling and testing on samples taken independently of the Contractor's quality control samples at a frequency equal to or greater than 5% of the required QC sample frequency; and
6. By any combination of the above

In all cases, the Engineer's quality assurance and verification testing will be independent of the Contractor's tests. The Department's quality assurance program will be conducted by a certified QMS technician(s).

The Engineer will conduct assurance tests on split samples taken by the Contractor for quality control testing. These samples may be the regular quality control samples or a sample selected by the Engineer from any location in the process. The frequency will be equal to or greater than 10% of that required of the Contractor as stated in Section 5.4 - "Required Sampling and Testing". The Engineer may select any or all split samples for assurance testing. Results of quality assurance tests will be provided to the Contractor within 3 working days after the sample has been obtained. Differences between the Contractor's and the Department's split sample test results will be considered acceptable if within the following limits:

Test Parameter	Acceptable Limits of Precision
12.5 mm Sieve	±6.0
9.5 mm Sieve	±5.0
4.75 mm Sieve	±5.0
2.36 mm Sieve	±5.0
0.075 mm Sieve	±2.0
Binder Content, %	±0.5
Maximum Specific Gravity Mix, $G_{mm}$	±0.020
SGC Bulk Specific Gravity, $G_{mb}$	±0.030

In the event comparison test results are outside the above acceptable limits of precision, or the quality assurance test results are either outside the individual test control limits or fail to meet Specification requirements, the Engineer will immediately investigate the reason for the difference. If the potential for a pavement failure is present, the Engineer may suspend production, wholly or in part, in accordance with Article 108-7 while the investigation is in progress. The Engineer's investigation may include joint testing of any remaining split samples, review and observation of the Contractor technician's sampling and testing procedures and equipment, and a comparison of split sample test results on mix currently being produced. If reasons for the difference cannot be determined, payment for the mix in question will be determined in accordance with Article 105-3.

The Engineer will periodically witness the sampling and testing being performed by the Contractor. If the Engineer observes that the sampling and quality control tests are not being performed in accordance with the applicable test procedures, the Engineer may stop production until corrective action is taken. The Engineer will promptly notify the Contractor of observed deficiencies, both verbally and in writing. The Engineer will document all witnessed samples and tests.

The Engineer will elect to obtain verification samples for testing independent of the Contractor's quality control process. These samples will be split for testing by the Engineer and the Contractor.

#### **7.0 ACCEPTANCE of MIX:**

The Engineer will base final acceptance of the mix on the results of random testing made on split samples during the assurance process and validation of the Contractor's quality control process as outlined in Sections 5.9 and 6.0.

#### **8.0 MILLING DEPTH QUALITY MANAGEMENT:**

##### **8.1 Quality Control of Milling Depth:**

The Contractor shall perform quality control of the milling process in accordance with applicable provisions of Section 607 of the Standard Specifications, except as modified herein.

The minimum frequency of checking the milling depth shall be at least one set of measurements for each 500 feet of milled pavement length. These measurements shall be taken by either stretching a stringline transversely across the milled area or by extending a straightedge from the existing pavement transversely over the milled area and taking measurements at the approximate quarter points of the milled pavement. When the average depth of milling is less than the depth specified on the plans by more than  $\frac{1}{4}$  inch, corrective action shall be initiated. When two consecutive averages from the above sets of measurements exceed the tolerance specified, work shall be stopped until the process can be corrected.

A permanent field record of these milled depths shall be maintained by the Contractor and made available to the Engineer anytime upon request and upon completion of the project.

**8.2 Quality Assurance of Milling Depth:**

The Departments quality assurance program for milling depth will consist of the following:

1. By re-measuring randomly selected quality control measurements at a frequency equal to or greater than 10% of the frequency required of the Contractor;
2. By periodically observing measurements performed by the Contractor; and
3. By conducting verification measurements independently of the Contractor's quality control measurements at a frequency equal to or greater than 5% of the required QC sample frequency;

**8.3 Quality Acceptance of Milling Depth:**

The Department will evaluate the finished asphalt pavement for milling depth compliance using the Contractor's milling depth quality control test results, the Department's quality assurance test results, and by observation of the Contractor's depth quality control process as outlined in Subarticle 8.1 and Subarticle 8.2. Any pavement found to be deficient in milled depth shall be evaluated for acceptance in accordance with Article 105-3 of the Standard Specifications.

**9.0 FIELD COMPACTION QUALITY MANAGEMENT:****9.1 Contractor Quality Control of Density:**

The Contractor shall perform quality control of the compaction process in accordance with applicable provisions of Article 609-5(D) of the Standard Specifications, except as modified herein. The Contractor may elect to use either cored sample density procedures or nuclear gauge density procedures. The method of density quality control shall be provided to the Engineer by the Contractor at the preconstruction conference.

The minimum frequency of sampling and testing by either method shall be based on test sections consisting of not more than 2000 linear feet of laydown width.

Nuclear density control procedures shall be in accordance with the Department's most current Nuclear Gauge Operator's Manual. This manual may be obtained through the Department's M&T Soils Section. Density shall be determined by the backscatter method of testing using a thin-lift nuclear gauge, with printer, which has been approved by the Department. The Contractor shall furnish, maintain, and operate the nuclear gauge. The gauge operator shall have been certified by the Department. The gauge shall have been calibrated within the previous 12 months by an approved calibration service. The Contractor shall maintain documentation of such calibration service for a 12 month period.

The Contractor shall establish acceptable control strips at locations approved by the Engineer. Control strip shall be 300 feet in length at the laydown width of the paver. Nuclear density control strips shall be placed at the frequencies specified in the Department's most current Nuclear Gauge Operators Manual. Core sample control strips shall be placed anytime the Contractor is proceeding on limited production due to failing densities. In addition, control strips shall be placed anytime deemed necessary by the Engineer.

When cored sample control is being utilized the testing frequency shall consist of a minimum of one random 6 inch (152 millimeters) core sample taken from each test section, except that not less than three cored samples shall be taken from each mix type and/or lot placed on a given day. The Contractor may elect to take full depth cores instead of placing a separator beneath the layer to be tested. Should full depth cores be taken, he is responsible to separate the layer of mix to be tested in a manner such that it is not damaged.

When cored sample control is being utilized and a core sample appears not to be representative in comparison with other cores from the same lot and is more than 2.0 percent below the average of all core samples from the same lot, check samples may be taken by the Contractor. For each core sample that is in question, there shall be three check samples taken: one adjacent to the initial sample and one ten feet to each side, longitudinally, of the initial sample. The results of these 3 check samples will be averaged and this average will be used instead of the initial core results in question. The initial core sample results will not be used if check samples are taken. Check samples must be taken within 2 calendar days of the date of the initial sample. Only one set of check samples per sample location will be allowed. If full depth cores are necessary at these check sample locations, separation of the layer to be tested will be the responsibility of the Contractor. All check samples shall be taken in the presence of a representative of the Engineer. In addition, a QA comparison core sample(s) may be taken adjacent to one or more of these check samples.

When nuclear gauge control is being utilized, the testing frequency shall consist of five random gauge readings ( one from each of five equally spaced increments) from each test section.

The Contractor shall maintain minimum test frequencies as established above. Should the Contractor's density testing frequency fail to meet the minimum frequency as specified above, all mix without required density test representation shall be considered unsatisfactory and if allowed to remain in place, will be paid for at 50 percent of the contract unit bid price for the mixture.

All QC nuclear density tests shall be conducted the same day that the mix being tested was placed and compacted. All core samples shall be cored no later than the beginning of the next production day, not to exceed three (3) calendar days. QC core samples shall be tested and test results submitted to the Engineer within one working day of the time the samples were taken. Should the specified density tests not be completed within the applicable time frame, production will cease at that point until such time the required tests are completed.

The Contractor's quality control density core samples shall be retained for 5 calendar days, commencing the day the samples are tested, at the laboratory located on or near the project, or until disposal permission is granted by the Quality Assurance personnel, whichever occurs first. The Department's comparison quality assurance core samples shall be retained in a sealed container at the above laboratory site until obtained by quality assurance personnel. All retained density samples shall be stored on a smooth, flat surface in a cool, dry protected location.

Proceed on limited production when three failing density lots occur, not to exceed two production days or two consecutive failing nuclear control strips occur for the same mix type.



Limited production is defined as the production, placement, and compaction of a sufficient quantity of hot in-place recycled mix to construct a 300 feet control strip plus 100 feet of pavement adjacent to each end of the control strip. The Contractor shall remain on limited production until such time as satisfactory density results are attained or two control strips have been attempted without achieving acceptable density test results, whichever occurs first.

If the Contractor fails to achieve satisfactory density at this point, production of the asphalt mix shall cease until the cause of the failing density test results can be determined. Should the Contractor not operate by the limited production procedures as specified above, the two consecutive failing production days and all mix produced thereafter will be considered unacceptable. This material shall be reprocessed or removed and replaced with material that complies with the Specifications, unless otherwise approved by the Engineer.

**9.2 Quality Assurance of Density:**

The Departments quality assurance program for density will consist of the following:

1. By retesting randomly selected quality control test sections (either cores or nuclear);
2. By periodically observing tests performed by the Contractor;
3. By testing randomly selected comparison core samples taken adjacent to the Contractor’s quality control core samples (8” (200 mm) center-to-center) at a frequency equal to or greater than 10% of the frequency required of the Contractor;
4. By conducting verification sampling and testing on test sections (either core or nuclear) independently of the Contractor’s quality control test sections at a frequency equal to or greater than 5% of the required QC sample frequency;

Comparison and verification core samples will be taken in the presence of a DOT technician, and either delivered directly to the appropriate QA Lab by a DOT technician or placed in a sealed container and delivered to the Contractor’s QC Lab for QA testing.

Results of all density quality assurance tests will be provided to the Contractor within 3 working days after the samples have been obtained by the QA personnel.

Differences between the Contractor's quality control and the Department's quality assurance test results will be considered acceptable if within the following limits.

Test	Acceptable Limits of Precision
Retest of QC Core Sample	±1.2% (% Compaction)
Comparison QA Core Sample	±2.0% (% Compaction)
QA Verification Core Sample	±2.0% (% Compaction)
Nuclear Comparison of QC Test Section (Average of 5 Tests in Test Section)	±2.0 %(% Compaction)
QA Nuclear Verification Test	±2.0% (% Compaction)

In the event test results are outside the above acceptable limits of precision or the quality assurance test results are below the minimum specification requirements, the Engineer will immediately investigate the reason for the difference. If the potential for a pavement failure is present, the Engineer may suspend production, wholly or in part, as stated in Article 108-7 of the Standard Specifications while the investigation is in progress. The Engineer's investigation may include checking of the Contractor's testing equipment, comparison testing of other retained quality control samples, or additional core sample testing of the roadway pavement in question. If additional core samples are necessary to resolve the difference, the Contractor shall core these samples at the direction of the Engineer and these will be tested jointly by the Contractor's quality control and Department's quality assurance personnel. If the reason for the difference cannot be determined, payment for the mix in question will be determined in accordance with Article 105-3 of the Standard Specifications. If the reason for the difference is determined to be an error or other discrepancy in the quality control test results, the applicable quality assurance test results will be used to determine compliance with the Specification density requirements.

### **9.3 Acceptance of Density:**

The Department will evaluate the asphalt pavement for density compliance after the asphalt mix has been placed and compacted using the Contractor's quality control test results, the Department's quality assurance test results, and by observation of the Contractor's density quality control process. Minimum density requirements will be as specified for each mix type in the project special provision titled Hot In-Place Recycled Asphalt Concrete. Density compliance for nuclear gauge control will be as provided in the Department's Nuclear Gauge Operator's Manual. Density compliance for core samples will be determined by use of the average Marshall lab specific gravity until a moving average of four lab specific gravities is attained. Once a moving average is established for the lab specific gravity, the last moving average in effect at the end of the same day's production will then be used to determine density compliance.

The pavement will be accepted for density on a lot by lot basis. A lot will consist of one (1) day's production of a given mix type on the project except that individual map sections will be evaluated as separate lots, unless otherwise approved by the Engineer. The Engineer will determine the final quantity of each lot.

A failing lot for density purposes is defined as a lot for which the average of all test sections fails to meet the minimum specification requirement. In addition, any lot or portion of a lot that is obviously unacceptable will be rejected for use in the work.

Acceptance of all failing lots will be made under the provisions of Article 105-3 of the Standard Specifications.

Any reduction in pay due to failing densities will be in addition to any reduction in pay due to failing mix property test results on the same mix.

**10.0 COMPENSATION:**

The production and construction of all hot in-place recycled asphalt mixtures and pavements shall be performed in accordance with these provisions. There will be no direct payment for the quality control work required herein. Payment at the contract unit prices for the various asphalt related items will be full compensation for all work covered by this provision.

**ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES: 1-01-02<sub>R</sub>**

The approximate asphalt binder content of the asphalt concrete plant mixtures used on this project will be as follows:

Asphalt Concrete Base Course, Type B 25.0_	4.3%
Asphalt Concrete Intermediate Course, Type I 19.0_	4.7%
Asphalt Concrete Surface Course, Type S 4.75A	7.0%
Asphalt Concrete Surface Course, Type SF 9.5A	6.5%
Asphalt Concrete Surface Course, Type S 9.5_	6.0%
Asphalt Concrete Surface Course, Type S 12.5_	5.5%

The actual asphalt binder content will be established during construction by the Engineer within the limits established in the Standard Specifications or Project Special Provisions.

RR43

**ASPHALT CONCRETE SURFACE COURSE COMPACTION: 7-1-95**

Compact the asphalt surface course on this project in accordance with Subarticle 610-9 of the Standard Specifications and the following provision:

Perform the first rolling with a steel wheel roller followed by rolling with a self-propelled pneumatic tired roller with the final rolling by a steel wheel roller.

RR49

**AGGREGATE PRODUCTION: 11-20-01**

Provide aggregate from a producer who utilizes the new Aggregate Quality Control/Quality Assurance Program which is in effect at the time of shipment.

No price adjustment is allowed to contractors or producers who utilize the new program. Participation in the new program does not relieve the producer of the responsibility of complying with all requirements of the Standard Specifications. Copies of this procedure are available upon request from the Materials and Test Unit.

RR109

**DRUMS:**

**07-16-02**

Revise the 2002 Standard Specifications as follows:

Page 10-195, Subarticle 1089-5(C)

Delete the first (1<sup>st</sup>) sentence of the first (1<sup>st</sup>) paragraph and insert the following:

“Provide a minimum of three orange and two white alternating horizontal circumferential stripes covering the entire outside with each drum.”

RR116

**PORTABLE CONCRETE BARRIER:**

**11-19-02<sub>c</sub>**

Portable Concrete Barrier used on this project shall meet one of the following:

- NC Approved NCHRP 350 Portable Concrete Barrier (design can be found at <http://www.doh.dot.state.nc.us/construction/wztc/> or can be obtained by calling the Traffic Control Unit at (919) 250-4159)
- Other NCHRP 350 Portable Concrete Barrier as approved by the Engineer and the Traffic Control Section
- NC Approved NCHRP 230 Portable Concrete Barrier in Roadway Standard Drawing 1170.01 manufactured before October 1, 2002

RR117

**REMOVAL OF EXISTING PAVEMENT MARKERS:**

**7-1-95**

The Contractor's attention is directed to the fact that there are pavement markers on this project.

Remove and dispose of these markers prior to the paving operation.

No direct payment will be made for this work, as it will be incidental to the paving operation and payment at the contract unit price for the various asphalt items in the contract will be full compensation for such work.

RR118

**PAVEMENT MARKING GENERAL REQUIREMENTS:**

**07-16-02<sub>c</sub>**

Revise the 2002 Standard Specifications as follows:

Page 12-10, Subarticle 1205-3(J)

Delete the 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph and insert the following:

Have at least one member of every pavement marking crew working on a project certified through the NCDOT Pavement Marking Technician Certification Process. For more information contact the Traffic Control, Marking and Delineation Section of the North Carolina Department of Transportation at 919-250-4151 or <http://www.doh.dot.state.nc.us/construction/wztc/>

RR119

WBS#: 38737.3.1 (I-4726)  
Date: 04-03-2006  
Revised:

**THERMOPLASTIC MATERIAL- HOT SPRAY**

***Hot Spray Thermoplastic Material***

March 21, 2006

Revise the 2002 Standard Specifications as follows:

Page 12-1, 1205-1 **DESCRIPTION:**

Replace the first sentence with the following:

*This special provision covers machine applied hot spray thermoplastic pavement marking material with drop-on glass beads.*

Page 12-1, 1205-2 **MATERIALS**

Delete section (A) General

Replace section (B) Material Qualifications with the following:

*All hot spray thermoplastic manufacturers must be prequalified. In order to be prequalified, all hot spray Thermoplastic Pavement Marking manufacturers must have their material installed on the NTPEP test deck.*

**1205-3 CONSTRUCTION METHODS**

Page 12-3, 1205-3(B)(5) **Thermoplastic Application Equipment**

Replace the last paragraph with the following:

*Use application equipment that provides multiple width settings ranging from 4" to 12" and multiple thickness settings to achieve a 40 mil thickness in one pass.*

*Hand-liners shall not be allowed.*

Page 12-7, 1205-3 (G) (5) **Thermoplastic Application**

Delete the 1<sup>st</sup> paragraph and replace with the following:

*All thermoplastic markings shall be of the hot, machine applied type. Application shall be accomplished by spraying methods only.*

Delete the 5<sup>th</sup> paragraph.

Delete the 6<sup>th</sup> paragraph and replace with the following:

*Produce a crosssectional thickness of hot spray thermoplastic markings on the rumble strips with a minimum thickness of 40 mils without glass beads and/or a minimum thickness of 55 mils with glass beads as shown in the drawings.*

Add the following paragraph:

*The Manufacturer of that material shall certify the Contractor to place the material. The Contractor shall furnish the Engineer written confirmation of this training from the material manufacturer prior to the beginning of work.*

Page 12-11, 1205-6 **BASIS OF PAYMENT**

Section 1205-6 Description: Delete and replace with the following:

The quantity of pavement marking lines, measured as provided in Article 1205-5, will be paid for at the contract unit price per linear foot for "Type Pavement Marking Lines, (width)", \_\_\_mils".

Such prices and payment will be full compensation for all work covered by this section including but not limited to furnishing, installing, and removing pavement markings during the life of the project.

Payment will be made under:

\_\_\_\_\_ Pavement Marking Lines (6", 40 mils).....Linear Foot