# 600 - OVERLAND PARK SUPERPAVE ASPHALTIC CONCRETE SURFACE AND INTERMEDIATE COURSE

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12/13/2019

## 600.1 DESCRIPTION

The **2015 Standard Specifications for State Road and Bridge Construction**, Sections 109, 601, 611 (Class A), 1201, 1202, and 1203 shall govern the asphaltic concrete work except as otherwise modified herein. All testing required by this specification including mix design and field verification of the mix shall be the responsibility of the Contractor. The mix design shall be modified or redesigned whenever a material source changes or a quarry starts producing from a different geological unit or a major change is made to the asphalt plant. This work shall be subsidiary to other bid items.

## 600.2 MATERIALS

### a. Asphalt Cement

Asphalt cement shall conform to the requirements of AASHTO-MP 1a-04[1, 2] Performance Graded Asphalt Binder PG 64-22. The grade of the asphaltic binder shall not be changed without a laboratory remix design. It shall also comply with Sections 1201 and 1202. Each shipment of asphalt to the asphalt plant shall have a bill of lading stating the asphalt cement meets the specifications referenced above. Copies of the bill of lading shall be submitted to the City Engineer.

### b. Anti-Stripping Agent

All bituminous mixtures shall contain an anti-stripping agent. AD-here® LOF 65-00 LS as - manufactured by ARR-MAZ Products, L.P. shall be added to the asphalt cement at the rate of 0.75% by weight of the total added asphalt cement. Other asphalt anti-stripping additives and their application rate may be used when proven equal after testing as specified in Paragraph "Resistance of Compacted Bituminous Mixture to Moisture Induced Damage AASHTO T 283-03" and approved by the City Engineer. Copies of the bill of lading shall be submitted to the City Engineer**.**

### c. Fractionated Reclaimed Asphalt Pavement (FRAP)

The contractor may use Fractionated Reclaimed Asphalt Pavement (FRAP) as an aggregate source. FRAP is defined as having two or more stockpiles, where Reclaimed Asphalt Pavement (RAP) is processed into coarse and fine fractions. The fine FRAP stockpile shall contain only material passing the ¼ inch screen. The coarse FRAP stockpile shall contain milled material retained on the ¼ inch screen and passing the ¾ inch screen.

The maximum combined percentage of FRAP is 35% of the total mix by weight. FRAP may be comprised of coarse or fine FRAP or a combination thereof. Utilize a separate cold feed bin for each stockpile of FRAP used. Do not blend course and fine FRAP either in the stockpile or in a cold feed bin. Add FRAP to the mix through the RAP collar. Sources and types of FRAP shall be recorded and submitted to the City Engineer upon request. **Recycled Asphalt Shingles (RAS) or RAP that contains RAS is not allowed.**

The FRAP used in production shall be similar in composition (extracted gradation and asphalt content) to the source used for design.

FRAP stockpiles shall be prequalified in accordance to the paragraph entitled "Aggregates General" and in the procedures described below

(1) Sampling

The following steps can be used to obtain representative samples from a FRAP stockpile:

a) Use a front-end loader to dig into the FRAP stockpile.
b) Empty the front-end loader onto a clean, flat surface to form a miniature stockpile.
c) Use the bucket of the front-end loader to level the surface of the miniature stockpile.
d) Use a square-ended shovel to dig into the level surface of the miniature stockpile.
e) Sample from three locations within the mini-stockpile.
f) Combine the samples from the three locations to provide a representative sample from the FRAP stockpile location.

g) Repeat the above steps to obtain the appropriate number of samples.

A minimum of ten samples shall be obtained from around the FRAP stockpile. Sample locations should be selected to provide a representative sample of the entire FRAP stockpile. The ten locations should encompass all sides of the stockpile.

(2) Testing

Testing of the FRAP shall include the asphalt content and gradation of the FRAP samples. Asphalt content shall be determined utilizing both an ignition oven in accordance with ASTM D6307 and by solvent extraction in accordance with AASHTO T-164. When using the ignition oven, no aggregate or asphalt correction factor is needed for the FRAP stockpile materials. The gradation shall be determined using the aggregates remaining after ignition or extraction testing in accordance with ASTM C117 and C136. Half of the ten samples (5) shall be tested using ignition, the remaining half (5) using extraction. The average difference of the two test methods will be an asphalt content correction constant that will be added or subtracted from the FRAP asphalt content determined by ignition during asphalt production and for the remaining prequalification tests. The aggregates from the ten gradation tests should not be thrown away in case further analysis is required, as described below.

(3) Requirements for Prequalification of RAP Stockpiles

Evaluation of the data will entail determining the average and standard deviation for the different test properties. Averages determined from testing of the ten locations should be used during the development of the job-mix-formula for the project. Target values for evaluation of uniformity are provided for three specific properties, including asphalt content, the percent passing the median sieve size, and the percent passing the No. 200 sieve. The median sieve size is the sieve with the percent passing closest to 50 percent. Table 1 provides the target standard deviations for these three properties. Test Properties from a uniform FRAP stockpile will have standard deviations at or below the target standard deviations. Table 1 also provides maximum allowable standard deviations.

**Table 1: Target and Maximum Allowable Standard Deviations**

| RAP Property | Target Std. Deviation (%) | Max. Allowable Std. Deviation (%)[2] |
|---|---|---|
| Asphalt Content, % | Less than 0.5 | 0.75 |
| % Passing Median Sieve[1] | Less than 5.0 | 7.5 |
| % Passing No. 200 Sieve | Less than 1.5 | 2.0 |
| [1] Median Sieve is the sieve closest to having an average of 50% passing<br>[2] Maximum allowable values. | | |

Figure 1 provides an example spreadsheet used for evaluating the data. For this example, the No. 8 sieve is the median sieve because it is the sieve with the percent passing closest to 50 percent. As shown in Figure 1, the asphalt content meets the target standard deviation as the calculated standard deviation is less than 0.5 percent (0.43 percent). The median sieve (No. 8) has a standard deviation slightly above the target of 5.0 percent. However, this standard deviation is not above the maximum allowable standard deviation of 7.5 percent. For the No. 200 sieve, the calculated standard deviation is 0.86 percent which is less than the target standard deviation.

**Figure 1: Example RAP Stockpile Evaluation**

**RAP STOCKPILE ANALYSIS**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Plant:** | Smithville | | | **Material:** | Fine FRAP | | | **Source:** | Multiple Sources | | |
| | Sample | Pb | 3/4 " | 1/2" | 3/8" | No. 4 | No. 8 | No. 16 | No. 30 | No. 50 | No. 100 | No. 200 |
| Ignition | 1 | 5.66 | 100 | 100 | 100 | 76 | 52 | 39 | 30 | 21 | 15 | 12.1 |
| | 2 | 4.97 | 100 | 100 | 100 | 69 | 54 | 31 | 23 | 17 | 12 | 10.0 |
| | 3 | 5.46 | 100 | 100 | 100 | 75 | 41 | 35 | 27 | 19 | 14 | 11.2 |
| | 4 | 5.45 | 100 | 100 | 100 | 73 | 53 | 34 | 26 | 18 | 13 | 10.4 |
| | 5 | 5.42 | 100 | 100 | 100 | 75 | 49 | 35 | 27 | 19 | 13 | 10.6 |
| Extraction | 6 | 4.63 | 100 | 100 | 100 | 74 | 54 | 35 | 27 | 18 | 13 | 10.6 |
| | 7 | 4.60 | 100 | 100 | 100 | 72 | 41 | 30 | 23 | 16 | 11 | 9.0 |
| | 8 | 4.99 | 100 | 100 | 100 | 78 | 46 | 39 | 30 | 20 | 14 | 10.7 |
| | 9 | 4.75 | 100 | 100 | 100 | 74 | 50 | 36 | 27 | 19 | 14 | 11.4 |
| | 10 | 4.47 | 100 | 100 | 100 | 72 | 45 | 32 | 24 | 19 | 12 | 10.0 |
| | Average: | | 100 | 100 | 100 | 74 | 49 | 35 | 26 | 19 | 13 | 10.6 |
| | St. Dev. | 0.43 | 0.00 | 0.00 | 0.00 | 2.49 | 5.02 | 3.03 | 2.50 | 1.43 | 1.20 | 0.86 |
| Target St. Dev | | 0.5 | | | | | 5.0 | | | | | 1.5 |

| | | | |
|---|---|---|---|
| Average Igintion Pb = | 5.39 | Asphalt Content Correction Constant = | 0.70 |
| Average Extraction Pb = | 4.69 | | |

| | | | | |
|---|---|---|---|---|
| Percent Passing No. 30 (P30) = | 26 | | | |
| Percent Passing No. 8 (P8) = | 49 | Sand Ratio = | 41.7 | ≤60.0% |
| Percent Passing No. 200 (P200) = | 10.6 | | | |
| Percent Passing No. 8 (P8) = | 49 | | | |
| Percent Passing No. 100 (P100) = | 13 | % Sand Fraction = | 7.1 | (Contributed by stockpile) |
| Percent Stockpile in Blend (%RAP) = | 20 | | | |

(4) Fine Aggregate Fraction of the FRAP Stockpile

a) Using the results of the FRAP Stockpile Analysis (Figure 1), calculate the Sand Ratio using the following Equation. If the Sand Ratio is above 60 percent, it suggests a relatively large percentage of natural, uncrushed fine aggregate exists within the RAP stockpile.

$$Sand\ Ratio = \frac{B - D}{C - D} * 100 \ \leq 60.0\%$$

Where,
B = % of Gradation passing the No. 30 Sieve
C = % of Gradation passing the No. 8 Sieve
D = % of Gradation passing the No. 200 Sieve

b) If the Sand Ratio is above 60.0 percent, calculate the percentage of fine aggregate contributed to the total aggregate blend by the fine aggregate fraction of the RAP stockpile as follows:

$$\%\ Sand\ Fraction = (\%P8 - \%P100) * \frac{\%RAP}{100}$$

Where:
% Sand Fraction = % Sand Fraction from FRAP stockpile in Total aggregate blend
%P8 = percent of gradation passing No. 8 sieve
%P100 = percent of gradation passing No. 100 sieve
%RAP = percent of FRAP within the total aggregate blend

c) If the combined % Sand Fraction of all FRAP stockpiles plus the percentage of natural sand within the total aggregate blend is more than 25.0 percent, a Fine Aggregate Angularity test shall be conducted. Using the aggregates remaining from the ten FRAP stockpile evaluation tests, first conduct a specific gravity and absorption test

on the fine aggregate fraction in accordance with ASTM C128. After determining the bulk specific gravity of the fine aggregate fraction of the FRAP aggregates, conduct the Fine Aggregate Angularity (FAA) test on the entire aggregate blend in accordance with Method A of ASTM C1252. The FAA of the combined FRAP and natural sand shall be above 45.0%.

**d. Aggregates General**

The total aggregate (coarse aggregate, fine aggregate, and the material passing the No. 200 sieve) shall contain not less than 85 percent crushed material for intermediate course and surface course. Coarse aggregate shall be tested in accordance with KT-31 and reported on the JMF submittal.

**e. Aggregate for Asphaltic Concrete Surface Course**

The exact gradation shall be determined by the contractor's laboratory.

**Table 2– Gradation for Surface Course**

| Sieve Size | Percent Passing 12.5 mm Nominal Size Control Points | |
|---|---|---|
| 19mm (3/4 inch) | - | 100 |
| 12.5 mm (1/2 inch) | 90 | 100 |
| 9.5 mm (3/8 inch) | 80 | 95 |
| 4.75 mm (No. 4) | - | - |
| 2.36 mm (No. 8) | 36 | 48 |
| 1.18 mm (No. 16) | - | - |
| 600 µm (No. 30) | - | - |
| 300 µm (No. 50) | - | - |
| 150 µm (No. 100) | - | - |
| 75 µm (No. 200) | 2 | 8 |

**Surface mixtures for streets designated thoroughfares by the city shall contain the following:**

Fifteen percent of the minus No. 4 sieve material and 15 percent of the total aggregate shall be chat, crushed sandstone, crushed gravel, crushed steel slag, or crushed porphyry (rhyolite, basalt, granite, and Iron Mountain Trap Rock are examples of crushed porphyry).

**f. Aggregate for Asphalt Concrete Intermediate or Leveling Course**

The exact gradation shall be determined by the contractor's laboratory.

**Table 3 – Gradation for Intermediate or Leveling Course**

| Sieve Size | Percent Passing 12.5 mm Nominal Size Control Points | |
|---|---|---|
| 19 mm (3/4 inch) | - | 100 |
| 12.5 mm (1/2 inch) | 85 | 100 |
| 9.5 mm (3/8 inch) | 75 | 90 |
| 4.75 mm (No. 4) | - | - |
| 2.36 mm (No. 8) | 34 | 44 |
| 1.18 mm (No. 16) | - | - |
| 600 µm (No. 30) | - | - |
| 300 µm (No. 50) | - | - |
| 150 µm (No. 100) | - | - |
| 75 µm (No. 200) | 2 | 8 |

**600.3 SUBMITTALS**

**a. Superpave Asphaltic Concrete Mix Design Method**

The job mix formula (JMF) shall be within the control points shown below. It shall be noted that when the gradation of extracted plant produced mix varies appreciably from JMF, the test properties of the mix will be out of specifications.

The contractor shall submit a complete mix design report annually to the City Engineer, prior to asphalt placement during that calendar year. This report shall contain the calculations as described in the following sections and shall contain material certifications for all materials used in the asphaltic concrete. All aggregate quality tests must have been run within 12 months of the submission date of a mix design or a volumetric test report.

The finished mixture shall meet the requirements described below when prepared in accordance with AASHTO T 312-04 (using 6 inch nominal size molds) and the volumetric properties of compacted paving mixtures as calculated using Chapter 4 of Superpave Mix Design, Superpave Series No. 2 (SP-2), Third Edition 2001 Printing, Published by the Asphalt Institute referred hereafter as "SP-2", unless otherwise specified. The procedure shall be as specified in Chapter 5 and 6 of the SP-2.

The Theoretical Specific Gravity (Gmm) shall be determined following AASHTO T 209-99 (2004) and the Bulk Specific Gravity of the Compacted Asphalt Mixture (Gmb) shall be determined following AASHTO T166-00.

The material for the theoretical specific gravity (Gmm) and the material for the Gyratory Compactor specimens (pucks) shall be cured at 140+/-3º C (285+/-5º F) for four hours in a closed oven after the mix is produced in the laboratory. Also, the plant-produced mixture shall cure for four hours prior to testing. The mixture shall be transported to the laboratory in an insulated container and then stored in a laboratory oven at 140 +/-3° C (285 +/-5° F) minimum temperature for the remainder of the curing period. The curing oven shall be the forced air type and may be operated at a temperature not to exceed the maximum temperature at which the mixture may be discharged from the plant as specified in paragraph "Mixing Plants". This procedure shall be used when the water-absorption as determined by ASTM C 127-04 and ASTM C 128-04a of any individual aggregate stockpile in the aggregate blend exceeds 1.25 percent. The mixture shall be compacted at 140 +/-3° C (285 +/-5° F).

The theoretical specific gravity (Gmm) shall be performed using the Type E-A 4500ml metal vacuum pycnometer with a clear polymethyl methacylate PMMA lid. The vacuum shall be applied for 15 minutes to gradually reduce the residual pressure in the vacuum vessel to 28 mm Hg. The bulk specific gravity of the Fine Sand Chat shall be determined using the standard Cone Test for Surface Moisture as stated in ASTM C-128-04a unless otherwise directed by the City Engineer**.**

The $G_{se}$ of the FRAP material shall be used as aggregate $G_{sb}$ in volumetric calculations provided that the asphaltic cement content of the FRAP fraction is determined through the use of AASHTO T-164 Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot-Mix Asphalt (HMA) (ASTM Designation: D 2172/D 2172M-11). **The AASHTO Specification shall be used when this specification references the AASHTO number.**

The contractor shall furnish four uncompacted HMA samples, sized to the design weight for 1 gyratory plug, four 1200 gram samples of uncompacted HMA, and 2 gyratory plugs compacted to Ndesign when submitting the mix design for approval.

**When the aggregate absorption is high, the produced mixture will be tender until the asphalt is absorbed into the aggregate. Therefore, it may be beneficial to silo the mixture at the plant for a time before delivering to the project site. This is more important when the truck haul is short**.

**Table 4 – Superpave Design and Testing Properties**

| Superpave Design and Testing Properties<br>Required Density (% of Theoretical<br>Maximum Specific Gravity (Gmm)<br>Number of Gyrations (Average of 2-6 inch specimens) | | |
|---|---|---|
| $N_{initial}$ 6 | | 85 - 91% |
| $N_{design}$ 60 | (Mix Design Only) | 96% |
| Percent Air Voids, in compacted mixture<br>0% FRAP | Mix Design Only<br>Field | 4.0%<br>3.0-5.0% |
| Percent Air Voids, in compacted mixture<br>5-25% FRAP | Mix Design Only<br>Field | 3.7%<br>2.8-4.5% |
| Percent Air Voids, in compacted mixture<br>26-35% FRAP | Mix Design Only<br>Field | 3.4%<br>2.6-4.1% |
| VEA%[1] | (0% FRAP)<br>(5-25% FRAP)<br>(26-35% FRAP) | 10.0%<br>10.3%<br>10.6% |
| The ratio of minus 75µm (No. 200) material to % effective asphalt control (Pbe)based on the weight of the aggregate from the extraction test | Mix Design<br>Field (0-25% FRAP)<br>Field (26-35% FRAP) | 0.6-1.2<br>0.6-1.6<br>0.5-1.5 |

[1]*VEA% = Volume of Effective Asphalt (%) which is the numerical difference between VMA and Air Voids.*

**b. FRAP Control Charts**

The Contractor shall maintain Control Charts for the percent passing the median sieve, percent passing the No. 200 sieve, and asphalt binder content for each FRAP stockpile contained within the approved JMF. The Control Charts will use the average value of each of the three properties determined from the prequalification of the FRAP stockpile(s) as the target values.

The Contractor shall maintain Control Charts for the percent passing the median sieve, percent passing the No. 200 sieve, and asphalt binder content for each FRAP stockpile contained within the approved JMF. Asphalt binder will be determined using either of an extracted value or an adjusted ignition value as described above. The Control Charts will use the average value of each of the three properties determined from the prequalification of the FRAP stockpile(s) as the target values. Table 4 presents Action Limits and Suspension Limits for use with the Control Charts. Examples of appropriate Control Charts are shown in Figures 2 through 4. Target values within these figures are the averages within the example shown within Table 5.

**Table 5: Action and Suspension Limits for FRAP Stockpiles**

| Property | Action Limits | Suspension Limits |
|---|---|---|
| FRAP Asphalt Content | ± 1.0% | ±1.4 % |
| % Passing Median Sieve | ±10.0 % | ±14.0 % |
| % Passing No. 200 Sieve | ± 3.0 % | ±4.5 % |

**Figure 2: Example Control Chart for a FRAP Stockpile - Asphalt Content**

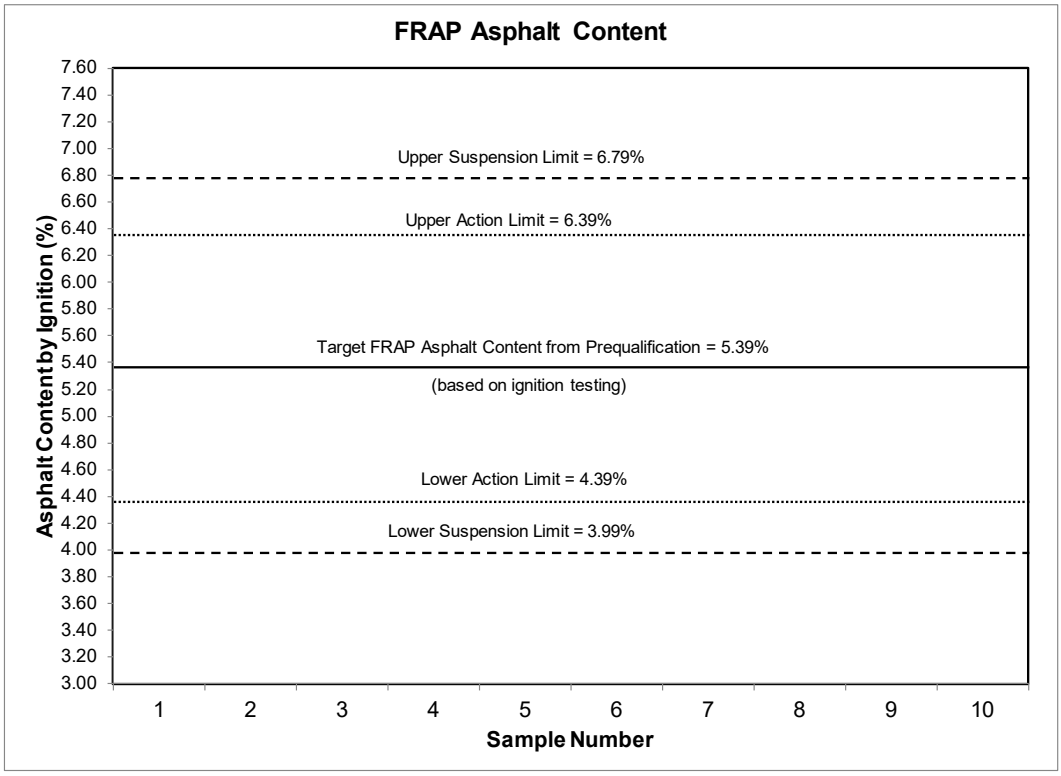



**Figure 3: Example Control Chart for FRAP Stockpiles - Median Sieve Size**

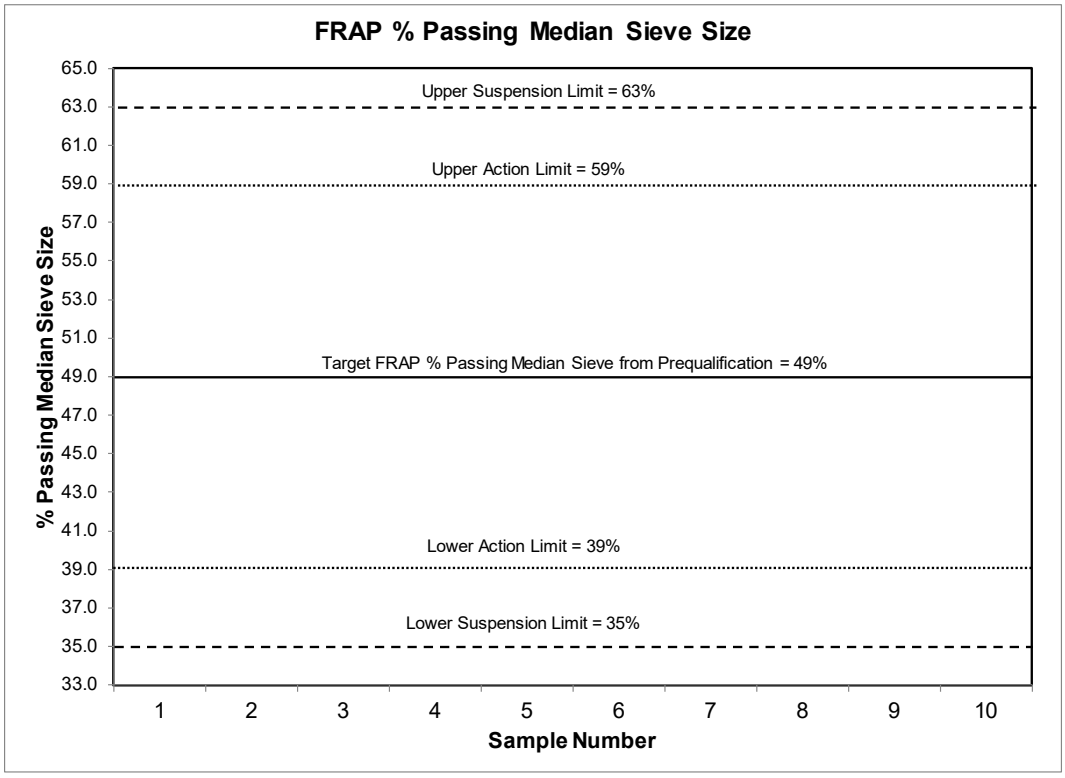
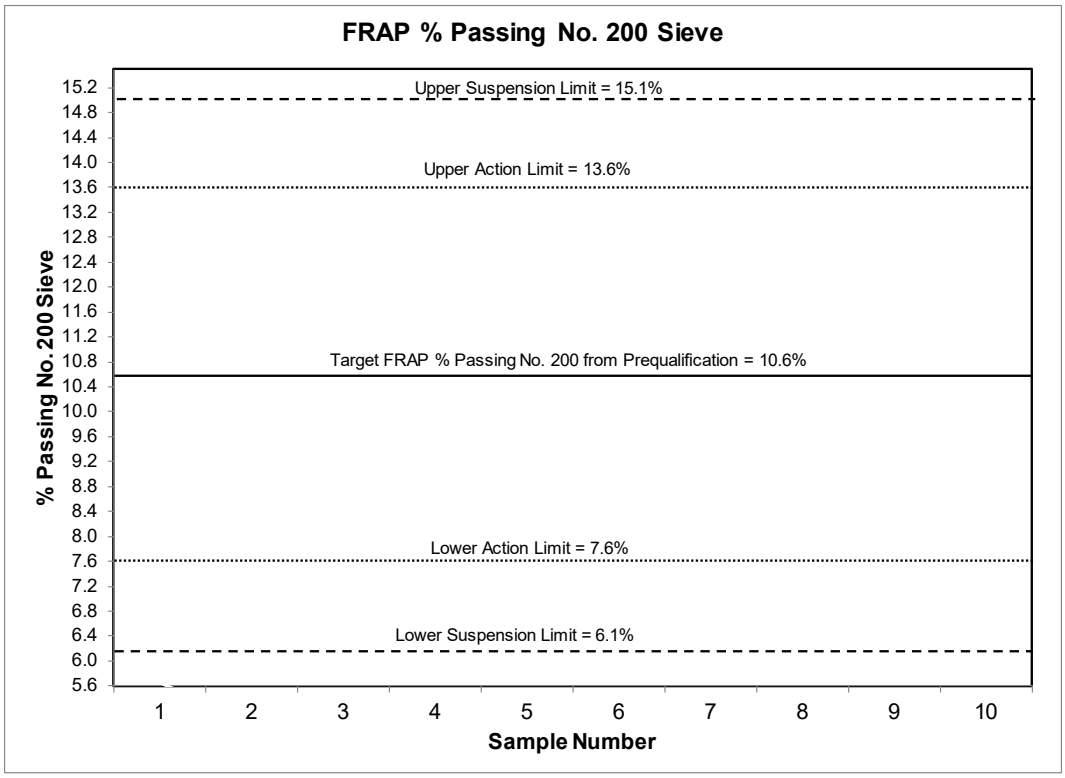


**Figure 4: Example Control Chart for FRAP - No. 200 Sieve**




**The report from this process shall be included in the mix design submittal.** The City Engineer may verify the uniformity of the RAP stockpile at any time at the City's expense.

**c. Asphalt Content Correction Constant**

With each test for AASHTO T 283, the contractor shall also obtain 4 samples from each FRAP fraction to validate the Asphalt Content Correction Constant. Two samples will be tested using Ignition (ASTM D-6307-05), the remaining two samples will be tested using Extraction (AASHTO T-164). The difference between the average ignition content and extracted content will be compared to the prequalification constant. If the difference exceeds 0.4% that FRAP fraction must be requalified and a new constant determined. If the difference is less than 0.4% the correction constant derived during prequalification will continue to be used for volumetric calculations.

**d. Resistance of Compacted Bituminous Mixture to Moisture Induced Damage**

The index of retained strength must be greater than 80 percent as determined by AASHTO T 283-03 (using a 4 inch nominal size mold). Specimens shall be conditioned by freezing and thawing. When the index of retained strength is less than 80 the amount of anti-strip may have to be adjusted. No additional payment will be made to the Contractor for addition of anti-stripping agent required. The mix shall contain the anti-stripping agent specified in paragraph "Anti-Stripping Agent" and tested by AASHTO T 283

(1) Method of determining the retained strength of plant-produced mixtures

Sample the plant produced mixture at the plant site in accordance with ASTM D 979 or behind the paver using the procedure specified herein. Transport the mixture to the laboratory and determine the theoretical specific gravity as specified in paragraph "Asphaltic Concrete Mix Design Method". Prepare the specimens for the AASHTO T 283 test using the same four-hour cured material and compact to 7 ± 0.5 percent air voids. Allow the samples to cool and cure overnight at room temperature and proceed with testing by determining the thickness and bulk specific gravity, then separating the specimens into subsets and preconditioning as specified herein. Then proceed with the testing as specified in AASHTO T 283.

(2) Test for AASHTO T 283

One set of tests for each mix design from each plant shall be made as the final verification of the plant produced mix design by the contractor's laboratory.

a) One set of tests for each mix produced for Public Works Department Contracts shall be taken during the initial production each year and one set of tests for each 10,000 tons produced that year. Sampling frequency shall be adjusted when the Contractor has multiple contracts with the Public Works Department so that tests are taken every 10,000 tons of production. The City Engineer may take an additional test at the City's expense. Any test that fails will require the contractor to adjust the JMF and take additional test at the contractor's expense.

b) One set of tests shall be made and approved by the City Engineer at contractor's expense when any of the material sources change or when requested by the City Engineer.

**600.4 CONSTRUCTION REQUIREMENTS**

**a. Contractor's Laboratory**

Asphaltic Concrete Mix Design shall be the responsibility of the Contractor's Laboratory. The laboratory shall be a commercial testing laboratory meeting the requirements of ASTM D 3666-05a**. The manager of the laboratory shall submit a signed certificate stating that the laboratory has a current certificate stating that the laboratory meets the ASTM D 3666-05a requirements**. The laboratory shall have past experience in testing materials and making Superpave Asphaltic Concrete mix designs. The laboratory shall be approved by the City Engineer. The laboratory shall establish the mix design using the criteria specified herein. Certified test results of the mix design and materials shall be submitted 30 days prior to commencing construction for review by the City Engineer. The test results shall include all detailed raw calculations for the composition of the mix design and shall include all specific gravity calculations. The calculations must be legible but not necessarily typed.

**b. Verification of the Plant Produced Mix Design by the Contractor's Laboratory**

All properties of the mix shall be verified by sampling and testing the uncompacted mix placed behind the paver. Testing shall be performed in accordance with paragraph "Superpave Asphaltic Concrete Mix Design Method" and shall indicate the test properties of the mix shown in Table 4 "Superpave Design and Testing Properties". The properties shall be determined at $N_{design}$ from the average of two 6 inch nominal size samples.

An extraction and gradation test shall be made using the ignition oven. The contractor's laboratory shall adjust the mix design entering the plant to obtain the test properties behind the paver.

Material for the sample shall be from the following locations: one from each side of the placed bituminous mat and one from the center of the mat. A square, pointed shovel shall be used for taking the sample and for evenly laying material back into the disturbed mat. Care shall be taken` not to get foreign material or tack oil into the sample.

Testing shall be conducted daily, or as directed by the engineer when the plant has produced a minimum of 200 tons. Each test shall include:

a) Gradation test ASTM C-136-96a of hot bin material for conventional plants, or total aggregate material from the final feed belt for dryer-drum plants.

**NOTE: The result of the gradation test is very important in determining how to adjust the mix. After the gradation or the bitumen content has been adjusted to obtain the properties of the mix, this verified mix design becomes the Job Mix Formula (JMF). The plant settings may have to be adjusted again whenever the gradation of the materials changes. When a change is made it shall be reported on the Superpave Asphaltic Concrete Test Report form.**

b) Gradation and asphalt content of the mix shall be performed using ASTM D-6307-05 Standard Test Methods for Asphalt Content of Hot Mix Asphalt by the Ignition Method and ASTM D 5444-05. The initial temperature setting of the Ignition Oven shall not exceed 525° C (975° F). If FRAP is used, control tests as described above

and an additional gradation and asphalt content test shall be performed for the combined FRAP sampled from the RAP cold feed into the plant.

c) Laboratory test results shall be shown on the test report form "Superpave Asphaltic Concrete Test" shown at the end of this specification section. Test results shall be received by the contractor and the City Engineer field representatives within approximately 7 hours after the samples are taken. Signed checked copies may be sent later. The laboratory shall determine the Percent Voids, VMA and VEA as soon as possible and evaluate in accordance with paragraph below: "Corrective action to be taken when Asphaltic Concrete Test indicates the mix is out of specification." **Whenever the Percent Voids or VEA is out of specification the laboratory shall contact the Contractor and the City Engineer immediately.** The Contractors laboratory shall furnish the City's laboratory other items such as the JMF mix gradation, plant setting, the bulk specific gravity of the aggregate $G_{sb}$ and the specific gravity of the asphalt $G_b$. **Laboratories shall compare final test results when the mix is out of specification.** The test results shall indicate whether the plant needs adjusting and recommendations shall be provided on correcting the problem.

d) The most recent Asphalt Concrete Test that indicates the mixture meets the specifications is the current mix design for that paving season, except if the FRAP stockpile becomes out of specification.

**c. Verification testing of the plant produced asphaltic concrete by the city.**

The City Engineer will take verification tests at random times, at the City's expense

**d. Pre-Construction test strips**

Test strips shall be constructed by the Contractor off city property at the contractor's expense. However, the City shall observe the sampling and testing. The contractor may negotiate the construction of a test strip on the project with the engineer. In that event, asphalt not meeting specification shall be removed at contractor's expense. Asphalt meeting specifications will be paid for at unit prices.

The Contractor's laboratory shall test the final belt gradation if the plant is a dryer-drum plant or the hot bin material if the plant is a conventional plant, and adjust the feeds to ensure the plant is producing the gradation of the mix design, before hot mix production begins for the tested strip.

Test strips shall contain at least 85 tons of asphaltic concrete. A test sample shall be taken behind the paver at 80 tons. The paver shall be set 12 feet wide and at plan depth when the sample is taken. Care shall be taken not to get foreign material or tack oil into the sample.

If the laboratory test results indicate the mix can be adjusted to meet the properties stated in paragraph "Superpave Design and Testing Properties", project paving may begin. However, this has to be agreed upon by the Contractor's laboratory, the Contractor, and the City Engineer. Otherwise, another test strip shall be constructed. Test strips will not be required on other projects which use this mix design. However, all materials have to be from the same sources and geological units. Also, the mix has to be produced by the same plant.

**e. Corrective action to be taken when Asphaltic Concrete Test indicates the mix is out of specification.**

(1) Asphaltic Concrete Surface, Intermediate or Leveling Course

The mix should be adjusted when consecutive lot tests show the percent voids in the compacted mix are getting close to being the minimum or the maximum field values.

**Paving shall stop and the mixture shall be redesigned whenever any of the following occurs:**

a) Three consecutive sets of lot tests show the percent voids in the compacted mix are less than the minimum field value or more than the maximum field value
b) Two consecutive sets of lot tests show the percent voids in the compacted mix are less than 0.5 percent below the minimum field value or 0.5 percent greater than the maximum field value.
c) Three consecutive sets of lot tests show the VEA is more than 1.0% greater or 1.0% less than the VEA specified in Table 3 Superpave Design and Testing Properties

When a test indicates the VEA is 2.0% above the value specified in Table 4 Superpave Design and Testing Properties, asphaltic concrete shall be removed unless directed otherwise by the City Engineer.

(2) FRAP Control Charts

Evaluation of the FRAP Control Charts shall occur with each mix test. Each FRAP stockpile within the JMF will be deemed out of specification, construction stopped and corrective action taken if:

a) One point falls outside the Suspension Limits for an individual measurement; or,
b) Two points in a row fall outside the Action Limits for individual measurements.

Corrective action may include, but is not limited to, remixing of the FRAP stockpile, utilizing a different FRAP stockpile, development of a new JMF, etc. Anytime that construction is stopped and corrective actions taken, FRAP stockpile(s) shall go through the prequalification program prior to further construction. New Control Charts shall be developed and evaluated as described above with the target values being the average from the prequalification process.

**f. Mixing Plants**

Mixing plants shall meet the requirements of KDOT's latest specification in effect when this project's bids are received by the City, except the mixture discharged from the plant shall not exceed 157.2°C (315°F).

**g. Weather Limitations**

Weather limitations in Section 611.3(b) of the Standard Specifications shall apply except that the following table shall be used.

**Table 6: Asphalt Placement Temperature Limitations**

| Paving Course | Compacted Thickness (inches) | Air Temperature (°F) | Road Surface Temp. (°F) |
|---|---|---|---|
| Surface | All | 55 | 60 |
| Subsurface | < 1.5 | 50 | 55 |
| Subsurface | ≥ 1.5 and < 3 | 40 | 45 |
| Subsurface | ≥ 3 | 30 | 35 |

**h. Road Surface Preparation**

When the bituminous mixture is placed on an existing bituminous surface, the surface shall be cleaned of all foreign material and broomed as necessary to remove dust. Areas shown on the plans or designated by the City Engineer to be patched shall be excavated to a depth directed by the City Engineer, filled with bituminous mixture and compacted. When the contract does not provide for a patching item, an amount two and one-half times the unit price for the bituminous mixture shall be used. The excavation required will not be paid for directly but will be considered subsidiary. In addition to brooming, a high pressure type water truck, capable of washing all fines, dirt, and debris from the surface, may be required prior to overlaying as directed by the City Engineer. Equipment compliance with this specification shall be visual observation by the City Engineer at the commencement of washing operations. Unless specified, no direct payment shall be made for this item, as it shall be considered subsidiary to other bid items.

**i. Tack Coat**

Emulsified Asphalt CSS-1h meeting the requirements of Section 1203 of the Standard Specifications shall be used for tack coat. All existing and new asphaltic concrete surfaces shall receive a tack coat not more than six hours prior to placing an asphaltic concrete paving course. Surfaces previously tack coated and not covered with new asphaltic concrete for more than six hours shall be retacked. The rate of application shall be 0.05 gal./sy to 0.12 gal./sy, or as otherwise directed by the City

Engineer. At locations where asphalt is being placed on top of existing concrete pavement, or for night work where temperatures warrant, the emulsified asphalt shall be diluted 10 percent with water versus the normal 50 percent dilution with water. Tack coat shall not be paid for directly but shall be considered subsidiary to other bid items.

**j. Placing**

Asphaltic concrete intermediate and surface courses shall not be placed in compacted lifts greater than 3 inches deep except when otherwise indicated on maintenance project plans. Asphaltic concrete surface course shall not be placed thinner than 2 inches deep. Asphaltic concrete intermediate course used as surface shall not be placed thinner than 2 inches. Interim layers of intermediate course shall not be left uncovered by the subsequent course for more than 5 days, weather permitting. Material trucks hauling materials other than asphaltic concrete or tack coat shall not travel on previously constructed layers of asphaltic intermediate course until the final course of the intermediate is constructed.

The Contractor shall schedule and route his hauling operation to minimize hauling over a final course as much as feasible.

(1) Bituminous-Materials Spreaders

Bituminous-materials spreaders shall be the self-propelled type equipped with hoppers, tamping, or vibrating devices, distributing screws (augers), adjustable screeds operated either manually or automatically, equipment for heating the screeds and equalizing devices. The spreader shall be capable of spreading hot bituminous mixtures without leaving indented areas, tearing, shoving, or gouging and capable of confining edge of strips to true lines without use of stationary side forms and capable of placing the course to the required thickness. It shall also be capable of producing a finished surface conforming to the smoothness requirements specified. Spreaders shall be designed to operate forward at variable speeds and in reverse at traveling speeds of not less than 100 feet per minute. If an automatic grade control device is used on the spreader for two-lane paving operations, it shall consist of sensing device for control of one end of the screed and a slope-control mechanism for control of the other end of the screed, or a sensing device on each side of the paving machine. Where the paver is used on multiple paving lanes (more than two paving lanes), sensing devices shall be used on each side of the spreader for control of the screed. The slope-control mechanism shall not be used for grade control in multiple paving lane operations.

When the contractor chooses to pave lanes through the project wider than 12 ft. the spreader (paver) shall be equipped with auger extensions. Through lanes shall be paved before left turn lanes and side street intersections. Through lane pavers shall not stop for other areas to be paved.

All bituminous mixtures shall be delivered to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance. **Asphalt mixtures having temperatures less than 113°C (235°F), when dumped into the mechanical spreader will be rejected.** All delivery trucks shall be totally covered with a water proof tarpaulin at the asphalt plant and shall not be uncovered until they are next in line to unload.

(2) Special Procedures to Prevent Segregation

The wings of the spreader hopper shall not be emptied (flipped) between truck loads. The depth of the material in the screed auger champer shall be kept approximately three-fourths (3/4) full - all the way out to the end gate. The augers should be running automatically and the vibrating screed turned on. The hopper conveyor shall always have approximately 6 inches of material covering it and not be allowed to run out of material. **Whenever the paver is run empty (conveyor exposed) the area behind the paver should be checked for a segregated spot. If a spot exists the paver should be stopped and the segregated spot repaired before it is rolled.**

(3) Joints General

Joints between old and new pavements or between successive day's work shall be cut back vertical with a saw. Other joints shall be sawed vertical as directed by the City Engineer. All joints shall be tacked and shall be made carefully to insure continuous bond between old and new sections of the course. All joints shall have the same texture, density, and smoothness as other sections of the course. The tack shall be overlapped onto the previous pavement 1 inch to 2 inches. Contact surfaces of previously constructed pavements, curbs, gutters, manholes, etc., shall be tacked. Surfaces that have become coated with dust, sand, or other objectionable material shall be cleaned by brushing or cut back

with an approved power saw, as directed. The surface against which new material is to be placed shall be sprayed with a thin, uniform coat of bituminous material conforming to the requirements of paragraph "Tack Coat". The material shall be applied far enough in advance of placement of the fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

Edges of previously placed pavement that have cooled and are irregular, honeycombed, poorly compacted, damaged, or otherwise defective unsatisfactory sections shall be cut back to expose a clean, sound surface for the full thickness of the course as directed by the City Engineer.

*a) Transverse Joints*

The roller shall pass over the unprotected end of freshly placed mixture only when placing of the course is discontinued or when delivery of mixture is interrupted to the extent that unrolled material may become cold. In all cases, the edge of the previously placed course shall be cut back to expose an even, vertical surface the full thickness of the course. In continuing placement of the strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling which conforms to the required density and smoothness specified herein.
A string line shall be used to set pavement elevations twenty-five feet after a beginning at a transverse joint or twenty-five feet before an ending at a transverse joint.

*b) Offsetting Joints in Intermediate and Surface Courses*

The surface course shall be placed so that longitudinal joints of the surface course will not coincide with joints in the intermediate course by approximately 9 inches. Care shall be taken when possible to offset longitudinal joints in a manner that the final surface course joint is in the center of the pavement or at the location shown on the plans. Transverse joints in the surface course shall be offset by at least two feet from transverse joints in the intermediate course.

*c) Special Requirements for Placing Paving Lanes Succeeding Initial Lanes*

In placing each succeeding lane after the initial lane has been placed and compacted as specified hereafter, the screed endgate of the mechanical paver shall overlap the previously placed lane slightly and shall be approximately 1.25 times thicker than the existing compacted lane to allow for compaction roll down and produce a smooth compacted joint with the specified density. Mixture placed on the edge of the previously placed lane by the mechanical paver shall be pushed back (tucked) to the edge of the lane being placed by use of a lute (rake). The pushed back material shall form a ridge on the uncompacted lane along the edge of the previously placed lane. The height of the ridge above the uncompacted lane should be approximately equal to the thickness being allowed for roll down during compaction. These procedures shall be used to facilitate getting a smooth joint with density. Excess mixture shall be removed and wasted. Excess material shall not be spread over the uncompacted mat.

(4) Steel-Drum Rollers

Steel-drum rollers shall be self-propelled, tandem (two-axle) with both drums the same size, powered by both drums, vibratory types, weighing not less than 20,000 pounds static weight and not less than 150 lb/in of drum. Drums shall be equipped with adjustable scrapers, water tanks, and sprinkling apparatus for keeping the drums wet, thereby preventing the bituminous mixture from sticking to the wheels. Rollers shall be capable of reversing without backlash and free from worn parts. Roller drums with flat and pitted areas or projections that leave marks in the pavement will not be permitted.

(5) Heavy Pneumatic-Tired Rollers

Heavy pneumatic-tired rollers shall be self-propelled and shall consist of two axles on which are mounted an odd number of pneumatic-tired wheels. The roller shall have at least nine pneumatic-tired wheels in such manner that the rear group of wheels will not follow in the tracks of the forward group, but spaced to give essentially uniform coverage with each pass. Axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. Tires shall be smooth, inflated to 90 p.s.i.. Construction of the roller shall be such that each wheel can be loaded to a minimum of 2,300 pounds.

(6) Blowers and Brooms

Blowers and brooms shall be power type and suitable for cleaning the surface to be paved. Open faced brooms may only be used when approved by the City Engineer.

**k. Compaction of Mixture**

The contractor is responsible for the development of a compaction procedure that will obtain the required density. The following paragraphs describe a procedure that generally obtains density. **The contractor shall determine the exact amount of rolling (coverages needed) to obtain a density meeting paragraph: "Density and Density Test". The ideal density is an average density between 93% and 96%.**

(1) General

The surface of the placed material shall be corrected if necessary before compaction begins. Compaction of the mixture shall be accomplished using a minimum of two steel-drum rollers and a pneumatic-tired roller as specified above. Breakdown rolling shall be as close behind the paver as possible. The break down roller shall be a steel-drum and operated in the vibratory mode on the first forward pass and may be operated in vibratory made on subsequent passes either forward or back. Delays in rolling freshly spread mixture will not be permitted. The pneumatic-tired roller shall be used as an intermediate roller; however, it shall also roll closely behind the break down roller. The pneumatic-tired roller shall always be kept moving in order to keep its tires warm. The second steel-drum roller shall be used as a final finish roller. Rollers shall not travel faster than 3 mph. Steel-drum rollers shall not be used in the vibratory mode except for initial breakdown rolling. When steel-drum rollers are used in the vibratory mode they shall be operated at maximum frequency and minimum amplitude. Rolling shall be continued until density is obtained in all portions of each course.

The speed of rollers shall be slow enough at all times to avoid displacement of the hot mixture. Displacement of the mixture resulting from reversing the direction of the roller or from any other cause shall be corrected at once by raking or removing and replacing fresh mixture when necessary. Alternate passes of the roller shall be varied slightly in length. During rolling, the wheels of steel-drum rollers and plates of vibro plate compactors shall be moistened to prevent adhesion of the mixture to the drums or plates, but excess water will not be permitted. Tires of heavy pneumatic roller shall be moistened with soapy water when required to prevent mixture from sticking to tires during rolling. Rollers shall not be permitted to stand on finished courses until the courses have thoroughly cooled. The contractor shall supply ample rollers to obtain the specified density. Places inaccessible to rollers shall be thoroughly compacted with hot hand-tampers or vibro plate compactors.

(2) Break Down Rolling

Rollers shall be operated as specified above. The unconfined edge or low side edge of the paving lane shall be broken down first. The other edge shall be broken down second and the middle broken down last. This is considered one coverage. Steel-drum break down rollers shall not hang over the free edge of the mat or stay back from it even though they are going to back up for the adjoining lane. The entire lane shall be broken down at the same temperature.

(3) Intermediate Rolling

The rubber tired roller shall be close behind the break down roller after the mat has cooled a few degrees. The rubber tired roller shall roll the same pattern making the same coverage as the breakdown. The rubber tired roller should stay the thickness of the lift from the free edge.

The number of coverages shall be determined by the contractor. This will change with temperature, humidity and thickness of the lift.

(4) Longitudinal Joint Break Down Rolling of Paving Lanes Succeeding Initial Lanes

The break down roller in the vibratory mode shall lap over the tucked joint approximately six inches (6") on to the previously placed compacted lane.

As part of the break-down rolling and immediately after the break-down roller completes its first passes, the longitudinal joint shall be pinched to ensure compaction with the pneumatic-tired roller. The rubber tired roller shall make at least one complete pass (forward and backward) operated on the hot lane with the outside tire pinching the joint.

After the rubber tired roller rolls the joint, it shall make at least one pass over the rest of the mat and then drop back to its intermediate rolling. The steel drum roller in static mode shall immediately smooth out the rubber tired marks.

(5) Finish Rolling

Finish rolling should start when the mat has cooled down 20°F to 40°F below the intermediate rolling (This could be approximately 225°F). The steel wheeled roller in static mode shall immediately smooth out the rubber tired marks using the same pattern making the same type coverages as the breakdown roller. Do not roll until cracks appear, let it cool. Finish rolling can continue until the temperature reaches 175°F to 150°F.

**The finish rolling shall continue until the pavement is smooth and has the density specified above.**

**l. Sampling Pavements for Density**

Samples of finished pavement shall be obtained by the contractor or the contractor's laboratory. A minimum of one test (three cores) shall be taken for each tonnage lot represented by a Superpave Asphaltic Concrete test. Lots larger than 1200 tons shall have one set of (three cores) for each 1000 tons placed or as directed by the Engineer. The cores samples shall be taken at locations throughout the tonnage lot. The locations shall not be previously marked. The core locations shall be marked by the City Engineer after each tonnage lot placement is completed. Cores shall be at least 4 inches in diameter. Sample holes shall be backfilled by the contractor using Quikrete, Rapid Road Repair manufactured by The Quikrete Companies, Atlanta Georgia, 30329, Crystex manufactured by L&M Construction Chemicals Inc., Omaha Nebraska, 68152 or approved equal. The top of the patch shall be sprayed black with paint. The samples shall be tested by the contractor's laboratory to determine conformance to density and thickness. The City Engineer may require the contractor to take more samples at the contractor's expense if the density is marginal.

**m. Density and Density Test**

Density of the compacted mixture of the surface or intermediate course shall be determined by tests made on specimens taken from the compacted course in accordance with the requirements of the previous paragraph: SAMPLING PAVEMENTS FOR DENSITY. The density shall be the average of the three cores 93% to 96% of max theoretical specific gravity of the Superpave Asphaltic Concrete test for the lot. When the average density of the compacted course is not between 93 and 96%, the layer may be removed at the discretion of the Engineer. No core shall be less than 90%.

**n. Surface Smoothness**

The surface course, upon completion of final rolling, shall be smooth and true to grade and cross-section. When a 12-foot straightedge is laid on the surface parallel with the centerline, the surface shall not vary more than 1/8 inch from the straightedge. When the 12-foot straightedge is laid on the surface transverse to the centerline between the crown and edge of pavement, the surface shall not vary more than 1/4 inch from the straightedge. Low or defective areas shall be immediately corrected by cutting out the faulty areas and replacing with fresh hot mixture and compacting the area to conform to the remainder of the pavement. Testing for plan grade conformance and surface smoothness shall be performed by the Contractor in the presence of a representative of the City Engineer. Tests shall be made at intervals as directed by the City Engineer. The City Engineer may direct the contractor to diamond grind areas that are out of tolerance in lieu of above replacement.

**600.5 MEASUREMENT**

Measurement shall be in accordance with Section 109.01 of the Standard Specifications and as modified herein after. The asphalt mixture shall be weighed on approved, certified scales at the contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory. The City Engineer will verify the weights at random times, at the City's expense.

**600.6 PAYMENT**

Payment will be made at the contract unit price bid per ton for "Asphaltic Concrete Intermediate Course" and "Asphaltic Concrete Surface Course". This shall be considered payment for all items of work specified in this section. No separate payment will be made for tack coat and asphalt cement.

# SUPERPAVE ASPHALTIC CONCRETE TEST (Verified Mix Design)

| | | | | | |
|---|---|---|---|---|---|
| Description | | Mix Design Approval Date | | | |
| Lab I.D.: | | Total Tons Mix to Date: | | | |
| Sample I.D.: | | | | | |
| Project Name: | | HMA Producer: | | | |
| Project No: | | Paving Contractor: | | | |
| City Project No: | | HMA Type: | | | |
| City Inspector: | | | Belt(Cold Feed) | HMA(Hot Mixed Asphalt) | |
| Date Sampled: | | Tonnage: | | | |
| Sampled By: | | Time Produced: | | | |

GRAIN SIZE DATA - ASTM D5444, C136, C117

| SIEVE SIZE | BELT SAMPLE | HOT-MIX SAMPLE* | COARSE FRAP | FINE FRAP | MASTER GRADE LIMITS | CALCULATED SINGLE POINT |
|---|---|---|---|---|---|---|
| 19.0mm (3/4") | | | | | | |
| 12.5mm (1/2") | | | | | | |
| 9.5mm (3/8") | | | | | | |
| 4.75mm (No. 4) | | | | | | |
| 2.36mm (No. 8) | | | | | | |
| 2.00mm (No.10) | | | | | | |
| 1.18mm(No.16) | | | | | | |
| 600µm (No 30) | | | | | | |
| 300µm (No 50) | | | | | | |
| 150µm (No 100) | | | | | | |
| 75µm (No 200) | | | | | | |

*from uncompacted mat

| EXTRACTION DATA-ASTM D6307 | SAMPLE | COARSE FRAP | FINE FRAP | PLANT SETTING | RECYCLED AC % |
|---|---|---|---|---|---|
| %AC, total mix basis | | | | | |

| Aggregate Type | %** | Aggregate Type | %** |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

** total aggregate basis

**VOLUMETRIC DATA 6" NOMINAL SIZE Gyratory Specimens**

Gyrations (average of 2 specimens) @280-290 °F - AASHTO T312-01

$N_{initial}$ = 6 $N_{design}$ = 60

| | Sample* | Specifications | |
|---|---|---|---|
| Mix Bulk Specific Gravity @ $N_{design}$, $G_{mb}$ | | | |
| %Voids @ $N_{design}$ | | 3.0-5.0/2.8-4.5/2.6-4.1 | AASHTO T T-169<br>0%/5-25%/26-35% RAP |
| %VMA @ $N_{design}$, $G_{sb}$ basis | | | |
| %VEA @ $N_{design}$ | | 9.0-11<br>9.3-11.3<br>9.6-11.6 | =%VMA-%Voids (0-5%<br>5-25%<br>26-35% RAP) |
| %Gmm @$N_{ini}$ | | 85-91 | AASHTO T 166-00 |
| Ratio (-) 75 um (No. 200) to % Eff. Binder | | 0.6-1.6/0.5-1.5 | 0-25%/26-40% RAP |
| Tensile Strength Ratio, % | | 80 minimum | AASHTO T283-03 |
| Max Theoretical Specific Gravity, $G_{mm}$ | | -- | AASHTO T 209-99(04) |
| Max Theoretical Density, pcf | | -- | |
| Effective Specific Gravity Agg., $G_{se}$ | | -- | |
| Bulk Specific Gravity of Total Agg., $G_{sb}$ | | -- | ASTM C128, C127 |
| Specific Gravity of Asphalt, $G_b$ | | -- | |
| Shale or shale-like (virgin aggregates only) | | 1.0% Maximum | KT-8 |

**COMMENTS:**