

State of Illinois
Department of Transportation
Division of Aeronautics

POLICY MEMORANDUM

January 15, 2007

Springfield, Illinois

Number 2003-1

TO: CONTRACTORS

SUBJECT: REQUIREMENTS FOR LABORATORY, TESTING, QUALITY CONTROL, AND PAVING OF SUPERPAVE HMA CONCRETE MIXTURES FOR AIRPORTS

I. SCOPE

The purpose of this policy memorandum is to define to the Contractor the requirements concerning the laboratory, testing, Quality Control, and paving of HMA concrete mixtures utilizing Superpave technology. References are made to the most recent issue of the Standard Specifications for Construction of Airports and to American Society for Testing and Materials (ASTM) testing methods. The Quality Assurance and acceptance responsibilities of the Engineer are described in Policy Memorandum 96-3.

II. LABORATORY

The Contractor shall provide a laboratory located at the plant and approved by the Illinois Division of Aeronautics (IDA). The laboratory shall be of sufficient size and be furnished with the necessary equipment and supplies for adequately and safely performing the Contractor's Quality Control testing as well as the Engineer's acceptance testing as described in Policy Memorandum 96-3.

The effective working area of the laboratory shall be a minimum of 600 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 70° F ±5°F.

The laboratory shall have equipment that is in good working order and that meets the requirements set forth in the following ASTM test standards:

| | |
|-------------|--|
| ASTM D 70 | Test Method for Specific Gravity and Density of Semi-Solid Materials |
| ASTM C 117 | Test Method for Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C 136 | Sieve or Screen Analysis of Fine and Coarse Aggregate |
| ASTM C 566 | Total Moisture Content of Aggregate by Drying |
| ASTM D 75 | Sampling Aggregates |
| ASTM D 2041 | Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures |
| ASTM D 2172 | Quantitative Extraction of Bitumen from Bituminous Paving Mixtures |
| IDOT | Ignition Method for Determining Asphalt Content |
| ASTM D 2726 | Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface Dry Specimens |

| | |
|-------------|--|
| ASTM D 3203 | Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures |
| ASTM D 2950 | Density of Bituminous Concrete in Place by Nuclear Method |
| ASTM D 4125 | Asphalt Content of Bituminous Mixtures by Nuclear Method |
| ASTM C 127 | Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate |
| ASTM C 128 | Standard Test Method for Specific Gravity and Absorption of Fine Aggregate |

The Asphalt Institute's *Superpave Mix Design, Superpave Series No. 2 (SP-2)*

The laboratory and equipment furnished by the Contractor shall be properly calibrated and maintained. The Contractor shall maintain a record of calibration results at the laboratory. The Engineer may inspect measuring and testing devices at any time to confirm both calibration and condition. If the Resident Engineer determines that the equipment is not within the limits of dimensions or calibration described in the appropriate test method, the Engineer may stop production until corrective action is taken. If laboratory equipment becomes inoperable or insufficient to keep up with mix production testing, the Contractor shall cease mix production until adequate and/or sufficient equipment is provided.

III. MIX DESIGN SUBMITTAL

Based upon data and test results submitted by the Contractor, the Illinois Division of Aeronautics Engineer of Construction & Materials shall issue the final Job Mix Formula approval letter that concurs or rejects the Contractor's proposed JMF. The Contractor will be required to perform the sampling and laboratory testing and develop a complete mix design, according to the following guidelines: [Note: A testing summary chart can be found in Appendix B.]

- A. Material sources meeting the requirements of the contract shall be submitted in writing at or before the preconstruction conference (see BITUMINOUS WORKSHEET in Appendix A) in the following format:
 1. To: Steven J. Long, P.E., Acting Chief Engineer
Attn: Michael F. Wilhelm, P.E., Engineer of Construction & Materials
Division of Aeronautics
One Langhorne Bond Drive
Springfield, Illinois 62707
 2. Producer name and location of each aggregate
 3. Producer # for each aggregate (producers are assigned this number by IDOT Central Bureau of Materials)
 4. Material code for each aggregate
 5. Gradation and Quality designation for each aggregate (i.e. CA-11, etc.)
 6. Producer, producer #, and specific gravities of asphalt cement
 7. Performance Graded Binder 64-22 shall be used unless otherwise approved by the IDA Engineer of Materials.
- B. The Contractor shall obtain representative samples of each aggregate. The individual obtaining samples shall have successfully completed the IDOT Aggregate Technician Course under the

IDOT Division of Highways, QC/QA program. The sample size shall be approximately 280 lb. for each coarse aggregate, 150 lb. for each fine aggregate, 15 lb. for the mineral filler or collected dust, and 1 gallon of asphalt cement.

- C. The Contractor shall split the aggregate samples down and run gradation tests according to the testing methods referenced in Appendix B of this memorandum. The remaining aggregates shall be set aside for further Mix Design testing. The results of the gradation tests, along with the most recent stockpile gradations, shall be reported by fax to the IDA Engineer of Materials for engineering evaluation. If the gradation results are deemed non-representative or in any way unacceptable, new representative samples may be required at the direction of the IDA Engineer of Materials. Only composite gradations are required under this procedure.
- D. Based on the accepted gradation results, the Contractor will determine blend percentages in accordance with the contract specifications (see Section 201/401 – 3.2 JOB MIX FORMULA under Table 4) for each aggregate to be used in determining the Job Mix Formula, as well as mix temperature and asphalt content(s), and number of Gyration (N_{des}) for preparation of the Superpave Mix Design. The Contractor will verify the aggregate percentages, mix temperatures, asphalt content(s), and number of gyrations with the IDA Engineer of Construction & Materials before beginning any testing.
- E. After verification of the information from step D., the Contractor shall make specimens and perform the following tests at various asphalt contents in order to obtain the optimum mix design. [Note: Actual test designation is referenced in Appendix B of this memorandum.]

Tests

Maximum Specific Gravity -- G_{mm}

Bulk Specific Gravity -- G_{mb}

% air voids -- V_a

% VMA

VFA %

TSR

The JMF will be designed in accordance with TABLE 4 as modified in the Recurring Special Provisions for the type of mix being produced. Appendix C contains a copy of the TABLE 4 targets and ranges for the JMF.

- F. All technicians who will be performing mix design testing and plant sampling/testing shall have successfully completed the IDOT Division of Highways Bituminous Concrete Level 1 Technician Course "Bituminous Concrete Testing". The Contractor may also provide a Gradation who has successfully completed the Department's "Gradation Technician Course" to run gradation tests only under the supervision of a Bituminous Concrete Level 2 Technician.
- G. The mix design testing results and resulting optimal JMF shall be reported to the IDA Engineer of Construction & Materials with the following data included:
 - a) Aggregate & liquid asphalt material codes
 - b) Aggregate & liquid asphalt producer numbers, names, and locations
 - c) Aggregate Blend of each aggregate
 - d) Optimum Blend % for each sieve
 - e) AC Specific Gravity
 - f) Bulk Specific Gravity and Absorption for each aggregate
 - g) Summary of Superpave Design Data: AC % Mix, G_{mb} , G_{mm} , VMA, Voids (Total Mix), Voids Filled, V_{be} , P_{be} , P_{ba} , G_{se}
 - h) Optimum design data listing: AC % Mix, G_{mb} , G_{mm} , VMA, Voids (Total Mix), Voids Filled, G_{se} , G_{sb} , TSR
 - i) Percent of asphalt that any RAP will add to the mix
 - j) Graphs for the following: gradation on 0.45 Power Curve, AC vs. Voids (Total Mix), AC vs. Specific Gravities, AC vs. Voids Filled, AC vs. VMA

- H. The IDA Engineer of Construction & Materials shall generate and issue a concurrence or rejection of the Contractor's proposed Mix Design with the JMF for the manufacture of HMA mixtures based upon the Contractor's submitted testing and completed mix design results. The Contractor shall not be permitted to use the proposed HMA mix in production for the project until an approval letter is issued to the Contractor by the IDA Engineer of Construction & Materials, and the mix passes all test section requirements, when a test section is specified.
- I. The above procedure, III. MIX DESIGN SUBMITTAL, shall be repeated for each change in source or gradation of materials.

IV. MIX PRODUCTION TESTING

The Quality Control of the manufacture and placement of HMA mixtures is the responsibility of the Contractor. The Contractor shall perform or have performed the inspection and tests required to assure conformance to contract requirements. Quality Control includes the recognition of defects and their immediate correction. This may require increased testing, communication of test results to the plant or the job site, modification of operations, suspension of HMA production, rejection of material, or other actions as appropriate. The Resident Engineer shall be immediately notified of any failing tests and subsequent remedial action. Form AER M-14 shall be reported to the Engineer and Resident Engineer no later than the start of the next work day. In addition, AER M-9 and M-11 shall be given to the Resident Engineer daily (Appendix A). The Contractor shall provide a Quality Control (QC) Manager who will have overall responsibility and authority for Quality Control. This individual shall have successfully completed the IDOT Division of Highways Bituminous Concrete Level II Technician Course "Bituminous Concrete Proportioning and Mixture Evaluation." In addition to the QC Manager, the Contractor shall provide sufficient and qualified personnel to perform the required visual inspections, sampling, testing, and documentation in a timely manner. The following plant tests and documentation shall be required: [Note: A summary chart of testing can be found in Appendix B.]

- A. Minimum of one (1) complete hot bin or combined belt analysis per day of production or every 1,000 tons, whichever is more frequent.
- B. Minimum one (1) stockpile gradation for each aggregate and/or mineral filler per week when a batch plant is utilized. Minimum of one (1) gradation for each aggregate per day of production or every 1,000 tons when a drum plant is used, and one (1) gradation per week for mineral filler when a drum plant is used.
- C. A certification from the quarry for the total quantity of aggregate listing the source, gradation type, and quality designation of aggregate shipped. In lieu of a certification, the contractor may complete and submit an "Aggregate Certification of Compliance" form which may be obtained from IDA or found on the I.D.O.T. website.
- D. Original asphalt shipping tickets listing the source and type of asphalt shipped.

- E. One mix sample per 1,000 tons of mix. The sample shall be split in half. One half shall be reserved for testing by the Engineer. The other half shall be split and tested by the Contractor for Extraction, Gradation, Maximum Specific Gravity, and Air Void tests in accordance with the appropriate ASTM standard referenced herein. [See Appendix B.]
1. In place of the extraction test, the Contractor may provide the asphalt content by a calibrated ignition oven test using the IDOT Division of Highways' latest procedure. The correction (calibration) factor for aggregate type shall be clearly indicated in the reported test results.

From these tests, the Contractor shall interpret the test data and make necessary adjustments to the production process only in order to comply with the approved JMF.

V. QUALITY CONTROL

A. Control Limits

Target values shall be determined from the approved JMF. The target values shall be plotted on the control charts within the following control limits:

| <u>Parameter</u> | <u>Control Limits</u> | |
|------------------|------------------------|-------------------------|
| | <u>Individual Test</u> | <u>Moving Avg. of 4</u> |
| % Passing | | |
| 1/2 in. | ± 7 % | ±4 % |
| No. 4 | ±7 % | ±4 % |
| No. 8 | ±5 % | ±3 % |
| No. 30 | ±4 % | ±2.5 % |
| No. 200 * | ±2.0 % * | ±1.0 % * |
| Asphalt Content | ±0.45 % | ±0.2 % |

* No. 200 material percents shall be based on washed samples. Dry sieve gradations (-200) shall be adjusted based on anticipated degradation in the mixing process.

B. Control Charts

Standardized control charts shall be maintained by the Contractor at the field laboratory. The control charts shall be displayed and be accessible at the field laboratory at all times for review by the Engineer. The individual required test results obtained by the Contractor shall be recorded on the control chart immediately upon completion of a test, but no later than 24 hours after sampling. Only the required plant tests and resamples shall be recorded on the control chart. Any additional testing of check samples may be used for controlling the Contractor's processes, but shall be documented in the plant diary.

The results of assurance tests performed by the Engineer will be posted as soon as available.

The following parameters shall be recorded on control charts:

1. Combined Gradation of Hot-Bin (Batch Plant) or Combined Belt Aggregate Samples (Drier Drum Plant). (% Passing 1/2 in., No. 4., No. 8, No. 30, and No. 200 Sieves)
2. Asphalt Content
3. Bulk Specific Gravity (G_{mb})

4. Maximum Specific Gravity of Mixture (G_{mm})

C. Corrective Action for Required Plant Tests

Control Limits for each required parameter, both individual tests and the average of four tests, shall be exhibited on control charts. Test results shall be posted within the time limits previously outlined.

1. Individual Test Result. When an individual test result exceeds its control limit, the Contractor shall immediately resample and retest. If at the end of the day no material remains from which to resample, the first sample taken the following day shall serve as the resample as well as the first sample of the day. This result shall be recorded as a retest. If the retest passes, the Contractor may continue the required plant test frequency. Additional check samples should be taken to verify mix compliance.
2. Asphalt Content. If the retest for asphalt content exceeds control limits, mix production shall cease and immediate corrective action shall be instituted by the Contractor. After corrective action, mix production shall be restarted, the mix production shall be stabilized, and the Contractor shall immediately resample and retest. Mix production may continue when approved by the Engineer. The corrective action shall be documented.

Inability to control mix production is cause for the Engineer to stop the operation until the Contractor completes the investigation identifying the problems causing failing test results.

3. Combined Aggregate/Hot-Bin. For combined aggregate/hot-bin retest failures, immediate corrective action shall be instituted by the Contractor. After corrective action, the Contractor shall immediately resample and retest. The corrective action shall be documented.
 - a. Moving Average. When the moving average values trend toward the moving average control limits, the Contractor shall take corrective action and increase the sampling and testing frequency. The corrective action shall be documented.

The Contractor shall notify the Engineer whenever the moving average values exceed the moving average control limits. If two consecutive moving average values fall outside the moving average control limits, the Contractor shall cease operations. Corrective action shall be immediately instituted by the Contractor. Operations shall not be reinstated without the approval of the Engineer. Failure to cease operations shall subject all subsequently produced material to be considered unacceptable.
 - b. Mix Production Control. If the Contractor is not controlling the production process and is making no effort to take corrective action, the operation shall stop.

VI. TEST SECTION AND DENSITY ACCEPTANCE (Note: Applies only when specified.)

- A. The purpose of the test section is to determine if the mix is acceptable and can be compacted to a consistent passing density.

A quick way to determine the compactibility of the mix is by the use of a nuclear density gauge in the construction of a growth curve. An easy way to construct a growth curve is to use a good vibratory roller. To construct the curve, an area the width of the roller in the middle of the mat is chosen and the roller is allowed to make one compactive pass. With the roller stopped some 30 feet away, a nuclear reading is taken and the outline of the gauge is marked on the pavement. The roller then makes a compaction pass in the opposite direction and another reading is taken. This scenario is continued until at least two (2) passes are made past the maximum density obtained.

The maximum laboratory density potential of a given mix is a direct function of the mix design air voids. Whereas, the actual maximum field density is a function of the type of coarse aggregates, natural or manufactured sands, lift thickness, roller type (static or vibratory), roller and paver speed, base condition, mix variation, etc. All of these items are taken into consideration with the growth curve.

1. High Density in the Growth Curve. If the growth curve indicates a maximum achievable field density of between 95 to 98 percent of the Theoretical Maximum Density (D), you can proceed with the Rolling Pattern. On the other hand, if the maximum achievable density is greater than 98 percent, a quick evaluation (by use of an extractor, hot bin gradations, nuclear asphalt determinator, etc.) must be made of the mix. When adjustments are made in the mix, a new growth curve shall be constructed.
2. Low Density in the Growth Curve. If the growth curve indicates the maximum achievable density is below 94 percent, a thorough evaluation of the mix, rollers, and laydown operations should be made. After a thorough evaluation of all factors (mix, rollers, etc.), asphalt or gradation changes may be in order as directed by the Engineer. Again, any changes in the mix will require a new growth curve. Note that the nuclear density test is a quality control tool and not an acceptance test. All acceptance testing is to be conducted by the use of cores, unless otherwise specified.
3. Acceptance of Test Section. The Contractor may proceed with paving the day after the test section provided the following criteria have been met:
 - a. Four random locations (2 cores per location cut longitudinally and cored by the Contractor) will be selected by the Engineer within the test strip. All the cores must show a minimum of 94% density.
 - b. All Superpave and extraction test results from mix produced for the test section must be within the tolerances required by specification.
 - c. The Contractor shall correlate his nuclear gauge to the cores taken in the test section. Additional cores may be taken at the Contractor's expense for this purpose within the test section area, when approved by the Engineer.

4. Density Acceptance under Production Paving. The responsibility for obtaining the specified density lies with the Contractor. Therefore, it is important that the nuclear density gauge operator communicate with the roller operators to maintain the specified density requirements. The Contractor shall provide a Bituminous Concrete Density Tester who has successfully completed the Department's "Bituminous Concrete Nuclear Density Testing Course" to run all required density tests on the job site. Density acceptance testing, unless otherwise specified, is described as follows:
- a. The Contractor shall cut cores at random locations within 500 ton sublots as directed by the Resident Engineer.
 - b. The cores should be extracted so as not to damage them, since they are used to calculate the Contractor's pay.
 - c. The Engineer will run preliminary G_{mb} tests on the cores to give the Contractor an indication of how compaction is running for the next day's paving.
 - d. A running average of four (4) Maximum Theoretical Gravities (G_{mm}) will be used for calculating percent compaction.
 - e. Final core density tests and pay calculations will be performed by the Resident Engineer and delivered to the Contractor.
 - f. Should the contractor wish to resample the pavement as a result of pay calculations resulting in less than 100% payment, the request must be made within 48 hours of receipt of the original payment calculations.

Steven J. Long, P.E.
Acting Chief Engineer

Supersedes Policy Memorandum 2003-1 dated July 1, 2004

APPENDIX A

BITUMINOUS WORKSHEET

Airport: _____ Project No.: _____ AIP No.: _____

Mix Design #: _____ Material Code: _____ Producer: _____

Prod. #: _____

AGGREGATE

Mat'l. Code: _____

Producer #: _____

Prod. Name _____

Location: _____

Percent Passing

Sieve Size

| | | | | | |
|--------------|-------|-------|-------|-------|-------|
| 1 inch | _____ | _____ | _____ | _____ | _____ |
| 3/4 inch | _____ | _____ | _____ | _____ | _____ |
| 1/2 inch | _____ | _____ | _____ | _____ | _____ |
| 3/8 inch | _____ | _____ | _____ | _____ | _____ |
| No. 4 | _____ | _____ | _____ | _____ | _____ |
| No. 8 | _____ | _____ | _____ | _____ | _____ |
| No. 16 | _____ | _____ | _____ | _____ | _____ |
| No. 30 | _____ | _____ | _____ | _____ | _____ |
| No. 50 | _____ | _____ | _____ | _____ | _____ |
| No. 100 | _____ | _____ | _____ | _____ | _____ |
| No. 200 | _____ | _____ | _____ | _____ | _____ |
| Washed (y/n) | _____ | _____ | _____ | _____ | _____ |
| O.D. Gravity | _____ | _____ | _____ | _____ | _____ |
| App. Gravity | _____ | _____ | _____ | _____ | _____ |
| Absorption | _____ | _____ | _____ | _____ | _____ |

Asphalt Gravity _____ Asphalt Source _____ Asphalt Producer No. _____

MARSHALL DATA

| | | | | | |
|--------------|-------|-------|-------|-------|-------|
| % Asphalt | _____ | _____ | _____ | _____ | _____ |
| M. Stability | _____ | _____ | _____ | _____ | _____ |
| Flow | _____ | _____ | _____ | _____ | _____ |
| D | _____ | _____ | _____ | _____ | _____ |
| 0 | _____ | _____ | _____ | _____ | _____ |
| % Air Voids | _____ | _____ | _____ | _____ | _____ |

Q.C. Manager Name: _____ Phone number: _____

Laboratory Location: _____ Fax Number: _____

Remarks: _____

Bituminous Mixtures Extraction

Date: _____

Airport: _____ Consultant: _____

Illinois Project: _____ Contractor: _____

AIP Project No.: _____ Producer: _____

Mix #: _____ Dry Time: _____ Lot: _____ Sublot: _____

Type: _____ Washed: _____

| Sieve | Wt. | Accum. Wt. | % Passing | Mix Formula | Tolerance | Spec Range |
|---------|-----|------------|-----------|-------------|-----------|------------|
| 1.5 | | | | | | |
| 1 | | | | | | |
| 3/4 | | | | | | |
| 1/2 | | | | | | |
| 3/8 | | | | | | |
| 4 | | | | | | |
| 8 | | | | | | |
| 16 | | | | | | |
| 30 | | | | | | |
| 50 | | | | | | |
| 100 | | | | | | |
| 200 | | | | | | |
| Tot Agg | | | | | | |
| Bit | | | | | | |

| Extraction Data | | |
|-----------------------------|---|-------|
| Pan, New Filter & Sample | g | _____ |
| Pan & New Filter | g | _____ |
| Sample | g | _____ |
| Pan, Used Filter, Aggregate | g | _____ |
| Pan & New Filter | g | _____ |
| Aggregate | g | _____ |
| Pan & Used Filter | g | _____ |
| Pan & New Filter | g | _____ |
| Dust in Filter | g | _____ |
| Sample | g | _____ |
| Aggregate | g | _____ |
| Bitumen | g | _____ |

| | | | | | |
|------------|----------------|----------|------------|-------|------|
| New Bit: | Marshall Stab: | Blows: | Gyro: | Flow: | TSR: |
| Bulk SPGR: | Max SPGR: | % Voids: | DEN (PCF): | | |

Remarks: _____

CC: _____ Tested by: _____

APPENDIX B

QUALITY CONTROL TESTING (PLANT)

| PARAMETER | FREQUENCY | SAMPLE SIZE | TEST METHOD | REPORT FORM |
|---|---|--|--------------------|----------------------|
| Aggregate Gradations: Hot bins for batch and continuous plants--- Individual cold-feeds or combined belt-feeds for drier drum plants. | Minimum 1 per day of production and at least 1 per 1000 tons. | CA07/11: 5000 gm CA13: 2000 gm CA16: 1500 gm Fine agg: 500 gm 1 gallon asphalt cement | ASTM C 136 | AER M-9 |
| Aggregate gradations: Stockpiles | Minimum 1 per aggregate per week per stockpile. | CA07/11: 5000 gm CA13: 2000 gm CA16: 1500 gm Fine agg: 500 gm *Note: The above test sample sizes are to be obtained from splitting down a larger sample from the stockpiles. | ASTM C 136 | AER M-9 |
| Maximum Specific Gravity | Minimum 1 per 1000 tons | 1200 gm per test | ASTM D 2041 | AER M-11 and AERM-14 |
| Bulk Specific Gravity | Minimum 1 per 1000 tons | 1250 gm per briquette | ASTM D 2726 | AER M-11 and AERM-14 |
| Marshall Stability and Flow | Minimum 1 per 1000 tons | 1250 gm per briquette | ASTM D 1559 | AER M-11 and AERM-14 |
| % Air Voids | Minimum 1 per 1000 tons | | ASTM D 3203 | AER M-11 and AERM-14 |
| Extraction | Minimum 1 per 1000 tons | 1000 gm (surface) 1500 gm (base) | ASTM D 2172 | AER M-11 and AERM-14 |
| Ignition Oven Test | Minimum 1 per 1000 tons | 1500 gm | | AER M-14 |
| Nuclear Asphalt Gauge | Minimum 1 per 1000 tons | 1000-1100 gm | ASTM D 2145 | AER M-14 |
| Gyratory Brix | Minimum 1 per 1000 tons | 4700-4800 gm 115 mm +/- 5 mm | AASHTO TP4-99 | |

MIX DESIGN TESTING

| PARAMETER | FREQUENCY | SAMPLE SIZE | TEST METHOD | REPORT FORM |
|--|--|---|--------------------|-----------------------------------|
| Representative samples of each aggregate and asphalt cement. | 1 per aggregate and 1 asphalt cement. | 280 lb. (coarse) 150 lb. (fine) 15 lb. (min. filler) 1 gallon asphalt cement | ASTM D 75 | N/A |
| Aggregate Gradation | 1 per aggregate | CA07/11: 5000 gm CA13: 2000 gm CA16: 1500 gm Fine agg: 500 gm | ASTM C 136 | Bituminous Worksheet (Appendix A) |
| Maximum Specific Gravity | 2 per specified asphalt content | 1200 gm per test | ASTM D 2041 | Bituminous Worksheet (Appendix A) |
| Bulk Specific Gravity | 3 briquettes per specified asphalt content | 1250 gm per briquette | ASTM D 2726 | Bituminous Worksheet (Appendix A) |
| Marshall Stability and Flow | 3 briquettes | 1250 gm per briquette | ASTM D 1559 | Bituminous Worksheet (Appendix A) |
| % Air Voids | 1 per specified asphalt content (Avg. of G_{sb}/G_{mm}) | | ASTM D 3203 | Bituminous Worksheet (Appendix A) |
| Gyratory Brix | Minimum 1 per 1000 tons | 4700-4800 gm 115 mm +/- 5 mm | AASHTO TP4-99 | |

QUALITY CONTROL TESTING (PAVER)

| PARAMETER | FREQUENCY | SAMPLE SIZE | TEST METHOD | REPORT FORM |
|----------------------|--|--------------------|--------------------|--------------------|
| Nuclear Density Test | As required by the Contractor to maintain consistent passing density | Various locations | ASTM D 2950 | |

APPENDIX C

AGGREGATE BITUMINOUS BASE COURSE

| Percentage by Weight Passing Sieves Job Mix Formula (JMF) | | |
|--|---|-------------------------|
| Sieve Size | Gradation B Range 1" Maximum | Ideal Target |
| 1-1/4 in. | --- | --- |
| 1 in. | 100 | 100 |
| 3/4 in. | 93 – 97 | 95 |
| 1/2 in. | 75 – 79 | 77 |
| 3/8 in. | 64 – 68 | 66 |
| No. 4 | 45 – 51 | 48 |
| No. 8 | 34 – 40 | 37 |
| No. 16 | 27 – 33 | 30 |
| No. 30 | 19 – 23 | 21 |
| No. 100 | 6 – 10 | 8 |
| No. 200 | 4 – 6 | 5 |
| Bitumen %: | | |
| Stone | 4.5 – 7.0 | 5.5 |

AGGREGATE BITUMINOUS SURFACE COURSE

| Percentage by Weight Passing Sieves Job Mix Formula (JMF) | | |
|--|--|-------------------------|
| Sieve Size | Gradation B Range ^{3/4}" Maximum | Ideal Target |
| 1 in. | 100 | --- |
| 3/4 in. | 100 | 100 |
| 1/2 in. | 99 - 100 | 100 |
| 3/8 in. | 91 - 97 | 94 |
| No. 4 | 56 – 62 | 59 |
| No. 8 | 36 - 42 | 39 |
| No. 16 | 27 - 32 | 30 |
| No. 30 | 19 - 25 | 22 |
| No. 100 | 7 – 9 | 8 |
| No. 200 | 5 – 7 | 6 |
| Bitumen %: | | |
| Stone | 5.0 – 7.0 | 6.0 |