Kentucky Method 64-421-09
Revised 5/1/09
Supersedes KM 64-421-09
Dated 4/1/09

ESTABLISHING THE JOB-MIX FORMULA OF ASPHALT MIXTURES BY THE CONTRACTOR

1. SCOPE:

1.1. This method covers the requirements for the Contractor to establish his job-mix formula (JMF) for a project.

1.2. The JMF for a mix is defined as: (1) a single percentage (passing) for each specified sieve size for the aggregate gradation; and (2) a specified performance-graded (PG) asphalt binder content (AC) expressed to the nearest 0.1 percent. The JMF is specified as a whole number on all applicable sieves, except the No. 200 sieve, which is specified to the nearest 0.5 percent.

1.3. Establishing the JMF consists of two distinct phases.

1.3.1. In the first phase, submit the desired aggregate-blend combination and resulting proposed-mix gradation to the Division of Materials (the Division) or District Materials Section Supervisor (DME), as appropriate, for evaluation. The Department will use a qualified Superpave Mix-Design Technologist (SMDT) to report the acceptability of mix designs.

1.3.2. In the second phase, set the plant according to the JMF reported on the most current version of the "Asphalt-Mixture-Design Results" form, or "MixPack" spreadsheet.

1.4. Provide a qualified SMDT to submit the mixture design to the appropriate party for evaluation; provide a qualified Superpave Plant Technologist (SPT) to establish the JMF at the plant.

2. APPARATUS: Refer to the following Kentucky Methods (KM's) and AASHTO and ASTM procedures, as applicable, for the equipment and procedures necessary to fulfill the requirements of this method:

KM 64-401 *Calibrating and Checking Cold-Feed Flow on Asphalt Mixing Plants*

KM 64-404 *Sampling Liquid Asphalt Materials*

KM 64-405 *Extraction of Binder From Asphalt Paving Mixtures*

KM 64-407 *Sieve Analysis of Aggregate From Asphalt Mixing Plants*

KM 64-411 *Preparing Ingredient Materials for, and Performing, a Laboratory Mix Design of an Asphalt Mixture*

KM 64-424 *Method for Designing Open-Graded Friction Course Mixtures*

KM 64-425 *Sampling Asphalt Mixtures*

KM 64-433 *Wet-Sieve Analysis of Aggregates Used in Asphalt Mixtures*

KM 64-434 *Determination of Moisture Content in Asphalt Mixtures (Rapid Field Test)*

KM 64-436 *Asphalt Binder Content Determination of Asphalt Mixtures by Plant Recordation*

KM 64-437 *Determination of Asphalt Binder Content of Asphalt Mixtures Using the Nuclear Asphalt Content Gauge*

KM 64-438 *Asphalt Binder Content Determination of Asphalt Mixtures Based on the Maximum Specific Gravity*

KM 64-443 *Method for Verifying a Contractor's Laboratory Mix Design*

KM 64-444 *Kentucky Transportation Cabinet (KYTC) Approved Supplier Certification (ASC) Program for Performance-Graded (PG) Asphalt Binders*

KM 64-620 *Wet Sieve Analysis of Fine and Coarse Aggregate*

AASHTO M 323 *Superpave Volumetric Mix Design*

AASHTO R 35 *Superpave Volumetric Design for Hot Mix Asphalt (HMA)*

AASHTO T 2 *Sampling of Aggregates*

AASHTO T 27 *Sieve Analysis of Fine and Coarse Aggregates*

AASHTO T 308 *Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method*

ASTM D 4867 *Effect of Moisture on Asphalt Concrete Paving Mixtures*

3. SELECTING THE JMF:

3.1. Document the selected JMF on an "Asphalt-Mixture-Design Results" form, or "MixPack" spreadsheet, appropriate for the mixture in question, for transfer into the SiteManager®

Materials computer software (example copies attached). Submit the "Asphalt-Mixture-Design Results" form to the Division or DME via computer disk or electronic mail. Attachment No. 1 is an example of an "Asphalt-Mixture-Design Results" form, ready for submission to the Division or DME. Additionally, retain copies of all worksheets and data so that, in case of discrepancies, all supporting information is available for review.

3.2. As the first step in selecting the JMF, determine the source and size of aggregates to be used in the mix. Ensure the aggregate used in the design testing is representative of that to be used on the project.

3.3. Determine the gradations of the stockpiled aggregates according to R 35.

3.4. Develop a minimum of three aggregate trial blends, combining the aggregate fractions mathematically, according to R 35.

3.4.1. Determine the trial blends by the "trial-and-error" method. Assign percentages to each aggregate to be used. Attempt the first "guesses" by looking at critical sieves, which usually include the third and last sieve in the series. Multiply the assigned percentages for each aggregate by the percent passing a given sieve. Determine the sum of the product(s) obtained on a given sieve for all the aggregates. Compare the calculated gradation obtained to the desired gradation. Adjust the assigned percentage of each aggregate, and repeat the process until the "best fit" with the desired gradation is obtained.

3.4.2. If desired, consult additional detailed information and examples on combining stockpile gradations to determine the JMF as provided in the *SMDT Training Manual* from the Division. Additionally, use computer spreadsheets for combining stockpile gradations if desired.

3.5. Conform to KM 64-411 for the preparation of ingredient materials for: (1) trial blend gradations; (2) trial blend gyratory specimens and accompanying maximum specific gravity (G_{mm}) samples; (3) design aggregate structure gyratory specimens and accompanying G_{mm} samples; (4) moisture-susceptibility (D 4867) specimens and accompanying G_{mm} samples; and (5) aggregate consensus property samples.

3.6. According to R 35, after selecting the three aggregate trial blends, determining an initial trial AC for each trial blend, and evaluating the properties of each compacted trial mixture, choose the design aggregate structure. Record this gradation on the "Asphalt-Mixture-Design Results" form as the selected JMF as described in Subsection 3.1 of this method.

3.7. When previous experience exists with the same materials, submit a mix gradation, or reference mixture, which has proved satisfactory as the selected JMF, thus circumventing the requirements above.

3.8. Design AC:

3.8.1. Select the design AC according to R 35.

3.8.2. Justify the proposed AC based on: (1) a laboratory mix design, or one-point check as described later in this method, submitted by the Contractor; or (2) field-verification data sufficient to document satisfactory past performance (at least from the latest lot of mixture production). Determine the design AC, at 4.0 percent air voids, based on experience, laboratory data, and/or field-verification data. When applicable, the Division or DME will verify the Contractor's laboratory mix design or one-point check as described in KM 64-443. The Division or DME may, in isolated cases, modify the Contractor's proposed AC due to project conditions or experience with the involved materials.

3.9. Submitting mixtures for evaluation:

3.9.1. Mixtures submitted to the Division:

3.9.1.1. Submit an "Asphalt-Mixture-Design Results" form and any samples and/or specimens which may be required for any permanent mainline, shoulder, ramp, approach, median that could be used for turning movements, cross-over, or entrance application, regardless of tonnage, for the following mixtures:

3.9.1.1.1. ESAL Class 3 or 4 Superpave mixtures, Sand Asphalt, Sand Seal Surface, Open-Graded Friction Course (OGFC), Stone-Matrix Asphalt (SMA), or Drainage Blanket - Type II - Asphalt (ATDB); or

3.9.1.1.2. Other specialty mixtures which, by nature of the ingredient materials included or the application intended, would require the Division's involvement and/or evaluation.

3.9.1.2. Submit samples of aggregate, PG binder, and liquid anti-stripping additives, if used, to the Division in the instances given below:

3.9.1.2.1. All ESAL Class 4 mixtures.

3.9.1.2.2. Sand Asphalt, Sand Seal Surface, OGFC, SMA, ATDB, and all specialty mixtures as described in Subsection 3.9.1.1.2 of this method.

3.9.1.2.3. When requested by the Division in order to investigate an unsuccessful verification according to KM 64-443.

3.9.2. Mixtures submitted to the DME:

3.9.2.1. Submit an "Asphalt-Mixture-Design Results" form and any samples

and/or specimens which may be required for any permanent mainline, shoulder, ramp, approach, median that could be used for turning movements, cross-over, or entrance application, regardless of tonnage, for all ESAL Class 2 Superpave mixtures.

3.9.2.2. Submit an "Asphalt-Mixture-Design Results" form outlining the mixture composition (aggregate sources and percentages, mixture gradation, PG binder source, type and amount of liquid anti-stripping additive if applicable, recommended AC, etc.) for any other mixtures or applications not previously described (such as leveling-and-wedging, scratch course, Asphalt Mixture for Pavement Wedge, Asphalt Wedge Curb, asphalt mixture for base failure repair, mountable medians, trenches, maintenance mixtures purchased by price contract, incidental or temporary applications, etc.). The DME will not require any laboratory-mix-design testing on these mixtures.

3.9.3. Requirements for all mixtures:

3.9.3.1. For new mixture designs previously unsubmitted to the Department or reference mixture designs as described in Subsections 3.9.3.3 or 3.9.3.4 of this method, provide the "Asphalt-Mixture-Design Results" form and any required samples and/or specimens to the Division or DME at least 14 calendar days before the anticipated date of the start of work. When the Division's evaluation is required, submit the samples of aggregate, PG binder, and liquid anti-stripping additive (if used) to the Division at the same time. The Division or DME will not consider any mixture as "officially received" until all required materials have been submitted.

3.9.3.2. Reference a previously utilized mixture without further laboratory testing, provided the following exists: (1) a laboratory mix design, or one-point check when appropriate, submitted by the Contractor; or (2) field-verification data sufficient to document satisfactory past performance (at least from the latest lot of mixture production). The date of this preliminary mixture design information can be no more than one year prior to the date of the submission of the new mixture. In this case, submit the "Asphalt-Mixture-Design Results" form to the Division or DME, as appropriate, within five working days of the anticipated date of the start of work.

3.9.3.3. Reference a previously utilized mixture with additional laboratory testing when the date of the preliminary mixture design information is more than one year, but less than two years, prior to the date of the submission of the new mixture. In this case, perform a one-point check of the reference mixture at the optimum AC. Along with the results of the one-point check reported on the "Asphalt-

Mixture-Design Results" form, submit two mixture specimens, compacted to N_{des} gyrations, and two G_{mm} samples, all at the optimum AC, to the Division or DME, as appropriate.

3.9.3.4. When submitting a mixture whose preliminary design information is more than two years old, or when submitting a new mixture (not previously used), provide a complete mix design from the Contractor on the appropriate "Asphalt-Mixture-Design Results" form to the Division or DME, as appropriate. Along with this form, submit two mixture specimens, compacted to N_{des} gyrations, and two G_{mm} samples, all at the optimum AC.

3.9.3.5. When referencing to a mixture with an identical aggregate structure (sources, sizes, cold-feed percentages, and gradation) but a different grade of binder, submit an "Asphalt-Mixture-Design Results" form documenting the binder grade change to the Division or DME, as appropriate.

When requested by the Engineer, perform a moisture-susceptibility analysis with the different grade of binder, and submit the results of this analysis to the Division or DME, as appropriate. When requested, provide the Division with adequate samples of aggregate, binder, and liquid anti-stripping additive to perform a verification of the moisture-susceptibility analysis.

3.9.3.6. When referencing to a mixture with an identical aggregate structure (sources, sizes, cold-feed percentages, and gradation) and binder grade, but not the same binder source, submit an "Asphalt-Mixture-Design Results" form documenting the binder source change to the Division or DME, as appropriate.

When requested by the Engineer, perform a moisture-susceptibility analysis with binder from the different source, and submit the results of this analysis to the Division or DME, as appropriate. When requested, provide the Division with adequate samples of aggregate, binder, and liquid anti-stripping additive to perform a verification of the moisture-susceptibility analysis.

3.9.3.7. Subsection 403.03.03 of the Standard Specifications permits substitution of a mixture of one ESAL class higher than the specified asphalt mix without further testing, so the following case applies only when the referenced mixture was designed at a lower number of gyrations than the specified asphalt mix.

When referencing to a mixture with an identical aggregate structure (sources, sizes, cold-feed percentages, and gradation) and binder source and grade, but not the same number of gyrations, perform a

one-point check at the higher number of gyrations at an AC that yields acceptable mixture properties. Along with that information on the "Asphalt-Mixture-Design Results" form, submit two mixture specimens and two G_{mm} samples, produced at the higher number of gyrations and the optimum AC, to the Division or DME, as appropriate.

When referencing to a mixture in this case, the Division or DME will only accept design information produced at gyration levels within one ESAL class of the reference mixture design. For example, if the reference mixture design was performed at 50 gyrations (ESAL Class 2), then the Division or DME would accept a one-point check completed at 75 gyrations (ESAL Class 3) but not a one-point check completed at 100 gyrations (ESAL Class 4).

When requested by the Engineer, if the AC changes due to the higher number of gyrations, perform a moisture-susceptibility analysis at the different AC, and submit the results of this analysis to the Division or DME, as appropriate. When requested, provide the Division with adequate samples of aggregate, binder, and liquid anti-stripping additive to perform a verification of the moisture susceptibility analysis.

When requested by the Engineer, verify that the N_{max} criterion is satisfied at the higher number of gyrations.

3.10. Submitting samples:

3.10.1. As given in Subsection 3.9.1.2 of this method, send representative aggregate samples of all ingredient materials, including collected bag-house fines if used, to the Asphalt Mixtures Testing Section of the Division. Submit samples that accurately reflect the reported gradation according to the following guidelines:

Submit one standard sample bag, full of aggregate (approximately 70 lb_m), per 10 percent of that aggregate in the mixture (based on cold-feed percentages). For example, a 1.0-in.-nominal Superpave mixture is comprised of the following combination:

Limestone # 57's	40%
Limestone # 8's	20%
Limestone Sand	30%
Natural Sand	10%

In this case, when submitting aggregate to the Division during the mix-design process, properly sample, label, and submit four standard sample bags of limestone # 57's, two bags of limestone # 8's, three bags of limestone sand, and one bag of natural sand.

As an exception to these guidelines, when submitting aggregate to the Division for ATDB, properly sample, label, and submit two standard sample bags of each type and size of aggregate in the mixture.

3.10.2. Submit three gallons (in separate containers) of the PG binder, of the appropriate grade and source, for the mixture in question as specified in Subsection 3.9.1.2 of this method. Also submit the PG binder supplier's certification, conforming to KM 64-444, for the production lot from which these PG binder samples were obtained.

3.10.3. When solid additives (Gilsonite, Vestoplast, polyester fibers, polypropylene fibers, mineral fibers, etc.) or liquid anti-stripping additives are used in the asphalt mixture, submit a representative sample of this material to the Division with the mix-design information. Submit a sample of an adequate size to perform all necessary testing.

3.11. Review of the JMF:

3.11.1. The Division or DME will evaluate the acceptability of the mixture based on laboratory-mix-design data, field-verification data, and/or past experience with the proposed materials. When applicable, the DME or Division will verify the Contractor's laboratory mix design or one-point check as described in KM 64-443. The JMF reported as acceptable will normally correspond to the AC recommended by the Contractor as described in KM 64-443. The evaluating authority (either the Division or DME) may adjust the recommended AC if extensive justification (such as experience with similar mixtures, an obvious error in the mixture data, etc.) is available.

3.11.2. If small changes are necessary which can be coordinated with the Contractor, the evaluating authority will report the JMF as acceptable "with changes" and note the required changes. The Division or DME will consider the Contractor to have accepted the changes unless a revised JMF is submitted.

3.11.3. When significant changes are required in the JMF (due to the failure to satisfy the applicable mix-design criteria or gradation requirements) before a satisfactory mix can be produced, the evaluating authority will report the mixture as unacceptable. In this case, the Division or DME will require the Contractor to revise and resubmit the JMF.

3.11.4. For new mixture designs previously unsubmitted to the Department or reference mixture designs as described in Subsections 3.9.3.2, 3.9.3.3, or 3.9.3.4 of this method, the evaluating authority will return a copy of the JMF reported as acceptable to the contractor on the "Asphalt-Mixture-Design Results" form, or "MixPack" spreadsheet.

4. SETTING THE PLANT FOR THE JMF:

4.1. Provide a SPT to set the plant for the JMF reported as acceptable. Also, ensure the SPT is present and available at all times to perform mixture testing when producing and supplying asphalt mixtures for Department projects (according to Section 402 of the Department's *Standard Specifications for Road and Bridge Construction*).

4.2. Refer to the *SPT Training Manual* from the Division for examples of asphalt-plant-mix design.

4.3. Setup period (for all mixtures except Sand Asphalt, OGFC, and scratch course) - At the start of plant operations, provide a SPT to set the plant to meet the JMF reported as acceptable. Establish the JMF by the end of the first sublot of production for each type of mixture produced. Conform to the gradation requirements at all times unless permitted otherwise by the Division or DME.

4.4. Adjustment period ("minor changes" for Sand Asphalt, OGFC, and scratch course):

4.4.1. At the start of production, provide a SPT to set the plant to meet the JMF reported as acceptable. Establish the JMF by the end of the first sublot for each type of mixture produced. Ensure the new JMF is within the following tolerances of the JMF reported as acceptable. The Division or DME will consider these tolerances "minor changes." Conform to the gradation requirements unless permitted otherwise by the Division or DME.

Sieve Size	Tolerances for New JMF From Original JMF (%)
1 in.	± 4
3/4 in.	± 4
1/2 in.	± 4
3/8 in.	± 4
No. 4	± 4
No. 8	± 3
No. 16	± 3
No. 30	± 3
No. 50	± 3
No. 100	± 2
No. 200	± 1.0
Fineness Modulus*	± 0.10

*Sand Asphalt only

4.4.2. When desiring to produce a mixture with a JMF different than the JMF reported as acceptable, outside of the tolerances listed above, present the revised JMF to the Division or DME for evaluation by the end of the first sublot and prior to beginning the second sublot. The Division or DME may require an adjustment in the AC.

4.4.3. After establishing the JMF for a scratch course, conform to the gradation requirements (control points) of AASHTO M 323 for base, binder, or surface as the Engineer directs.

4.4.4. After establishing the JMF for an OGFC, conform to the gradation requirements and JMF tolerances given in Section 404 of the Department's *Standard Specifications for Road and Bridge Construction*.

4.4.5. After establishing the JMF for a Sand Asphalt, conform to the gradation requirements given in the *Special Note for Sand Asphalt Surface*.

5. CHANGES IN THE JMF:

5.1. For Sand Asphalt, OGFC, and scratch course:

5.1.1. Except those outlined in Subsection 4.4 of this method, make no changes in the JMF unless permitted otherwise by the Division or DME.

5.1.2. The Division or DME may allow JMF revisions during the course of the job.

5.2. For all mixtures:

5.2.1. When making major changes in the JMF, perform a new laboratory mix design, and submit it to the evaluating authority with all specimens, samples, and supporting information as described in Subsection 3.9 of this method, if applicable.

5.2.2. Requested changes: Submit changes on the appropriate "Asphalt-Mixture-Design Results" form with an explanation (the reason for the change) attached.

5.2.3. Changes to maintain bin balances:

5.2.3.1. Make no changes in the JMF to maintain bin balances without first assuring the Division or DME that the plant is operating properly (no holes in the screens, the screens not blinded, no carry-over, proper operation of the dust collector, proper operation of the scales and mixer, etc.).

5.2.3.2. Make no changes in the JMF to maintain bin balances due to segregated or improperly handled stockpiles, or an otherwise variable aggregate gradation into the individual aggregate feeders.

5.2.4. Permissible changes by the Contractor's SPT (within the gradation requirements for the applicable mixture) without immediate notification of the Division or DME are as follows:

5.2.4.1. Changing the hot-bin percentages for batch plants.

5.2.4.2. Changing the cold-feed proportions, except for the specific aggregate for skid-resistant mixes.

5.2.4.3. Changing the size of the cold-feed aggregates; however, do not change the sources of aggregates without prior notification of, and evaluation by, the Division or DME.

5.2.5. In addition to the JMF, make no changes in the mixing temperature and times without notification of, and evaluation by, the Division or DME.

5.2.5.1. The Division or DME may report a target mixing temperature on the "Asphalt-Mixture-Design Results" form and adjust this temperature during production due to the type of aggregate, coating characteristics, aggregate moisture, mixture workability and compactibility, and/or weather conditions.

5.2.5.2. The Division or DME may establish a mixing time. Because the PG binder coating on the aggregate is hardened by exposure to air and heat, the mixing time should be the shortest time within specifications that provides uniform distribution of aggregate sizes and uniform coating of the aggregate by the PG binder and any additives that are utilized. The Division or DME may revise this mixing time if insufficient coating of the aggregate or irregular AC or gradation values occur.

APPROVED _____

DIRECTOR
DIVISION OF MATERIALS

DATE 5/1/09

Kentucky Method 64-421-09
Revised 5/1/09
Supersedes KM 64-421-09
Dated 4/1/09

Attachments

km42109.doc

April 2009
Ver 6.01

Kentucky Transportation Cabinet, Department of Highways, Division of Materials
Asphalt Mixtures Testing Section
1227 Wilkinson Boulevard, Frankfort, KY 40601-1226

Asphalt-Mixture-Design Results

CONTRACT ID: 091234 **LETTING DATE:** 3/27/09 **TYPE OF MIX:** 00342 CL4 ASPH SURF 0.38A PG76-22

SM ID NUM.: 00640AMD090123 **MIX ID NUM.:** 00090123 **COUNTY:** Shelby **SUBMITTAL TYPE:** New Mix Design

FED/STATE #: IM NH 64-9 (999) 100 FD05 106 0064-000-010 **LAB UNIT:** LU00642 **TEST METHOD:** AASHTO M323 & R35 **TOTAL TONS:** 8765 (must equal sum on Project Items tab) **GRADATION:**

PROJ. (ITEM): MP00800180701 (0010) **DATE REC.:** 4/1/2009 **CNTR. & LOC.:** Casper & Sons Asphalt @ Spookville **CNTR. PROD. #:** AMP059999

BINDER SOURCE: Casper Oil Company @ Ghostville **DATE REL.:** 4/15/2009 **SUBMITTED BY:** sdoo **MIX MAT. CODE:** 20500

BINDER GRADE: PG76-22 **BIND. PROD. #:** LAP059999 **MIX/COMP TEMP:** 330/300 (deg. F)

Recycle selected: Use PG 76-22 virgin binder.

BINDER CODE: 60200 **ESAL CLASS:** 4 **DEPTH (mm):** 0

Reference Mixture Change Options
☐ Binder Source ☐ Binder Grade
☐ Plant Location ☐ Ref. Mix Requiring 1-Pt. Des.

Sieve	JMF	"WeighUp"
2 "	100	100
1 1/2 "	100	100
1 "	100	100
3/4 "	100	100
1/2 "	100	100
3/8 "	94	94
1/4 "	N / A	N / A
#4	61	61
#8	37	37
#16	24	24
#30	15	15
#50	9	8
#100	6	5
#200	4.0	3.2

AGG. PROD. NO.	PRODUCER NAME	MAT. CODE	AGG. TYPE	G_{sb}	%
AGP001234	Limestone Quarry #1 @ Spookville	10365	Dolomite #68's	2.63	35
AGP001234	Limestone Quarry #1 @ Spookville	10395	Dolomite #8's	2.63	17
AGP001234	Limestone Quarry #1 @ Spookville	10313	Dol. Sand (Unwashed)	2.66	20
AGP004321	Limestone Quarry #2 @ Ghostville	10310	LSS (Washed)	2.64	13
AMP009999	Casper & Company @ Ghostville	24025	RAP	2.68	15

Gravity Info.

G_{sb} = **2.64**
G_{se} = **2.723**
G_b = **1.030**

Recycle MSG's	
2.518	2.513
Rap Gsb =	2.68

Max. Specific Gravity Info.

%AC	MSG's
5.5	2.496
	2.499
Average:	**2.498**

Fill in Recycle MSG's and Recycle Info. on Page 2 and use Backcalculated Gsb as Agg. Gravity for Recycle.

Sample #	% AC (Mix)	Weight (g) (Air)	(Water)	(SSD)	Bulk Vol. (g)	BSG @ N_{des}	Unit Wt. @ N_{des} (pcf)	Max Spec Gravity	% Voids @ N_{des}	% Abs. AC (Mix)	% Eff. AC	% VMA @ N_{des}	% VFA @ N_{des}	Film Th. (µm)	$\%G_{mm}$ @ N_{ini}	D/A Ratio	Height @ N_{ini} (mm)	Height @ N_{des} (mm)
1		4696.3	2737.4	4748.6	2011.2	2.335											132.9	117.6
2		4695.5	2731.1	4746.2	2015.1	2.330											132.6	117.7
Average	4.5					2.333	145.6	2.536	8.0	1.07	3.4	15.8	49.2	8.0	81.5	1.2		
3		4698.1	2734.0	4727.6	1993.6	2.357											132.7	117.7
4		4697.0	2737.8	4725.8	1988.0	2.363											131.8	117.4
Average	5.0					2.360	147.2	2.516	6.2	1.07	3.9	15.2	59.1	9.2	83.3	1.0		
5		4696.9	2737.7	4719.0	1981.3	2.371											129.4	115.2
6		4696.7	2739.5	4717.6	1978.1	2.374											129.5	114.9
Average	5.5					2.372	148.0	2.498	5.0	1.06	4.4	15.2	67.1	10.5	84.4	0.9		
7		4700.6	2735.3	4709.6	1974.3	2.381											130.0	115.3
8		4698.0	2735.4	4706.3	1970.9	2.384											129.4	114.7
Average	6.0					2.382	148.7	2.479	3.9	1.06	4.9	15.3	74.6	11.7	85.2	0.8		

Specimens at optimum AC:

Sample #	% AC (Mix)	Weight (g) (Air)	(Water)	(SSD)	Bulk Vol. (g)	BSG @ N_{des}	Unit Wt. @ N_{des} (pcf)	Max Spec Gravity	% Voids @ N_{des}	% Abs. AC (Mix)	% Eff. AC	% VMA @ N_{des}	% VFA @ N_{des}	Film Th. (µm)	$\%G_{mm}$ @ N_{ini}	D/A Ratio	Height @ N_{ini} (mm)	Height @ N_{des} (mm)	Height @ N_{max} (mm)	$\%G_{mm}$ @ N_{max}
A		4695.6	2766.1	4710.6	1944.5	2.388											132.4	115.1	113.8	
B		4696.0	2765.7	4712.9	1947.2	2.372											133.0	115.6	113.7	
Average	5.9					2.380	148.5	2.483	4.1	1.06	4.8	15.3	73.0	11.5	83.3	0.8				97.2

RANDOM NUMBER GENERATOR

PLEASE NOTE: Random numbers can only be generated one time. Make sure the correct tonnage appears below. If so, press GENERATE.

English Tons = | **GENERATE**

Sublot	Rand. #	Sublot	Rand. #	Sublot	Rand. #	Sublot	Rand. #	Sublot	Rand. #

Design Property	Design Value	Criteria
Coarse Aggregate Angularity (%)	**100/100**	100/100 (minimum)
Fine Aggregate Angularity (%)	**46**	45 (minimum)
Flat & Elongated Particles (%)	**1**	10 (maximum)
Clay Content (SE) (%)	**81**	50 (minimum)
% VFA	**73.0**	73 - 76
% VMA	**15.3**	15.0 (minimum)
D/A Ratio	**0.8**	0.8 - 1.6
% G_{mm} @ $N_{initial}$	**85.2**	89.0 (maximum)
% G_{mm} @ N_{max}	**97.2**	98.0 (maximum)
% Air Voids	**4.0**	4.0
Unit Weight (lb/ft^3)	**148.6**	
% AC	**5.9**	
% Effective AC	**4.8**	
Maximum Specific Gravity	**2.483**	
% Absorbed AC (Mix)	**1.06**	
G_{sb}	**2.64**	
G_{se}	**2.723**	
Film Thickness (µm)	**11.5**	
Specimen Weight (g)	**4682**	
TSR Weight (g)	**3750**	
% TSR without additive	**78**	80 (minimum)
% TSR with additive	**88**	80 (minimum)
% Additive	**0.5**	
Type of Additive	**STICK-TITE 333 LS**	

NOTES:

Complete SGC Des.		1-Pt. SGC Des.	X
App.-New Design	X	App.-Ref. Mix	
MCL Design		Contr. Design	X

Revised Asphalt Content (+ or - 0.3 %):

Reference Information	
County:	N/A
Mix ID #:	N/A
Binder:	N/A
Date Released:	N/A
Design AC %:	N/A
Job Complete?	N/A
(Other information)	

Sieve	JMF	Revised
2 "	100	100
1 1/2 "	100	
1 "	100	
3/4 "	100	
1/2 "	100	
3/8 "	94	
1/4 "	N / A	N / A
#4	61	
#8	37	
#16	24	
#30	15	
#50	9	
#100	6	
#200	4.0	

Recycle Information	
%AC in Recycle:	**4.8**
%Virgin AC in mix:	**0.7**
%Recycle AC in mix:	**5.2**
Total %AC in mix:	**5.9**
APPROVED BY:	
cdracula	

April 2009

Project	Line Item Number	Represented Quantity (in item code unit)	Item Code Unit
MP00800180701	0010	8765	Tons

April 2009

Kentucky Transportation Cabinet, Department of Highways, Division of Materials
Asphalt Mixtures Testing Section
1227 Wilkinson Boulevard, Frankfort, KY 40601-1226

One-Point Gyratory Specimen Properties Evaluation

Mix ID # & County:	# 00090123, Shelby County	Mix Type:	00342 CL4 ASPH SURF 0.38A PG76-22
Tested By:	Scooby Doo		
Date Received:	April 1, 2009	Date Comp.:	April 2, 2009
Test Methods Used:	AASHTO T166 & T209	Lab:	LU00642

Specimens: ☐ Submitted by Contractor ☐ Made by MCL

Gyratory Specimen Weights

% AC	Spec. No.	Wt. in Air (g)	Wt. in H_20 (g)	SSD Wt. (g)	BSG
5.9	1	4697.4	2730.2	4713.7	2.368
	2	4695.0	2727.4	4715.3	2.362

Maximum Specific Gravity (G_{mm}) Determination

1. Wt. of Pycnometer + Mix (g)	2947.4	3079.4		
2. Wt. of Pycnometer (g)				
3. Wt. of Mix (g) [1-2]	2947.4	3079.4		
4. Calibration Wt. (g)	1321.2	1305.6		
5. Calibration Wt. + Wt. of Mix (g) [3+4]	4268.6	4385.0		**Average**
6. Final Wt. (g) [Test Complete]	3082.6	3147.2		
7. Volume of Mix (cm^3) [5-6]	1186.0	1237.8		
8. G_{mm} Without Dry-back (3/7)	2.485	2.488		2.486
9. Volume of Absorbed Water (cm^3)				
10. Adjusted Volume of Mix (cm^3) [7+9]				
11. G_{mm} With Dry-back (3/10)				

Gyratory Specimen Properties

Unit Wt. (lb/ft^3) =	147.6	D/A Ratio =	0.9	AC (%) =	5.9
% Air Voids =	4.9	G_{mm} =	2.486	% VMA =	15.7
% VFA =	68.9	% Eff. AC =	4.7	% Abs. AC (Mix) =	1.23
G_{sb} =	2.64	G_{se} =	2.728	ESAL Class	4

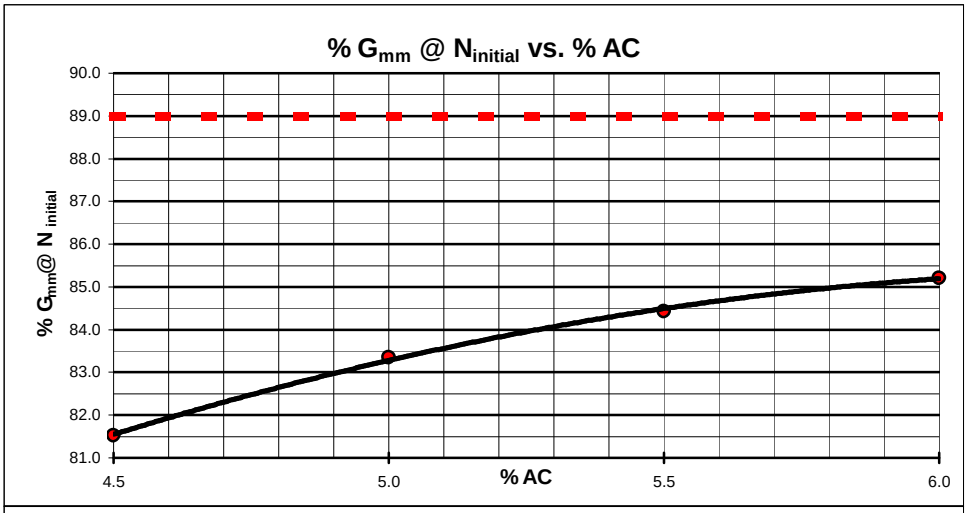
Deviations from Test Method:

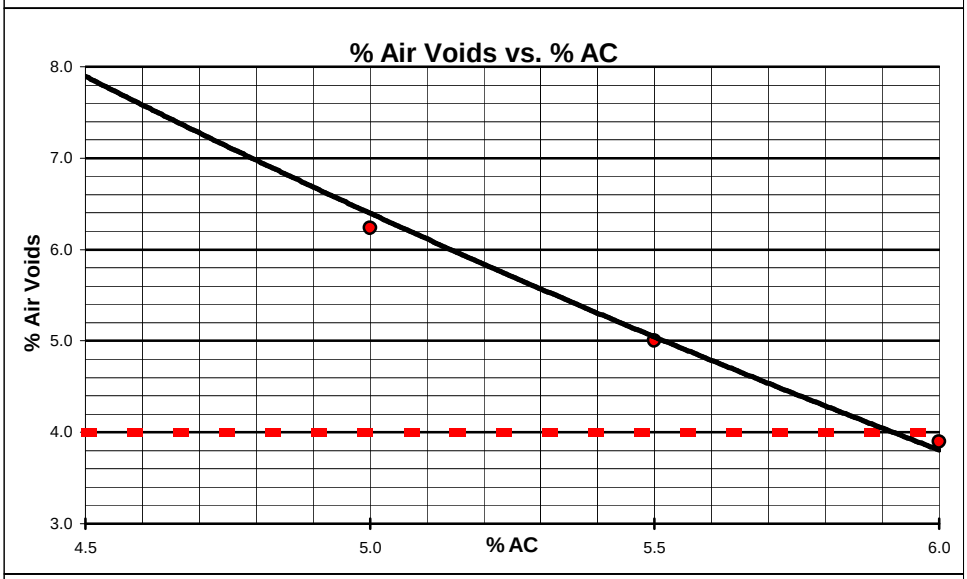
KENTUCKY DEPARTMENT OF HIGHWAYS
DIVISION OF MATERIALS
Laboratory Mix Design

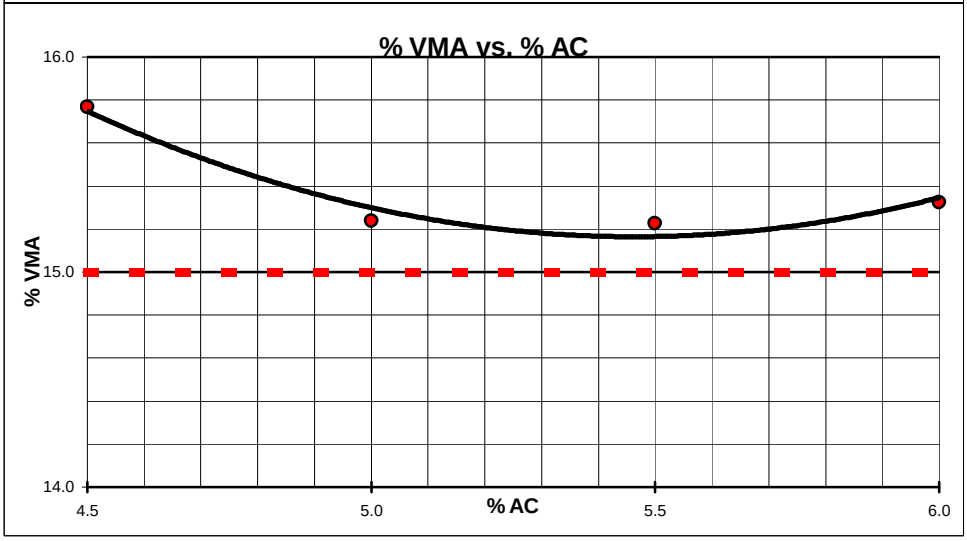
April 2009

Mix ID #: 00090123 **County:** Shelby **Type Mix:** 00342 CL4 ASPH SURF 0.38A PG76-22
Project Number: MP00800180701 (0010)
Contractor & Loc.: Casper & Sons Asphalt @ Spookville

N_{des} Gyrations: 100
Lab : LU00642
Date Completed: April 8, 2009
Date Released: April 15, 2009







RESULTS:

% AC:	5.9
% G_{mm} @ N_{ini}:	85.2
% Air Voids:	4.0
% VMA:	15.3

REMARKS:

Technical Responsibility:

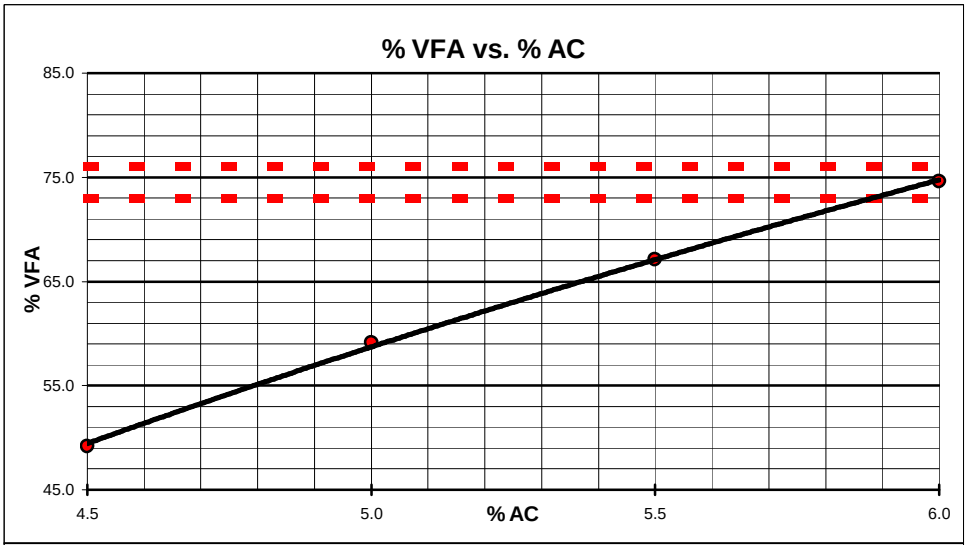
Count Dracula

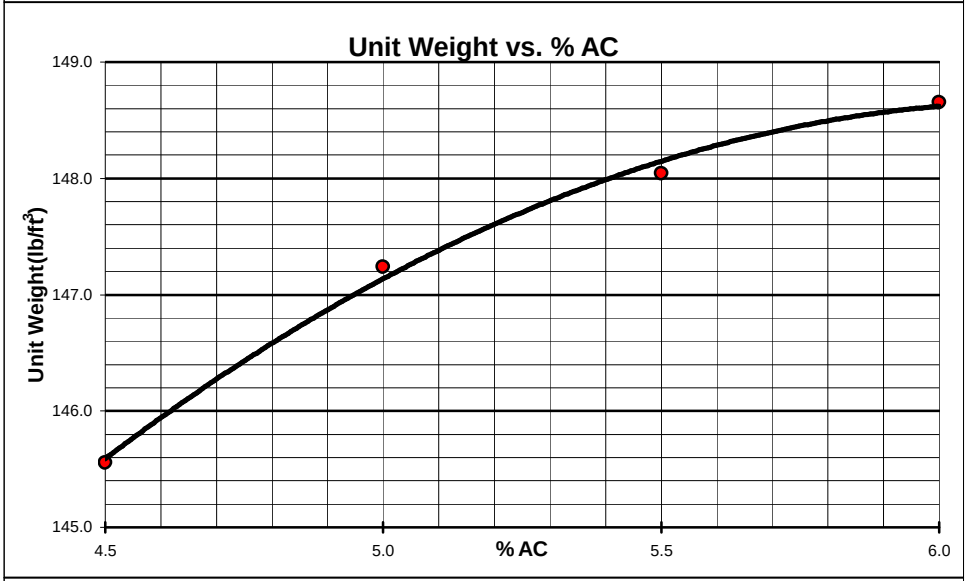
KENTUCKY DEPARTMENT OF HIGHWAYS
DIVISION OF MATERIALS
Laboratory Mix Design

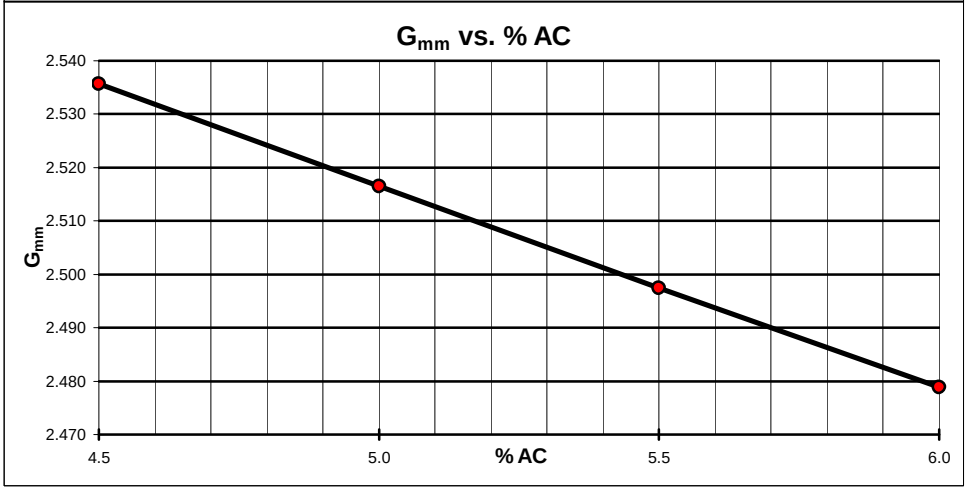
April 2009

Mix ID #: 00090123 **County:** Shelby **Type Mix:** 00342 CL4 ASPH SURF 0.38A PG76-22
Project Number: MP00800180701 (0010)
Contractor & Loc.: Casper & Sons Asphalt @ Spookville

N_{des} Gyrations: 100
Lab: LU00642
Date Completed: April 8, 2009
Date Released: April 15, 2009







RESULTS:

% AC:	5.9
% VFA:	73.0
Unit Weight (pcf):	148.6
G_{mm}:	2.483

REMARKS:

Technical Responsibility:

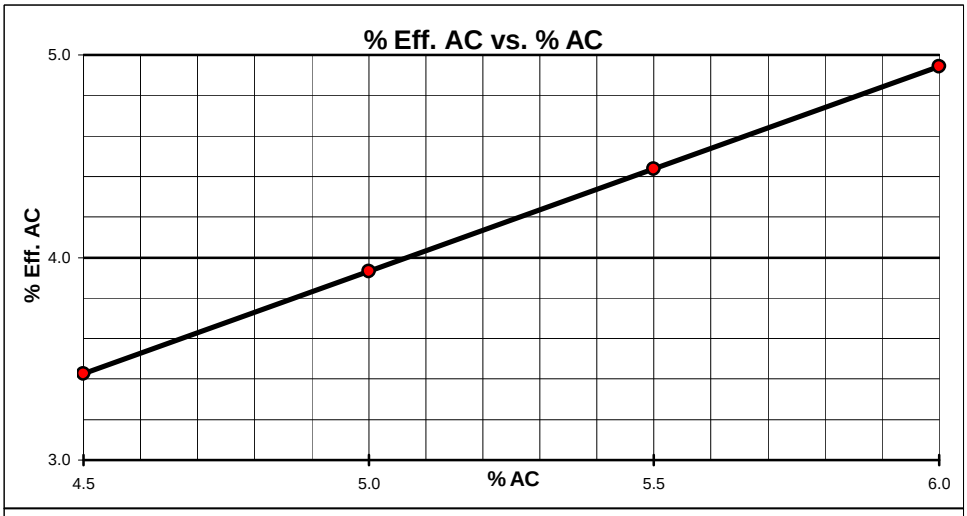
Count Dracula

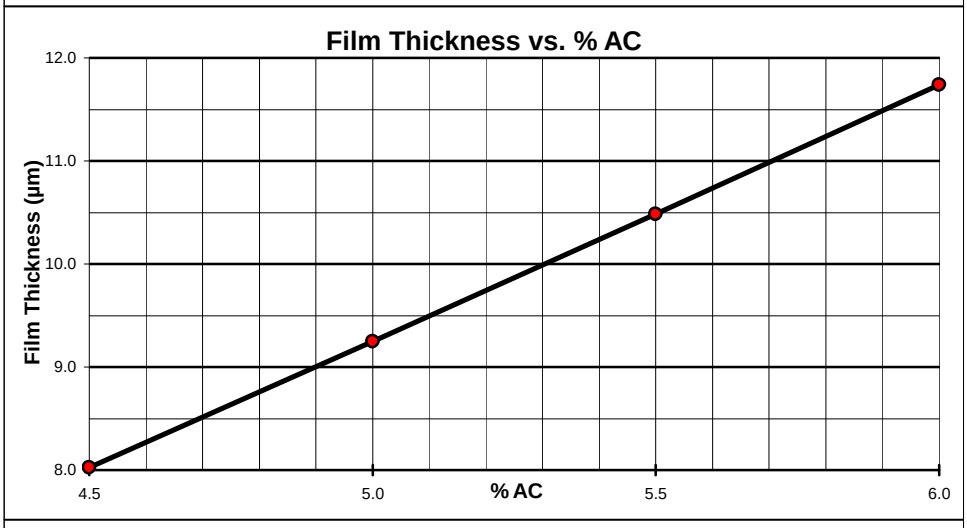
KENTUCKY DEPARTMENT OF HIGHWAYS
DIVISION OF MATERIALS
Laboratory Mix Design

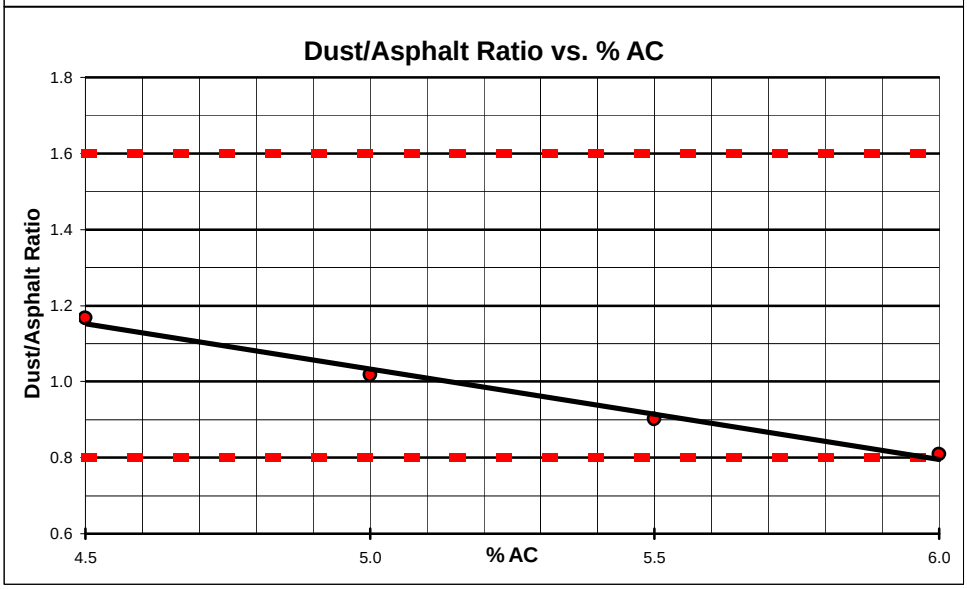
April 2009

Mix ID #: 00090123 **County:** Shelby **Type Mix:** 00342 CL4 ASPH SURF 0.38A PG76-22
Project Number: MP00800180701 (0010)
Contractor & Loc.: Casper & Sons Asphalt @ Spookville

N_{des} Gyrations: 100
Lab: LU00642
Date Completed: April 8, 2009
Date Released: April 15, 2009







RESULTS:

% AC:	5.9
% Eff. AC:	4.8
Film Thickness (µm):	11.5
Dust/Asphalt Ratio:	0.8

REMARKS:

Technical Responsibility:

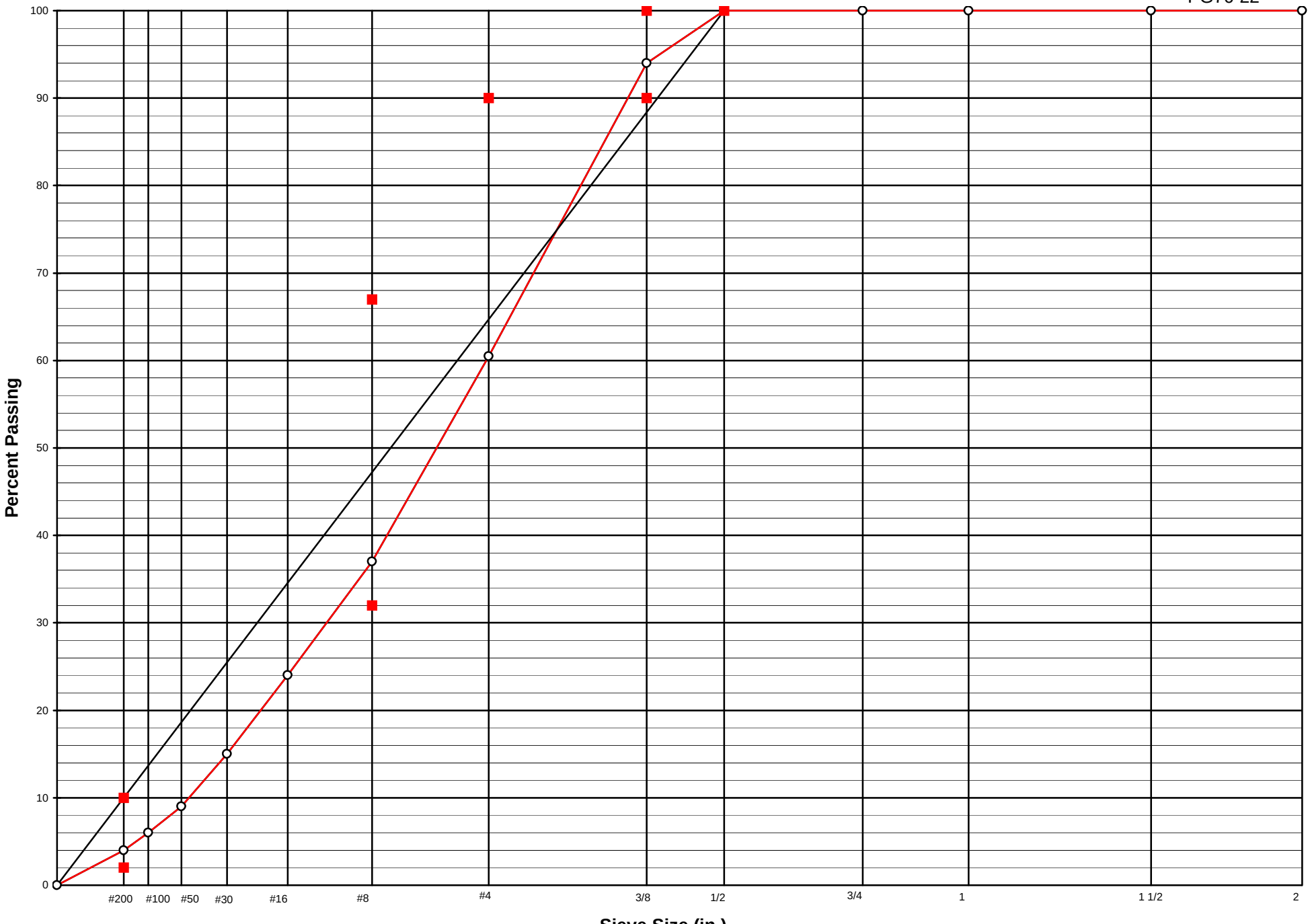
Count Dracula

April 2009

0.45 POWER CHART

#123, Shelby County

Superpave 0.38A Surface (RAP)
PG76-22



Technical Responsibility: Count Dracula Lab: 00 Date Received: N/A Date Completed: 5/5/2009

April 2009

Kentucky Transportation Cabinet, Department of Highways, Division of Materials
Asphalt Mixtures Testing Section
1227 Wilkinson Boulevard, Frankfort, KY 40601-1226

Percentage of Tensile Strength Retained (% TSR) Results

MIX ID #:	00090123	**COUNTY:**	Shelby	**TYPE OF MIX.:**	00342 CL4 ASPH SURF 0.38A PG76-22
PROJ. #:	MP00800180701 (0010)	**LAB:**	LU00642	**CONTR. & LOC.:**	Casper & Sons Asphalt @ Spookville
BIND. GRADE: (as per bid item)	PG76-22	**TSRs made with:**	PG64-22	**TEST METHOD:**	ASTM D4867
BIND. SOURCE:	Casper Oil Company @ Ghostville	**MIX/COMP TEMP:**	300/265 (deg. F)		

TSR specimens are to be compacted to a height of 95.0 mm with a target air void percentage of 7.0 % (+ or - 1.0 %). The target degree of initial saturation is 65.0% (+ or - 5.0 %).

% AC:	% ADDITIVE:
5.9	0.5

TYPE OF ADDITIVE:
STICK-TITE 333 LS

Process	Date:	Time:	By:
TSR's Made:	4/8/2009	8:00 AM	Frankenstein
TSR's Bulked:	4/8/2009	11:00 AM	Frankenstein
TSR's Saturated:	4/8/2009	1:00 PM	Frankenstein
TSR's in Freezer:	4/8/2009	3:00 PM	Frankenstein
TSR's in 140°F Bath:	4/9/2009	7:00 AM	Frankenstein
TSR's Broken :	4/10/2009	8:00 AM	Frankenstein

Test Specimen Results		
Sample Identification	1	2
Sample Aggregate Weight (g)	3450	3550
Grams of Asphalt Binder (g)	216	223
Dry Weight in Air (g)	3688.1	3793.5
Weight in Water (g)	2102.9	2189.9
SSD Weight (g)	3733.5	3823.0
Bulk Volume (cm^3)	1630.6	1633.1
Bulk Specific Gravity	2.262	2.323
Maximum Specific Gravity	2.483	2.483
% Air Voids	8.9	6.4
Target % Air Voids	7.0 %	
Target Aggregate Weight (g)	3528	
Asphalt Binder (g)	221	

Sample ID	1-C	2-T	3-T	4-T	5-C	6-C	Average	7	8	9	10	11	12	Average
Diameter (mm)	150.0	150.0	150.0	150.0	150.0	150.0		150.0	150.0	150.0	150.0	150.0	150.0	
Thickness (mm)	95.0	95.0	95.0	95.0	95.0	95.0		95.0	95.0	95.0	95.0	95.0	95.0	
Dry Weight (g)	3745.6	3744.3	3745.0	3742.4	3747.2	3679.8		3740.6	3739.1	3756.5	3756.8	3741.6	3748.8	
SSD Weight (g)	3798.5	3787.3	3789.8	3792.1	3793.5	3711.1		3762.1	3759.1	3776.3	3774.8	3766.4	3768.2	
Wt. in Water (g)	2168.4	2162.0	2164.1	2160.2	2167.0	2110.5		2130.3	2125.8	2145.9	2136.9	2133.9	2134.3	
Volume (cm^3)	1630.1	1625.3	1625.7	1631.9	1626.5	1600.6		1631.8	1633.3	1630.4	1637.9	1632.5	1633.9	
Bulk Spec. Gravity	2.298	2.304	2.304	2.293	2.304	2.299		2.292	2.289	2.304	2.294	2.292	2.294	
Max. Sp. Gravity	2.483	2.483	2.483	2.483	2.483	2.483		2.483	2.483	2.483	2.483	2.483	2.483	
% Air Voids	7.5	7.2	7.2	7.6	7.2	7.4	**7.4**	7.7	7.8	7.2	7.6	7.7	7.6	**7.6**
Vol. Air Voids (cm^3)	121.6	117.3	117.4	124.7	117.4	118.6		125.3	127.4	117.5	124.9	125.6	124.1	
Load (lb_f)	5870				6100	5610		5700	5680	6050				

Saturated

Sample ID	1-C	2-T	3-T	4-T	5-C	6-C	Average	7	8	9	10	11	12	Average
SSD Weight (g)		3820.2	3821.4	3825.4							3835.0	3825.6	3828.9	
Vol. Abs. Wat. (cm^3)		75.9	76.4	83.0							78.2	84.0	80.1	
% Saturation		64.7	65.1	66.6			**65.4**				62.6	66.9	64.5	**64.7**

Conditioned 24 hrs. in 140 °F water

Sample ID	1-C	2-T	3-T	4-T	5-C	6-C	Average	7	8	9	10	11	12	Average
Thickness (mm)		95.0	95.0	95.0							95.0	95.0	95.0	
SSD Weight (g)		3844.5	3845.6	3852.7							3847.0	3838.4	3839.0	
Vol. Abs. Wat. (cm^3)		100.2	100.6	110.3							90.2	96.8	90.2	
% Saturation		85.4	85.7	88.5			**86.5**				72.2	77.1	72.7	**74.0**
Load (lb_f)		4340	4525	4875							4750	5225	5380	
Wet Strength (psi)		125.1	130.4	140.5			**132.0**				136.9	150.6	155.1	**147.5**
Dry Strength (psi)	169.2				175.8	161.7	**168.9**	164.3	163.7	174.4				**167.5**

% TSR Without Additive = **78** **% TSR With Additive =** **88**

REMARKS: