5-2000

Issues pertaining to laboratory evaluation of hot mix asphalt

Patrick Vaughan Kiser

To the Graduate Council:

I am submitting herewith a thesis written by Patrick Vaughan Kiser entitled "Issues pertaining to laboratory evaluation of hot mix asphalt." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Civil Engineering.

N. Mike Jackson, Major Professor

We have read this thesis and recommend its acceptance:

Karen C. Chou, J. Harold Deatherage, Eric C. Drumm

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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ISSUES PERTAINING TO LABORATORY EVALUATION OF HOT MIX ASPHALT

A Thesis
Presented for the
Master of Science
Degree

The University of Tennessee, Knoxville

Patrick Vaughan Kiser
May 2000

DEDICATION

This work is dedicated to my wife, Becky, for her love and patience,

And

To my parents for their love and guidance

In loving memory of Mr Aubrey Lee Kiser

ACKNOWLEDGEMENTS

I would like to thank the faculty and staff of the Civil and Environmental Engineering Department for their support and encouragement during my tenure at the University of Tennessee A special thank you goes to Dr Mike Jackson for his guidance and friendship along the way I would also like to thank the Tennessee Department of Transportation for their assistance with this project. I would like to thank Dr Karen Chou, Dr Eric Drumm, and Dr Hal Deatherage for taking the time and putting forth the effort to be mentors for aspiring engineers A special thanks to Mr Ken Thomas and Mr Larry Roberts for fixing all of the things that I broke A special acknowledgement and note of thanks to Dexter Justis and Danny Oliver for the countless hours of time in the lab and their tireless effort Finally, I would like to thank my wife, Becky, for her love, support, and understanding

ABSTRACT

Since the early 1900's, research in the Hot Mix Asphalt (HMA) industry has focused on the development of a more mechanistic design approach and improving quality control procedures This paper presents the results of three observational studies conducted to evaluate problems associated with relatively recent developments in HMA design and analysis as follows

1) Aggregate degradation due to laboratory compaction using the Superpave™ Gyratory Compactor (SGC)

2) Aggregate degradation due to ignition oven testing using the NCAT Asphalt Content Tester

3) Comparison of the bulk specific gravity, saturated, surface dry (SSD) method with bulk specific gravity, Parafilm™ method for HMA specimens

These observational studies included HMA samples from over 20 paving projects constructed in the state of Tennessee during the 1998 construction season

The results of these studies suggest that there is no significant degradation of aggregate resulting from the SGC or the NCAT ignition oven for HMA typically produced in Tennessee The results suggest that the use of the Parafilm™ method in measuring bulk specific gravity of compacted HMA specimens results in an air-void content approximately 2% higher than using SSD methods It is not clear which method produces a more correct measure of air-void content The results also suggest

that the SSD method is more suitable for typical HMA specimens containing less than 6% air-voids It is suspected the internal voids are not interconnected with surface voids at this level of compaction.

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CHAPTER 1.0 INTRODUCTION

The implementation of the Superior Performing Asphalt Pavement (Superpave™) mix design and analysis system is the latest step towards the development of a mechanistic design approach for Hot Mix Asphalt (HMA) The Strategic Highway Research Program (SHRP), established by the U S Congress in 1987, was initiated to improve the performance and durability of the nation's highway system $50 million of the $150 million allocated to the program went towards HMA related research

Since the early 1900's, research and development in the HMA industry has focused on developing a more mechanistic design approach and improving quality control methods The Superpave™ Gyratory Compactor (SGC) and the NCAT Ignition Oven are two relatively recent introductions into the laboratory to improve and accelerate HMA design and testing. Over the past five to seven years, the SGC and the NCAT ignition oven have improved and accelerated the compaction and testing capabilities of HMA laboratories throughout the US and abroad However, some in the industry still express concerns regarding the degradation of aggregate during laboratory compaction and ignition oven testing.

Gradation is possibly the most important aggregate property to consider in the design and quality control of HMA Gradation affects the stability, durability, permeability, workability, fatigue resistance, frictional characteristics, and resistance to moisture damage of a mix (Roberts et al. 1996) Aggregate degradation is the breaking of aggregate particles. The breakdown of aggregates alters the gradation,

effectively altering the aforementioned performance properties of the binder/aggregate mixture

Aggregate degradation during laboratory compaction results in a gradation different from that designed Breakdown of the aggregate alters particle sizes, particle angularity, and increases the dust (-0 075-mm) content Alteration of the gradation of the specimen results in changes in the volumetric properties of the specimen [Voids in the Total Mix (VTM), Voids in the Mineral Aggregate (VMA), and Voids Filled with Asphalt (VFA)] The volumetric properties of the designed mix cannot be achieved with the altered gradation. Concerns posed by aggregate degradation during laboratory compaction are as follows.

- Performance of the designed aggregate/binder mixture
- Compliance with volumetric specifications (VTM, VMA, VFA)
- Repeatability of mix design

Quality control of asphalt mixtures is essential in providing a durable pavement The asphalt cement (AC) content and aggregate gradation of the aggregate/binder mixture are vital to the performance of the pavement Quality control procedures for asphalt production dictate a regular schedule of AC and gradation testing of the mix leaving the asphalt plant Aggregate degradation during asphalt content determination for quality control purposes may result in specification compliance complications For example, aggregate breakdown results in an increase in dust content and may cause the sample to fail dust content and dust proportion specifications.

An accurate measure of the specific gravity of a compacted specimen is essential in determining its volumetric properties Bulk specific gravity of laboratory compacted specimens is used to determine the volumetric properties for the aggregate/binder mixture The ratio of bulk specific gravity to maximum specific gravity of a cored specimen from a roadway project is used as a quality assurance measure Any variation in the specific gravity determination results in a misrepresentation of mixture or specimen properties.

Compacted specimens containing a relatively large amount of surface voids or interconnected air voids pose a problem with regard to accurate determination of specific gravity The problem arises when surface voids are interconnected with internal voids While obtaining the submerged weight in water, the internal voids are filled with water and are not measured as air voids Alternative methods such as paraffin coating or wrapping the specimen in Parafilm™ have been developed to supplement the bulk specific gravity determination for specimens with a high air void content (Harvey et al 1994)

1.1 Objective

The objective of this paper is to outline the results of three observational studies conducted for common Tennessee Department of Transportation (TDOT) mixes The studies documented herein are as follows

1) Quantify the observed aggregate degradation due to laboratory compaction using the SGC Assess the influence of mix type,

aggregate type, design gradation, and specimen diameter (150-mm vs 100-mm) on aggregate degradation.

2) Quantify the observed aggregate degradation due to laboratory asphalt cement content testing using the NCAT Ignition Oven Assess the influence of mix type, aggregate type, and design gradation on aggregate degradation.

3) Quantify the observed saturated surface dry (SSD) and Parafilm™ bulk specific gravities for laboratory compacted HMA specimens Develop a correlation between SSD bulk specific gravity and Parafilm™ bulk specific gravity

CHAPTER 2.0 SUPERPAVE™ GYRATORY COMPACTOR (SGC)

2.1 Introduction

The Superpave™ mix design and analysis system is a direct result of the asphalt-related research of SHRP The SGC was developed to replace the traditional Marshall and Hveem methods of laboratory compaction It has been documented that the SGC tends to orient aggregate particles similar to observed roadway conditions (Roberts et al 1996).

The goal of SHRP researchers was to identify a laboratory compaction device capable of compacting specimens to realistic densities achieved under actual field climate and loading conditions, that was able to accommodate large aggregates, and could measure compactability of the binder/aggregate mixture No existing compaction method possessed all of these characteristics, so a new product was introduced The SGC is basically a modification of the Texas gyratory compactor to employ the compaction principles of the French gyratory compactor (Asphalt Institute 1996)

The SGC is composed of a reaction frame with a rotating base and motor, loading system with a loading ram and pressure gage, a height measuring and recording system, and a mold with a base plate A constant 600 kPa (90 psi) compaction pressure is applied to the specimen through a loading ram with a pressure monitoring system, while it is being rotated at a constant 30 revolutions per minute The mold is held at an angle of 1.25°during compaction The height of the specimen

is recorded at each gyration and can be used to develop compaction characteristics of the mix (Asphalt Institute 1996)

The amount of compaction is determined by the number of gyrations experienced by the specimen Three gyration levels are of interest during design - $N_{initial}$, N_{design}, and N_{max} where N is the number of gyrations N_{design} is the number of gyrations required to produce a density equivalent to an expected field density after the indicated amount of traffic $N_{initial}$ is a measure of the compactability of the aggregate/binder mixture N_{max} is the number of gyrations required to simulate an expected field density that should never be exceeded (Asphalt Institute 1996) The number of gyrations is determined by traffic levels (design ESAL's) and average design high air temperature Table 1 summarizes the current Superpave™ specification for level of compaction

Table 1 Revised Superpave™ Specification for Level of Compaction from (Kandhal 1999)

Estimated Design Traffic Level (Million ESAL's)	Number of Gyrations Superpave Compaction Parameters			% G_{mm} $N_{initial}$ Requirement
	N_{ini}	N_{des}	N_{max}	
< 0 3	6	50	75	≤ 91 5
0 3 - 3	7	75	115	≤ 90 5
3 – 30	8	100	160	≤ 89.0
> 100	9	125	212	≤ 89 0

Standard HMA design using the SGC involves the compaction of specimens to N_{max} and then back-calculation of volumetric properties at $N_{initial}$ and N_{design} There are those in the industry that have expressed concern with respect to the degradation of aggregate during the compaction of specimens to N_{max} It should be noted that modifications to the Superpave™ procedures allow for compaction of specimens to N_{design} for determination of mixture properties instead of back-calculation from N_{max} (FHWA 1999). However, this study only compares the gradations of uncompacted HMA with specimens compacted to N_{max} It is assumed that any observed aggregate degradation at N_{max} will be significantly greater than that occurring at N_{design} or $N_{initial}$

A previous study conducted by the Georgia Department of Transportation concluded that no significant difference occurs in aggregate degradation of mixes compacted by the SGC They further stated that any change in the fines content (minus 0.075-mm) is not significant enough to prevent specimens from complying with dust proportion specifications (Collins, et al 1997)

2.2 Objective

The objective of this study was to document the observed aggregate degradation resulting from SGC testing for common TDOT mixes The effects of mix type, aggregate type, and design gradation were observed, documented and analyzed The aggregates evaluated during this study included limestones and river gravels commonly used for HMA production in Tennessee The limestones evaluated are typically composed of 60-90% calcium carbonate ($CaCo_3$), 5-20% magnesium carbonate ($MgCO_3$), and 5-15% silica dioxide (SiO_2) (Hershey and Maher 1985)

The river gravels evaluated typically contain silica dioxide (SiO_2) contents in excess of 90% It has been recommended to the state of Tennessee that 100-mm diameter specimens could be used in lieu of 150-mm diameter specimens for Superpave™ mix design (Jackson and Czor 1999) The effects of specimen size were observed, documented, and analyzed to further evaluate the validity of this recommendation with respect to aggregate degradation during compaction

The mixes evaluated in this study are identified as binder and surface mixes in accordance with Sections 307 and 411, respectively, of the TDOT Standard Specifications for Road and Bridge Construction (TDOT 1995) The mixes are further classified as conventional or Superpave™ with respect to the method of design used in developing the Job Mix Formula (JMF). The conventional TDOT mixes (411D and 307BM/BM-2 designations) were designed by the 75-blow Marshall method, whereas the Superpave™ mixes (411S and 307S designations) were designed in accordance with Superpave™ volumetric mix design criteria (TDOT Special Provision)

2.3 Test Program

Laboratory testing was performed in the Civil Engineering Materials Laboratory at the University of Tennessee The aggregate gradations for the respective mixes were determined before and after SGC testing for evaluation of aggregate degradation as a result of compaction Table 2 outlines the mixes evaluated in this study Table 3 summarizes the laboratory sampling and test procedures

Table 2 Summary of Mixes Evaluated for SGC Study

TDOT Mix Type	Mix Description	Aggregate Type	Gradation*
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	Granite	BRZ
307 BM/2	Conventional Marshall Binder	River Gravel	TRZ
411D w/ Latex	Conventional Marshall Surface	Limestone	TRZ
411D	Conventional Marshall Surface	Limestone	ARZ
307 BM	Conventional Marshall Binder	Limestone	ARZ
307 BM	Conventional Marshall Binder	Limestone	TRZ
411D	Conventional Marshall Surface	Limestone	ARZ
307S	Superpave™ Binder	River Gravel	BRZ
411S	Superpave™ Surface	River Gravel	BRZ
307 BM	Conventional Marshall Binder	Limestone	BRZ
307 BM/2	Conventional Marshall Binder	Limestone	TRZ
411D	Conventional Marshall Surface	River Gravel	ARZ
307 BM	Conventional Marshall Binder	Limestone	ARZ
307S w/ Fiber	Superpave™ Binder	Limestone	BRZ
307 BM/2	Conventional Marshall Binder	Limestone	ARZ
411S	Superpave™ Surface	River Gravel	BRZ
411S w/ Fiber	Superpave™ Surface	River Gravel	BRZ
411S	Superpave™ Surface	Limestone	BRZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	River Gravel	TRZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	Limestone	TRZ
411D	Conventional Marshall Surface	Limestone	ARZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	Limestone	BRZ
307 BM/2	Conventional Marshall Binder	Limestone	TRZ
411D	Conventional Marshall Surface	River Gravel	ARZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	River Gravel	BRZ
411S	Superpave™ Surface	River Gravel	BRZ

* Relative to Restricted Zone
ARZ – Above (Fine) BRZ – Below (Dense) TRZ - Through

Table 3 Laboratory Procedure Summary for SGC Study

	Procedure Description	Specification	
		ASTM	AASHTO
Field	Sample Collection	D 75	T 248
Laboratory	Sample Reduction	C 702	T 248
	SGC Compaction	N/A	TP 4
	Ignition Extraction	N/A	TP 53
	Washed Sieve Analysis	C 117	T 11
	Mechanical Sieve Analysis	C 136	T 27

followed during preparation of the gradation samples Loose HMA samples were collected during roadway construction and transported to the laboratory at the University of Tennessee 150-mm and 100-mm specimens were compacted from each project using the SGC. The removal of the asphalt from compacted and loose specimens was accomplished through burning using an ignition oven A washed sieve analysis was performed on the ignition-extracted aggregates to determine the gradation of each specimen A schematic of the testing program can be found in Figure 1

2.3.1 Sample Collection

Samples were collected from more than 20 paving projects that were constructed in the state of Tennessee during the 1998 construction season

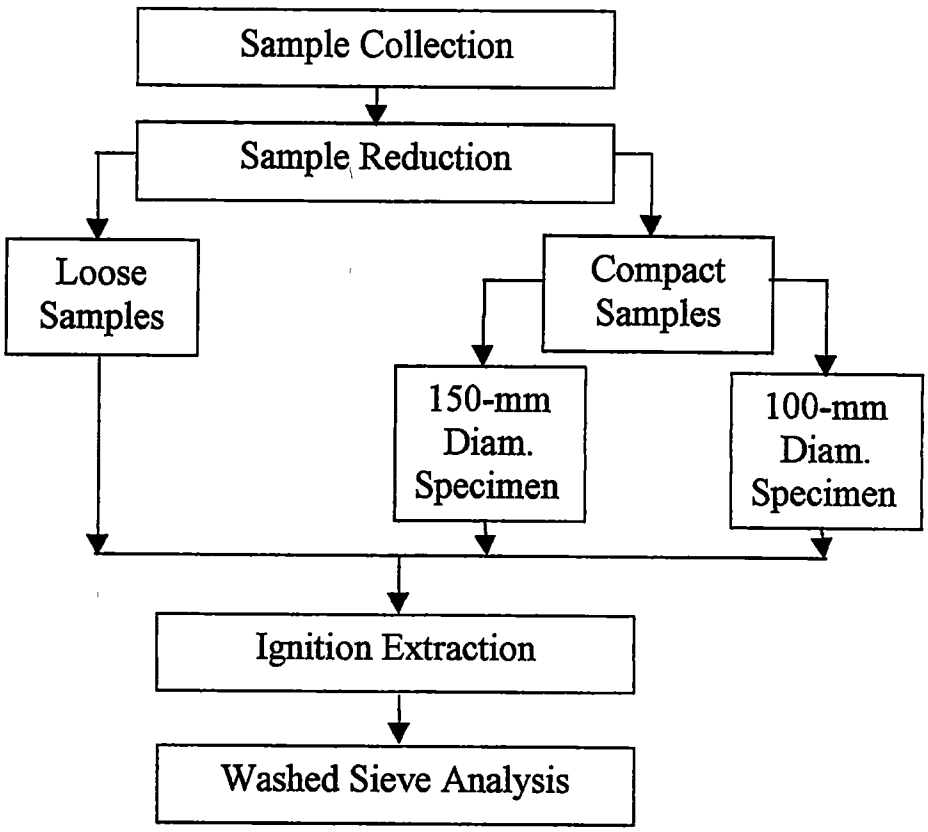

Figure 1 Testing Procedure Schematic for SGC Study

Representative samples were obtained in accordance with respective ASTM and AASHTO specifications TDOT personnel assisted in obtaining and transporting loose HMA samples to the laboratory at the University of Tennessee Bulk Samples were reduced to test sample sizes appropriate for SGC compaction and NCAT ignition oven testing of loose (uncompacted) samples

2.3.2 Laboratory Compaction

Specimens were compacted using the Pine Instrument Company, Model AFGC125X Gyratory Compactor, as shown in Figure 2 Samples were compacted at approximately 149°C (300°F) in accordance with AASHTO specifications 150-mm (6-in) and 100-mm (4-in) diameter specimens were compacted to N_{max} (152 gyrations) It has been recommended to the state of Tennessee that 100-mm diameter specimens could be used in lieu of 150-mm diameter specimens for Level I Superpave™ mix design (Jackson and Czor 1999). The effects of specimen size on aggregate degradation were observed to evaluate the validity of this recommendation with respect to aggregate breakdown during laboratory compaction

2.3.3 Gradation Analysis

The grain size distribution for each sample was determined by performing a washed sieve analysis. The mechanical sieve analysis was performed using a Humbolt Model H-4330 sieve shaker The cumulative percent passing each standard TDOT sieve size was determined and recorded An example gradation summary and graphical representation can be found in Figures 3 and 4, respectively The gradation summaries and their graphical representations for all of the mixes tested can be found in Appendix A with the respective JMF

As shown in Equation 1, the difference between the gradations before and after testing served as a tool for evaluating aggregate degradation.

$$\Delta P = P_{compacted} - P_{uncompacted} \quad (1)$$

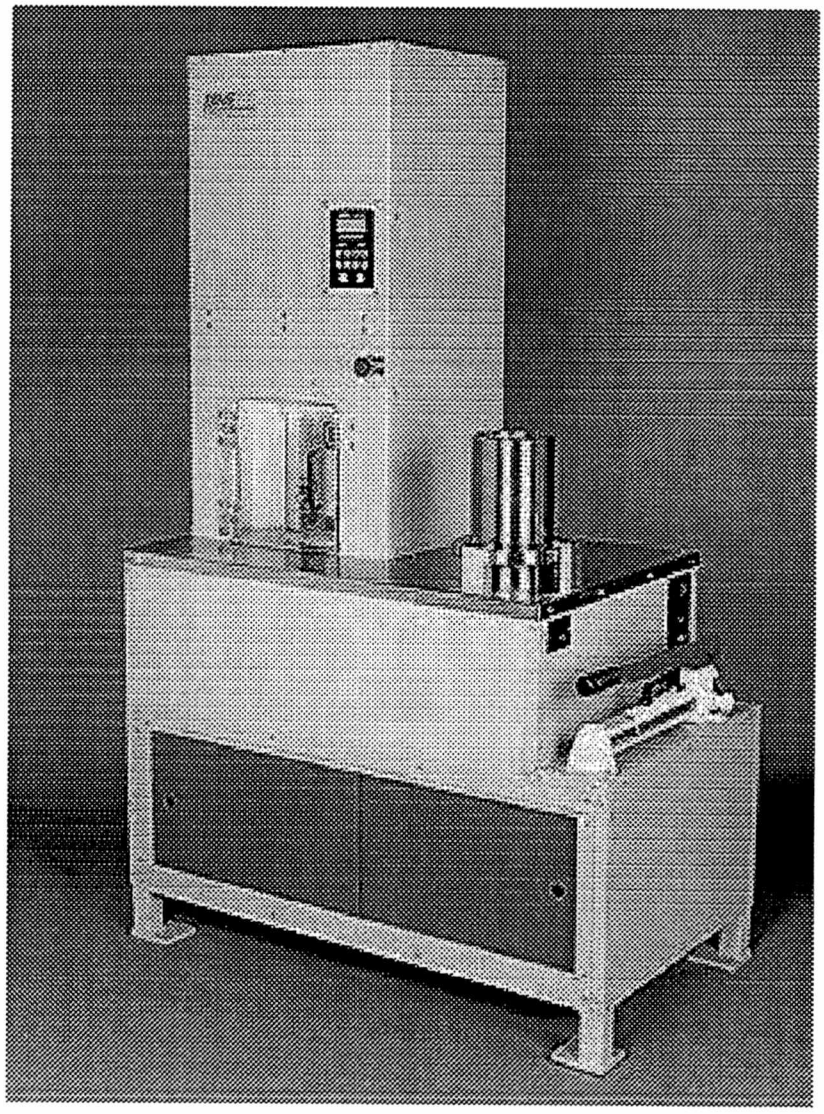

Figure 2 Pine Instrument Company, Model AFGC125X Gyratory Compactor

Gradation Comparison Sheet

University of Tennessee, Knoxville

County	Blount
Mix Type	Blount 307 S
Project Number	05002-4219-04(5267)
Contractor	APAC-Harrison Const

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	97	96 5	94.8	97 6
12 5 mm (1/2")	79	80 7	80 7	79 2
9 5 mm (3/8")	67	71 6	71 3	68 9
4 75 mm (#4)	49	50.1	50 8	49 4
2 36 mm (#8)	34	30 5	32 1	31 3
1 18 mm (#16)	23	20 1	21 8	21 3
0 6 mm (#30)	17	14 5	15 8	15 6
0 3 mm (#50)	8	8 0	8 8	9 0
0 15 mm (#100)	6	5.2	5 5	5 8
0.075 mm (#200)	5	3.8	3 7	4 1

Figure 3 Typical Gradation Summary for SGC Study – Blount 307 S

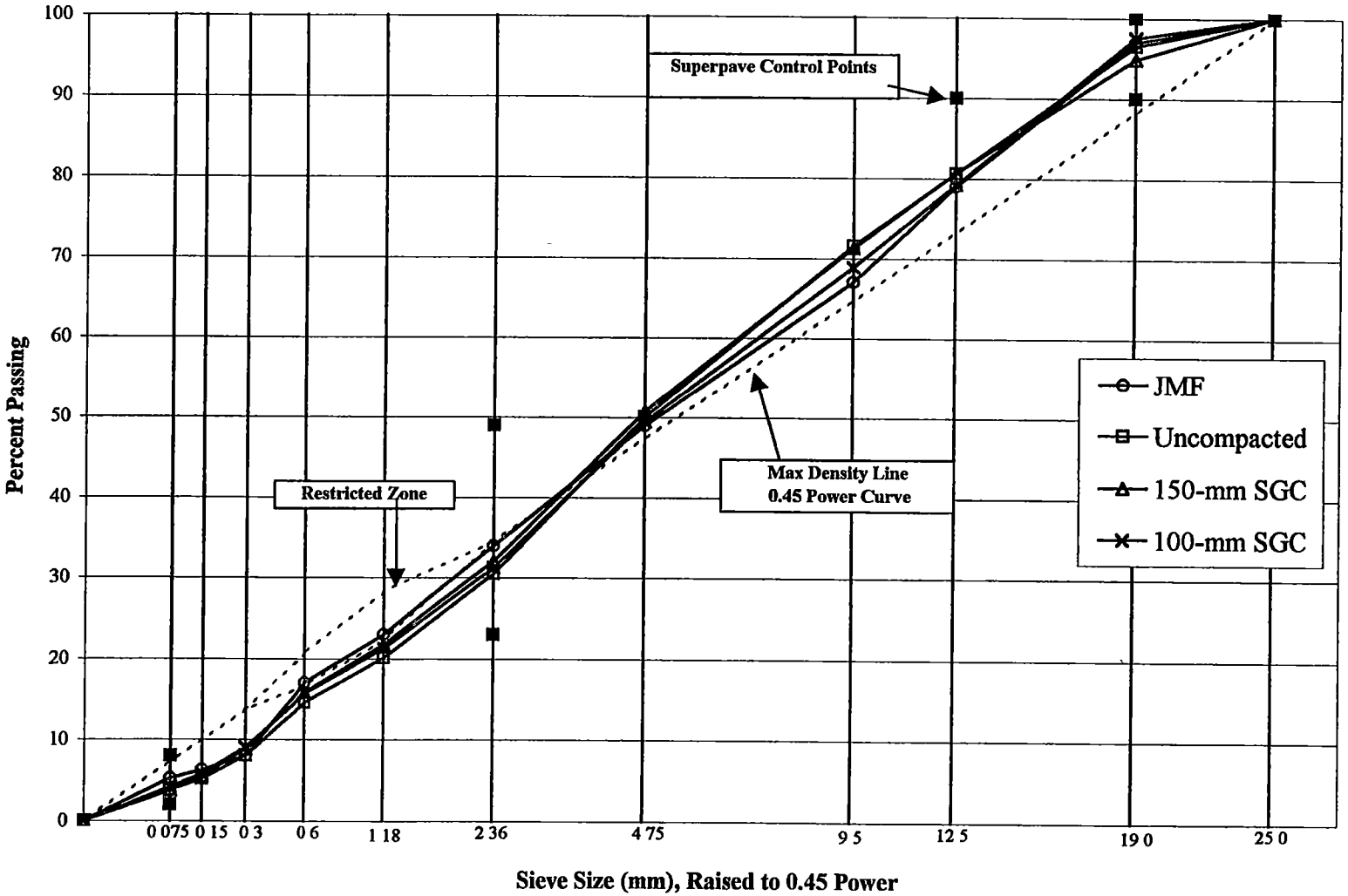

Figure 3 Typical Gradation Curve for SGC Study - Blount 307S

where

ΔP = change in gradation

$P_{compacted}$ = percent passing given sieve size for compacted specimen

$P_{uncompacted}$ = percent passing given sieve size for uncompacted specimen

A positive ΔP indicates that the percent passing a given sieve size is greater after laboratory compaction Conversely, a negative ΔP suggests that the percent passing a given sieve size is smaller after laboratory compaction Remembering that this was an observational study with multiple levels of sampling and testing, negative ΔP values are possible A statistical analysis was performed to evaluate the probability of the mean ΔP being equal to zero (no aggregate degradation resulting from compaction)

2.4 Statistical Analysis

Statistical Analysis Software (SAS) version 7 0 was used to analyze the test data A paired t-test was performed to statistically compare the mean differences in percent passing each sieve size. A 95% confidence level (alpha = 0 05 significance level) was used to evaluate the probability of aggregate degradation being equal to zero (null hypothesis, h_0 $|x_1-x_2|=0$) Based on this analysis, a probability value (p-value) greater than or equal to 0 05 indicates that there is no statistically significant difference in the observed mean difference in percent passing a given sieve size Conversely, a p-value less than 0 05 indicates that there is a statistically significant

difference in the mean difference in percent passing a given sieve A p-value of less than 0 05 indicates that there is more than 95% confidence that a population whose mean difference is zero could not produce a sample mean equal to that of the sample evaluated

The mean difference in percent passing each sieve size was also compared to the published precision statements for the mechanical sieve analysis procedure (ASTM C136-96a) to assess any "practical" or "engineering" significance in the results

2.5 Results

The statistical analysis results for the general grouping are summarized in Table 4, along with the associated precision values (d2s) from the respective ASTM standards. The mixes were grouped according to design type, aggregate type, and design gradation to evaluate the effects of these variables on aggregate degradation The statistical analysis results for the sub-grouping can be found in Appendix B with the associated precision values from the respective ASTM standards

As shown in Column 4 of Table 4, several sieve sizes exhibited significant statistical differences between the compacted and uncompacted gradations (p-values less than 0.05). However, when compared to the precision statement for the mechanical sieve analysis (Column 5 of Table 4) the mean difference in percent passing each sieve was found to be smaller than the allowable range of two results (d2s), published in the applicable ASTM specification Visual inspection of the differences in gradation (Figure 4) shows that the observed differences in gradation

Table 4 Data Analysis Summary for SGC – All Mixes

Standard Sieve Size	Mean Percent Passing*	Mean Difference in Percent Passing (%)	Paired t-Test p-value	ASTM C136-95a Precision (d2s)
25.0 mm (1")	99 5	0 0500	0 6879	0 9
19.0 mm (3/4")	97 3	0 3694	0 0441	0 9
12.5 mm (1/2")	89 3	0 3677	0 1925	2 3
9.5 mm (3/8")	77 9	1 2935	0 0004	6 4
4.75 mm (#4)	51 7	1 7823	<0 0001	2 4
2.36 mm (#8)	36 0	1 6081	<0 0001	2 4
1.18 mm (#16)	26 9	1.4694	<0 0001	2 4
0.6 mm (#30)	20 2	1 1887	<0 0001	1 5 or 2 4
0.3 mm (#50)	11 4	0 9726	<0 0001	1 0
0.15 mm (#100)	6 8	0 7339	<0 0001	1 1
0.075 mm (#200)	4 8	0 4338	0 0001	1 1

62 Sample pairs

* Mean percent passing the respective sieve size for the entire data set

are actually quite small Based on these observations, it is concluded that there is no "engineering" or "practical" significance to the observed mean differences documented in Column 3 of Table 4.

It should be noted that there was also no aggregate degradation of "engineering" or "practical" significance observed when analyzing the sub-groupings of mix type, aggregate type, and design gradation for the TDOT mixes evaluated The effects of specimen size on aggregate degradation during compaction were observed to determine the validity of the suggestion that 100-mm diameter specimens could be used in lieu of 150-mm diameter specimens for design purposes Neither the 150-mm nor the 100-mm diameter specimens exhibited significant levels of degradation during compaction A statistical comparison between the observed degradations for the two specimen sizes cannot be made because of the sampling error involved in the study and the limited precision of the mechanical sieve analysis procedure

2.6 Conclusions

Laboratory testing was conducted to assess the magnitude of aggregate degradation due to SGC compaction This observational study included HMA samples from over 20 paving projects in the state of Tennessee A paired t-test was performed to statistically compare the mean differences in percent passing each standard sieve size, before and after compaction with the SGC Based on this analysis, it was found that there are statistical differences in aggregate gradation before and after compaction However, the differences in gradation observed in this

study were found to be consistently smaller than the allowable ranges for two results (d2s) documented in the published ASTM precision statement Based on this observation, it is concluded that there is no aggregate degradation of "engineering" or "practical" significance resulting from the SGC for HMA typically produced in Tennessee

The results of the testing and data analysis are reinforced by the fact that this was an observational study Samples were not fabricated in the lab Each mix was sampled from actual roadway paving projects Thus, all gradations for both compacted and uncompacted specimens have been affected by sampling error It is believed that any aggregate degradation occurring during SGC testing was masked by sampling error involved in sampling and testing procedures Sampling error is the probable cause for the observed statistical significance related by the probability values However, the observed differences in gradation were still smaller than those allowed by the published testing standards

2.7 Recommendations

The SGC is capable of compacting laboratory specimens for the purpose of HMA design in the state of Tennessee without significantly altering the gradation of the asphalt/aggregate mixture Any aggregate degradation due to laboratory compaction does not exceed the precision statement for the mechanical sieve analysis Mix type, aggregate type, and design gradation do not significantly influence aggregate breakdown during compaction with the SGC It has been recommended to the Tennessee Department of Transportation that 100-mm diameter specimens can be

used for QA/QC testing in lieu of 150-mm diameter specimens (Jackson and Czor 1999) The results of this study also confirm that specimen size does not significantly affect degradation due to compaction with the SGC

These recommendations may not be applicable to aggregates with chemical and physical properties differing from those as previously described It is recommended that users employing aggregates differing from those evaluated in this study should perform their own testing to assess aggregate degradation during compaction using the SGC

CHAPTER 3.0 NCAT IGNITION OVEN (NCAT)

3.1 Introduction

Traditionally, chemical solvents have been used to remove asphalt from aggregate for the determination of the AC content Chemical extraction also facilitates the determination of the aggregate gradation for the sample However, the use of solvents is time consuming and expensive (Brown et al 1995) The solvents used for chemical extraction purposes may be hazardous, toxic materials, and difficult to dispose of after use Growing health and environmental concerns have forced agencies to seek faster and safer methods of determining the AC content of an asphalt/aggregate mixture (Yu 1992)

Nuclear asphalt content (NAC) gauges have been developed to determine the AC content of an HMA mixture NAC gauges are able to rapidly determine the asphalt content of HMA with accuracy comparable to traditional solvent extraction methods (Murphy 1994) However, NAC testing does not provide an asphalt free sample for gradation analysis purposes.

Non-chlorinated solvents, generically known as "biodegradable solvents " have been evaluated by many agencies to replace the chlorinated solvents used for traditional chemical extraction Biodegradable solvents require a modified extraction procedure that renders it more time consuming and less accurate than traditional solvents

The National Center for Asphalt Technology (NCAT) developed the ignition oven to replace the chemical extraction process and accelerate the determination of

asphalt content in the laboratory. The ignition oven method involves the heating of the HMA to remove the asphalt by burning, eliminating the use of costly and potentially hazardous solvents Burning off the asphalt leaves a "clean" sample for gradation determination

The determination of the AC content of a sample using the ignition oven is relatively simple An operator determines the initial weight of the binder/aggregate mixture, enters the initial weight into the oven computer, and places the sample in the oven The NCAT oven heats the sample to 538 C (1000° F) until the weight becomes constant Weight measurements are taken by an internal scale, eliminating the requirement of an operator to be present during testing Once the weight of the sample has stabilized, the test is terminated and an asphalt content for the sample is calculated and recorded by the oven

The ignition oven eliminates the primary expense of solvent purchase and the secondary expense of effluent disposal as well as the health risks involved It has been proposed that the average asphalt producer could pay for the cost of an ignition oven in less than one year just in solvent costs savings alone (Thermolyne).

The heating of the aggregate at such an elevated temperature has caused concern to some in the HMA industry with respect to aggregate degradation Previous studies have reported that some construction aggregates, especially limestone, exhibit significant mass loss during ignition oven testing (Murphy 1994) The 538 C (1000° F) testing temperature was established to minimize this mass loss A round robin study completed by NCAT reported that the ignition method can accurately measure the asphalt content of HMA mixes with greater precision than

solvent extraction, without significantly affecting the aggregate gradation (Brown and Mager 1995)

3.2 Objective

The objective of this study was to document the observed aggregate degradation resulting from ignition oven testing for common TDOT mixes The effects of mix type, aggregate type, and design gradation were observed, documented and analyzed The aggregates evaluated during this study included limestones and river gravels commonly used for HMA production in Tennessee. The limestones evaluated are typically composed of 60-90% calcium carbonate ($CaCo_3$), 5-20% magnesium carbonate ($MgCO_3$), and 5-15% silica dioxide (SiO_2) (Hershey and Maher 1985) The river gravels evaluated typically contain silica dioxide (SiO_2) contents in excess of 90%

The mixes evaluated in this study are identified as binder and surface mixes in accordance with Sections 307 and 411, respectively, of the TDOT Standard Specifications for Road and Bridge Construction (TDOT 1995) The mixes are further classified as conventional or Superpave™ with respect to the method of design used in developing the Job Mix Formula (JMF). The conventional TDOT mixes (411D and 307BM/BM-2 designations) were designed by the 75-blow Marshall method, whereas the Superpave™ mixes (411S and 307S designations) were designed in accordance with Superpave™ volumetric mix design criteria (TDOT Special Provision)

3.3 Test Program

Laboratory testing was performed in the Civil Engineering Materials Laboratory at the University of Tennessee The aggregate gradations for the respective mixes were determined before and after ignition oven testing for evaluation of aggregate degradation Table 5 outlines the mixes evaluated in this study Table 6 summarizes the laboratory sampling and test procedures followed during preparation of the gradation samples Loose HMA samples were collected during roadway construction and transported to the laboratory at the University of Tennessee. The AC content was determined for six samples for each mix, three by chemical and three by ignition extraction. A washed sieve analysis was performed on the extracted aggregates to determine the gradation of each specimen A schematic of the testing program can be found in Figure 5

3.3.1 Sample Collection

Samples were collected from more than 20 constructed in the state of Tennessee during the 1998 construction season Representative samples were obtained in accordance with respective ASTM and AASHTO specifications TDOT personnel assisted in obtaining and transporting loose HMA samples to the laboratory at the University of Tennessee Bulk Samples were reduced to test sample sizes appropriate for chemical and ignition extraction purposes.

Table 5 Summary of Mixes Evaluated for Ignition Oven Study

TDOT Mix Type	Mix Description	Aggregate Type	Gradation*
411S	Superpave™ Surface	Granite	BRZ
307 BM/2	Conventional Marshall Binder	River Gravel	TRZ
307S	Superpave™ Binder	River Gravel	BRZ
411S	Superpave™ Surface	River Gravel	BRZ
307 BM/2	Conventional Marshall Binder	Limestone	TRZ
411D	Conventional Marshall Surface	River Gravel	ARZ
307 BM/2	Conventional Marshall Binder	Limestone	ARZ
411S	Superpave™ Surface	River Gravel	BRZ
411S	Superpave™ Surface	Limestone	BRZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	River Gravel	TRZ
411D	Conventional Marshall Surface	Limestone	ARZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	Limestone	BRZ
411D	Conventional Marshall Surface	River Gravel	ARZ
307S	Superpave™ Binder	Limestone	BRZ
411S	Superpave™ Surface	River Gravel	BRZ

* Restricted Zone ARZ – Above (Fine) BRZ – Below (Dense) TRZ - Through

Table 6 Testing Procedure Summary for Ignition Oven Study

	Procedure Description	Specification	
		ASTM	AASHTO
Field	Sample Collection	D 75	T 248
Laboratory	Sample Reduction	C 702	T 248
	Chemical Extraction	D 2172	T 164
	Ignition Extraction	N/A	TP 53
	Washed Sieve Analysis	C 117	T 11
	Mechanical Analysis of Extracted Aggregates	N/A	T 30
	Mechanical Sieve Analysis	C 136	T 27

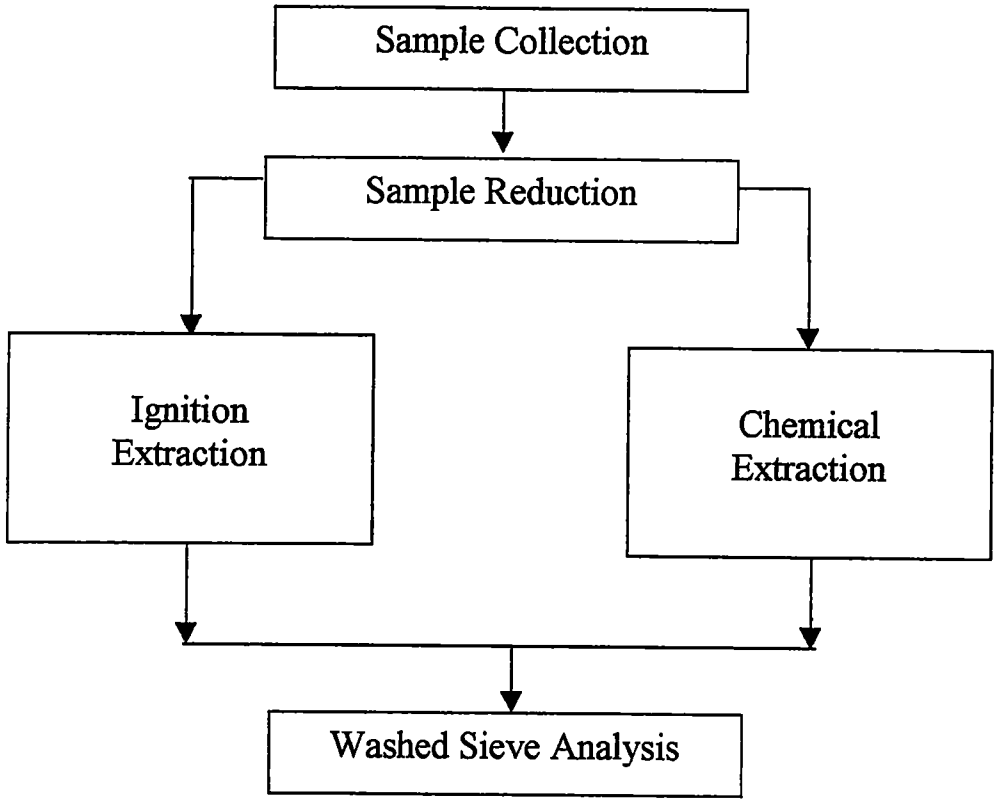

Figure 5 Testing Procedure Schematic for Ignition Oven Study

3.3.2 Chemical Extraction

Chemical extraction testing was performed in accordance with respective ASTM and AASHTO standards using a Soiltest Model AP-175 centrifuge Neugenic 4175, a biodegradable solvent from the Rochester Midland Corporation, was used for chemical extraction purposes Material remaining after the chemical extraction was retained for washed gradation analysis.

3.3.3 Ignition Extraction

Ignition oven testing was accomplished with a Barnstead/Thermolyne NCAT Asphalt Content Tester, Model F85938, as shown in Figure 6 Ignition oven testing was performed in accordance with AASHTO provisional standards Material remaining after ignition was removed from the metal baskets for washed gradation analysis.

3.3.4 Gradation Analysis

The grain size distribution for each sample was determined by performing a washed sieve analysis The mechanical sieve analysis was performed using a Humbolt Model H-4330 sieve shaker The cumulative percent passing each standard TDOT sieve size was determined and recorded An example gradation summary and graphical representation can be found in Figures 7 and 8, respectively. The gradation summaries and their graphical representations for all of the mixes tested can be found in Appendix A with the respective JMF

As presented in Equation 2, the mean difference in percent passing a given sieve for ignition extracted versus chemically extracted samples was used in this study to evaluate aggregate degradation

$$\Delta P = P_{ignition} - P_{chemical} \quad (2)$$

where

ΔP = change in gradation

$P_{ignition}$ = percent passing sieve size for ignition extracted sample

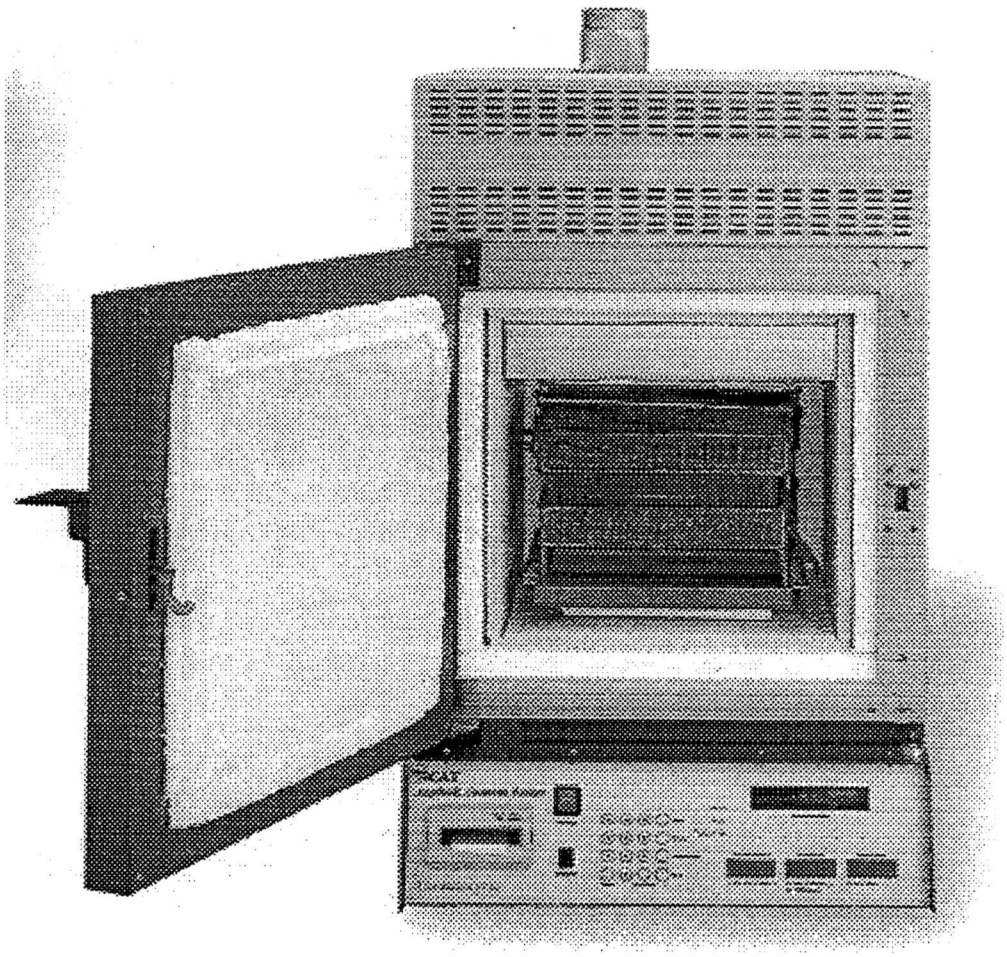

Figure 6 Barnstead/Thermolyne NCAT Asphalt Content Tester, Model F85938

Gradation Comparison Sheet

University of Tennessee, Knoxville

County	Madison
Mix Type	411 S
Project Number	50712-4209-04(5306)
Contractor	Dement Construction

	JMF	Chemical Extraction	Ignition Extraction
	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100.0	100.0
19 mm (3/4")	100	99 5	100 0
12 5 mm (1/2")	94	97.3	98 3
9.5 mm (3/8")	86	87 6	88 3
4 75 mm (#4)	54	51 5	52 5
2 36 mm (#8)	38	32 6	33 6
1 18 mm (#16)	26	21 7	22 7
0 6 mm (#30)	17	14 2	15.2
0.3 mm (#50)	9	8 5	9 0
0 15 mm (#100)	5	4 7	5 5
0 075 mm (#200)	4	3 2	3 7

Figure 7 Typical Gradation Summary for Ignition oven Study – Madison 411 S

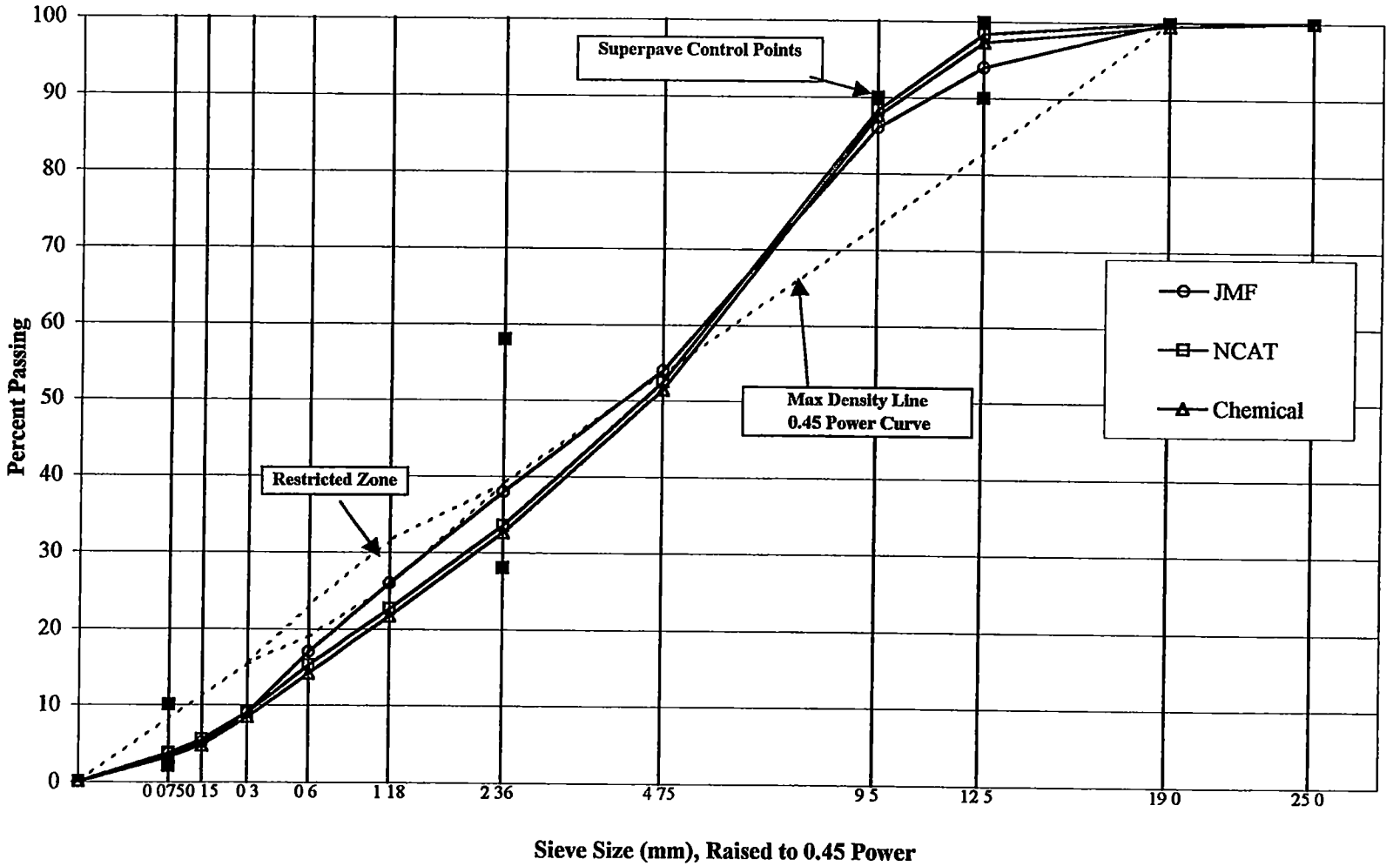

Figure 8 Typical Gradation Curve for Ignition Oven Study - Madison 411S

$P_{chemical}$ = percent passing sieve size for chemically extracted sample

A positive ΔP indicates that the percent passing a given sieve size is greater after ignition extraction Conversely, a negative ΔP suggests that the percent passing a given sieve size is smaller after ignition extraction Remembering that this was an observational study with multiple levels of sampling and testing, negative ΔP values are possible Assuming that the gradation for the chemically extracted specimen is the "true" gradation, a statistical analysis was performed to evaluate the probability of the mean ΔP being equal to zero (no aggregate degradation resulting from ignition testing)

3.4 Statistical Analysis

Statistical Analysis Software (SAS) version 7 0 was used to analyze the test data A paired t-test was performed to statistically compare the mean differences in percent passing each sieve size A 95% confidence level (alpha = 0 05 significance level) was used to evaluate the probability of aggregate degradation being equal to zero (null hypothesis h_0 $|x_1-x_2|=0$) Based on this analysis, a probability value (p-value) greater than or equal to 0 05 indicates that there is no statistically significant difference in the observed mean difference in percent passing a given sieve size Conversely, a p-value less than 0 05 indicates that there is a statistically significant difference in the mean difference in percent passing a given sieve A p-value of less than 0 05 indicates that there is more than 95% confidence that a population whose mean is zero could not produce a sample mean equal to that of the sample evaluated

The mean difference in percent passing each sieve size was also compared to the published precision statements for the mechanical sieve analysis procedure (ASTM C136-96a) and the mechanical analysis of extracted aggregates (AASHTO T30-93) to assess any "practical" or "engineering" significance in the observed results

3.5 Results

The statistical analysis results for the general grouping can be found in Table 7, along with the associated precision values from the respective ASTM standards The mixes were grouped according to design type, aggregate type, and design gradation to evaluate the effects of these variables on aggregate degradation The statistical analysis results for the sub-grouping can be found in Appendix C with the associated precision values from the respective ASTM and AASHTO standards

As shown in Column 4 of Table 7, the 0 075-mm (#200) sieve is the only size to exhibit a statistical significance in difference between the chemical extraction and ignition oven gradations (p-value less than 0 05) However, as shown in Columns 5 and 6 of Table 7, this difference was also found to be smaller than the allowable range of two results (d2s), as published in the applicable ASTM and AASHTO specifications Based on this observation, here again, it is concluded that there is no "engineering" or" practical" significance to the observed mean difference documented for the 0 075-mm (#200) sieve in Column 3 of Table 7.

It is suspected that sampling variability contributed to the slight differences observed in percent passing the standard sieve sizes in this study The results of the

Table 7 Data Analysis Summary for NCAT Ignition Oven – All Mixes

Standard Sieve Size	Mean Percent Passing*	Mean Difference in Percent Passing (%)	Paired t-Test p-value	ASTM C136-95a Precision (d2s)	AASHT0 T30-93 Precision (d2s)
25 0 mm (1")	99 3	-0.1563	0 3275	0 9	1 4
19 0 mm (3/4")	97 3	-0.4563	0 1564	0 9	1 4
12 5 mm (1/2")	90 1	-0 6313	0.3055	2.3	3 0
9 5 mm (3/8")	78 2	-0 6313	0 3012	6 4	3 0
4 75 mm (#4)	51 5	0 0188	0 9700	2 4	3 0
2 36 mm (#8)	34.9	0 2688	0 4441	2 4	1 8
1.18 mm (#16)	25.4	0.2313	0 4337	2 4	1.3
0 6 mm (#30)	19 1	0 3188	0 1917	1 5 or 2 4	1 3
0 3 mm (#50)	11 2	0 2750	0 1703	1 0	1.3
0 15 mm (#100)	6 7	-0 2188	0 3455	1.1	0 8
0 075 mm (#200)	4 9	-0 4688	0 0407	1 1	0 8

16 Sample pairs

* Mean percent passing the respective sieve size for the entire data set

data analyses for the sub-groupings of mix type, aggregate type, and design gradation were found to be consistent with the data analysis for all mixes described above This was found to be true for aggregate degradation due to both SGC and NCAT ignition oven testing

3.6 Conclusions

Laboratory testing was conducted to assess the magnitude of aggregate degradation due to ignition oven testing This observational study included HMA samples from 16 paving projects in the state of Tennessee A paired t-test was performed to statistically compare the mean differences in percent passing each standard sieve size, for ignition extracted samples using the NCAT Ignition Oven versus chemically extracted samples Based on this analysis, it was found that there is a statistical significance for the 0 075-mm sieve only The difference in gradation observed for this sieve was found to be significantly smaller than the allowable range for two results (d2s) documented in the ASTM and AASHTO precision statements Based on this observation, it is concluded that there is no aggregate degradation of "engineering" or "practical" significance resulting from NCAT ignition oven for HMA typically produced in Tennessee

It should be noted that a correction was not conducted for material lost in the extractant during chemical extraction. Noting the mean difference in percent passing recorded in Column 3 of Table 7, and applying Equation 2 indicates that a correction would have reinforced the position that there is no "practical difference observed for the 0 075-mm sieve A correction factor would tend to decrease the $P_{extracted}$ term in

Equation 2, rendering the mean for all of the samples as a smaller negative (closer to zero) This results in a larger p-value (probability that the calculated mean came from a sample that is part of a population whose mean is zero)

It should be noted that there was also no aggregate degradation of "engineering" or "practical" significance observed when analyzing the sub-groupings of mix type, aggregate type, and design gradation for the TDOT mixes evaluated

3.7 Recommendations

Ignition oven testing of typical Tennessee Department of Transportation mixtures using the NCAT Ignition Oven is a viable practice for determining AC content of HMA without significantly altering the gradation It was found that any aggregate degradation due to ignition oven testing does not exceed the precision statement for the mechanical sieve analysis test Mix type, aggregate type, and design gradation do not significantly influence aggregate breakdown during ignition oven testing

These recommendations may not be applicable to aggregates with chemical and physical properties differing from those previously described It is recommended that users employing aggregates differing from those evaluated in this study should perform their own testing to assess aggregate degradation during ignition oven testing using the NCAT Asphalt Content Tester.

CHAPTER 4.0 BULK SPECIFIC GRAVITY DETERMINATION

4.1 Introduction

HMA mix design and quality control procedures are based on volumetric properties (VTM, VMA, and VFA) of laboratory or field compacted specimens. Accurate measurements of the volumetric properties are essential in producing a cost-effective, durable pavement An accurate bulk specific gravity determination is vital in correctly determining the volumetric properties of the aggregate/binder mixture

Problems arise in bulk specific gravity determination when large amounts of surface voids are interconnected with internal voids During standard bulk specific gravity determination, the surface voids and internal voids can become filled with water when determining the submerged weight of the specimen (Harvey et al 1994) This results in the internal voids not being counted as air-voids in the specimen, rendering a lower VTM than the actual value Parafilm™ prevents the entry of water into internal voids during submergence It has been documented that VTM calculations using Parafilm™ bulk specific gravity results in 2% higher VTM than SSD methods (Ownby 1998)

Current specifications suggest that standard procedures for determining bulk specific gravity of a compacted HMA specimen should not be used for specimens that contain open or interconnecting voids or absorb more than two percent of water by volume (ASTM 2726-96a) Specimens containing open or interconnecting voids should be sealed with parafilm for bulk specific gravity determination It has been

suggested that a VTM of 8% is the level at which air-voids begin to become interconnected (Rorie 1999)

4.2 Objective

The objective of this study was to document observed SSD and Parafilm™ bulk specific gravities for laboratory compacted specimens and attempt to develop a correlation between SSD bulk specific gravity and Parafilm™ bulk specific gravity

4.3 Test Program

Laboratory testing was performed in the Civil Engineering Materials Laboratory at the University of Tennessee. Table 8 summarizes the laboratory sampling and test procedures followed during preparation and testing of the specimens Appendix D contains all of the data collected during this study

Loose HMA samples were collected during roadway construction and transported to the laboratory at the University of Tennessee 150-mm and 100-mm specimens were compacted from each project using the SGC SSD and Parafilm™ specific gravities were determined for each specimen. A schematic of the testing procedure can be found in Figure 9.

4.3.1 Sample Collection

Samples were collected from more than 20 paving projects in the state of Tennessee constructed during the 1998 construction season Representative samples

Table 8 Laboratory Procedure Summary for Bulk Specific Gravity Study

	Procedure Description	Specification	
		ASTM	AASHTO
Field	Sample Collection	D 75	T 248
Laboratory	Sample Reduction	C 702	T 248
	Maximum Theoretical Specific Gravity, G_{mm}	D 2041	T 209
	SGC Compaction	N/A	TP 4
	Bulk Specific Gravity, SSD	D 2726	T 166
	Bulk Specific Gravity, Parafilm™	D 1188	T 275
	Air-Void Content Determination	D 3203	T 269

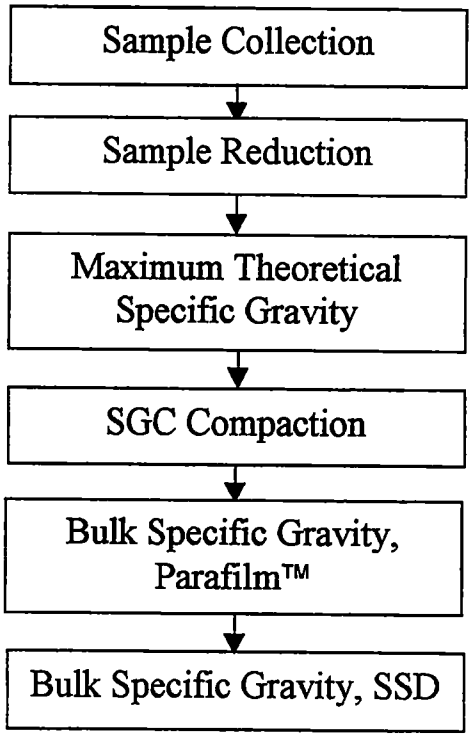

Figure 9 Testing Procedure Schematic for Bulk Specific Gravity Study

were obtained in accordance with respective ASTM and AASHTO specifications TDOT personnel assisted in obtaining and transporting loose HMA samples to the laboratory at the University of Tennessee. Samples were reduced to test sample sizes appropriate for SGC compaction

4.3.2 Saturated, Surface Dry (SSD) Bulk Specific Gravity Determination

Bulk specific gravity was determined in accordance with respective ASTM and AASHTO standards The specific gravity was determined as follows.

$$G_{sb} = \frac{W_a}{W_s - W_w} \tag{3}$$

where

G_{sb} = Bulk SSD Specific Gravity of the Specimen

W_a = Weight of dry specimen in air

W_s = Weight of saturated, surface dry specimen in air

W_w = Weight of the specimen submerged in water

4.3.3 Parafilm™ Bulk Specific Gravity Determination

Parafilm™ bulk specific gravity was determined in accordance with the appropriate ASTM and AASHTO standards The specific gravity was determined as follows

$$G_{sp} = \frac{W_a}{\left(W_{awp} - W_{wwp}\right) - \frac{\left(W_{awp} - W_a\right)}{G_{sf}}} \tag{4}$$

where .

G_{sp} = Parafilm™ Bulk Specific Gravity of the Specimen

W_a = Weight of unsealed, dry specimen in air

W_{awp} = Weight of Parafilm™ sealed, dry specimen in air

W_{wwp} = Weight of Parafilm™ sealed specimen submerged in water

G_{sf} = Specific Gravity of Parafilm™

Parafilm™ "M," manufactured by American National Can was used to seal the specimens for specific gravity determination It has been reported that the specific gravity of the Parafilm™ is the same as that for paraffin (0 9) (Harvey et al 1994) However, it has been found that the specific gravity of the Parafilm™ itself introduces error into the determination of the specific gravity of a compacted specimen. The density of the Parafilm™ is a function of the amount of stretching imposed on it during wrapping of the asphalt specimen Testing conducted as part of this study to verify the use of the industry standard of 0 9 for the specific gravity of Parafilm™ yielded a mean value of 0 6 (conducted in accordance with ASTM D 1188-96)

4.4 Results

Bulk specific gravity is used to calculate the air-void content (VTM) of a compacted HMA specimen It has been reported that Parafilm™ bulk specific gravity results in an air-void content of a compacted HMA specimen two percent higher than that calculated using SSD bulk specific gravity The air-void content calculated using

Parafilm™ specific gravity plotted against that calculated using SSD specific gravity can be found in Figures 10 and 11

The coefficient of determination (R^2) of 0 87 for the linear regression equation found in Figure 10 suggests that there is a strong linear correlation between air-voids calculated using the Parafilm™ and SSD bulk specific gravity Figure 11 presents a comparison of Parafilm™ and SSD calculated air-void contents for a range of VTM The difference of 1 96 for the 4 +/- 1% range generally agrees with documented value of about 2% difference for the two methods

4.5 Conclusions

Calculation of VTM using Parafilm™ bulk specific gravity instead of SSD bulk specific gravity results in about 2% higher VTM up to about 6% VTM Based on these results, it is not clear which method produces the more accurate measure of actual VTM However, it is suspected that the SSD method is suitable for typical HMA specimens containing less than about 6% VTM since the voids are typically not considered to be interconnected at this level of compaction There appears to be no added benefit in determining the Parafilm™ bulk specific gravity for typical ranges of VTM encountered in HMA in the state of Tennessee

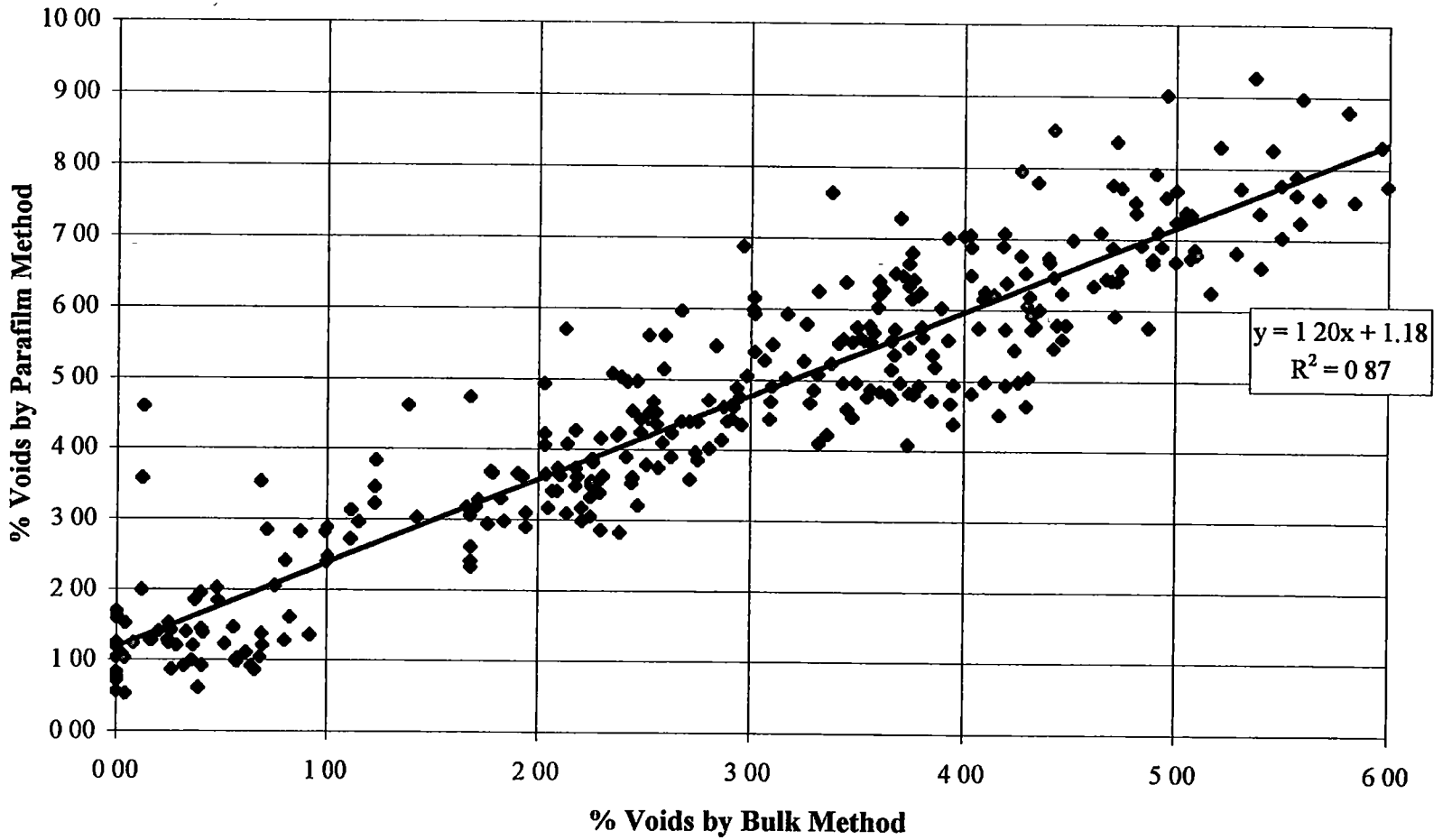

Figure 10 % Voids, Parafilm vs. SSD Method

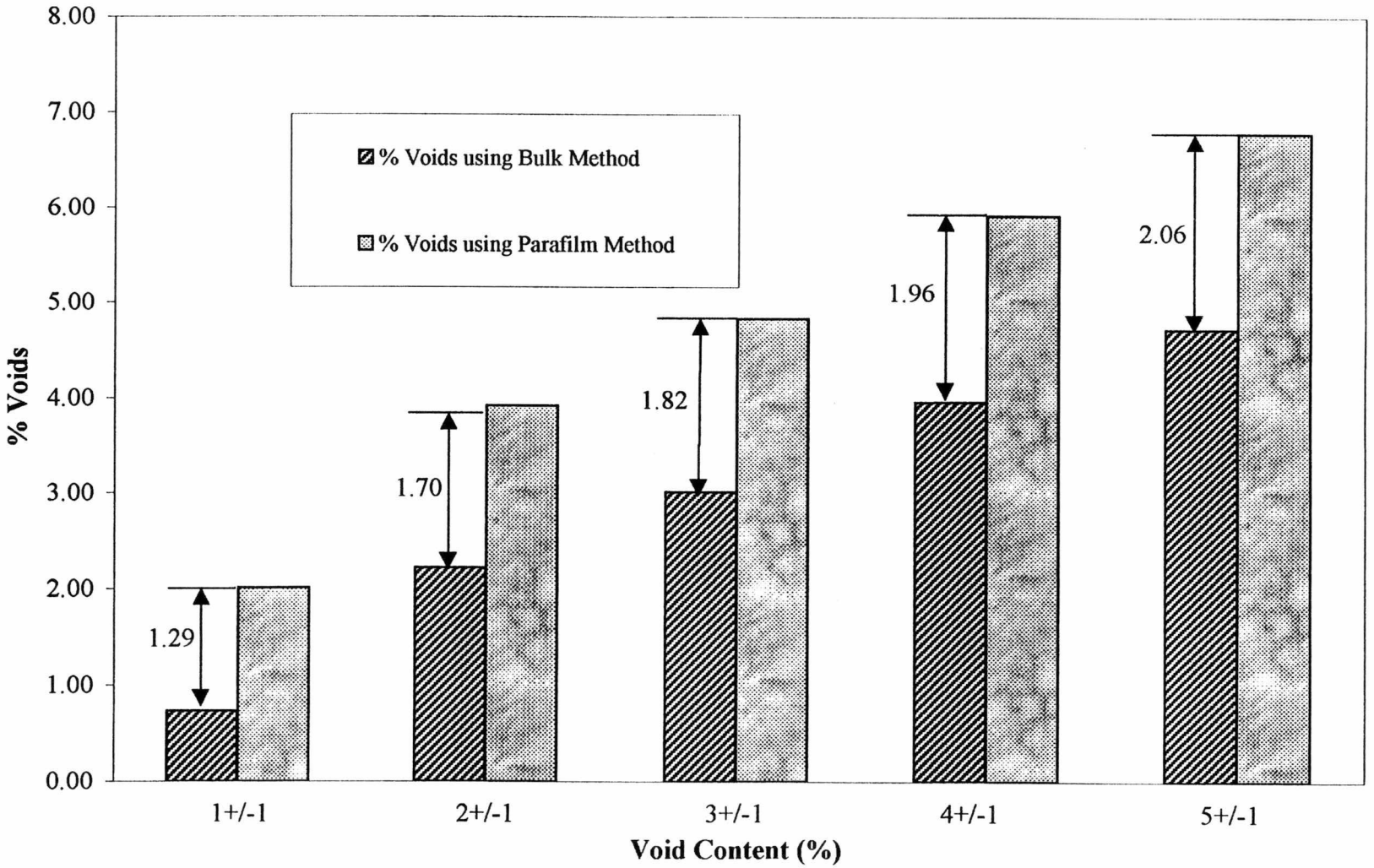

Figure 11 Air-Void Content, Paraflim vs. SSD Method

CHAPTER 5.0 GENERAL CONCLUSIONS

The general conclusions for the three observational studies previously discussed are as follows

1) The SGC is capable of compacting laboratory specimens for the purpose of HMA design in the state of Tennessee without significantly altering the gradation of the asphalt/aggregate mixture Specimen size does not significantly affect aggregate degradation due to laboratory compaction 100-mm diameter specimens can be used in lieu of 150-mm diameter specimens for QA/QC purposes in Tennessee

2) Ignition oven testing of typical TDOT mixtures using the NCAT Ignition Oven is a viable practice for extraction and gradation analysis of HMA without significantly altering the gradation of the mix

3) Calculation of VTM using Parafilm™ bulk specific gravity instead of SSD bulk specific gravity results in a 2% higher air-void content in the normal VTM range up to about 6% It is believed that the SSD method is suitable for use within this range of VTM since the voids are typically not considered to be interconnected at this level of compaction There appears to be no added benefit in determining the Parafilm™ bulk specific gravity for typical ranges of VTM encountered in HMA in the state of Tennessee.

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APPENDICES

APPENDIX A

Job Mix Formula Sheets

Gradation Summaries

Gradation Plots

Appendix A

Project Summary

County:	**Blount**
Mix Type:	**307 S**
TDOT Project No.:	**05002-4219-04**
Contract No.:	**5267**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/17/98

Project Ref No SP County Madison Region IV
Proj No 57012-4209-04 Layer Surface Contract No 5306
Type ACS-HM Sec No SP411-S Article
Contractor Dement Construction Subcontractor
State Rt 412 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
D Rock	5/8" Pan	Adamsville Sand & Gravel, Adamsville, TN	61 30
Block #10's	3/8" Pan	Vulcan Materials Co , Parsons, TN	9 43
Screw Sand	3/8" Pan	Vulcan Materials Co , Holladay, TN	14 15
Dement Sand	#4 Pan	Vulcan Materials Co , Holladay, TN	9 43
Asphalt Cement	PG76-22	Koch Materials, Memphis, TN	5 70
Anti-Strip	TYPE Agg-Grip	DOSAGE RATE 0 50%	

% Fractured Faces on +4 Material 72 1 % Glassy Particles on +4 Material N/A 100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	D Rock %	Block #10's %	Screw Sand %	Dement Sand %	0 Percent	Calculated Mix
		Percent		65 0	10 0	15 0	10 0		100 0
Temp		310 F			NCAT Furnace Corr Factor			0 76	
%A.C		5 7			**LOI:**	10 9			
Compaction Temp		300-315			**Theo:**	2 320			
Mixing Temp		325-340							
2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1 1/2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
3/4"	100 0	100 0		100 0	100 0	100 0	100 0	100 0	100 0
1/2"	90-100	94 0		90 0	100 0	100 0	100 0	100 0	93 5
3/8"		86 0		78 0	100 0	100 0	100 0	100 0	85 7
No 4		54 0		34 0	75 0	94 0	100 0	100 0	53 7
No 8	28-58	38 0		22 0	14 0	82 0	98 0	100 0	37 8
No 16		26 0		14 0	8 9	52 0	83 0	100 0	26 1
No 30		17 0		9 0	6 4	33 0	60 0	100 0	17 4
No 50		9 0		6 0	5 8	22 0	16 0	100 0	9 4
No 100		5 1		4 0	5 2	10 0	5 0	100 0	5 1
No 200	2-8	3 6		3 1	4 4	6 0	2 1	100 0	3 6

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

Gradation Comparison Sheet

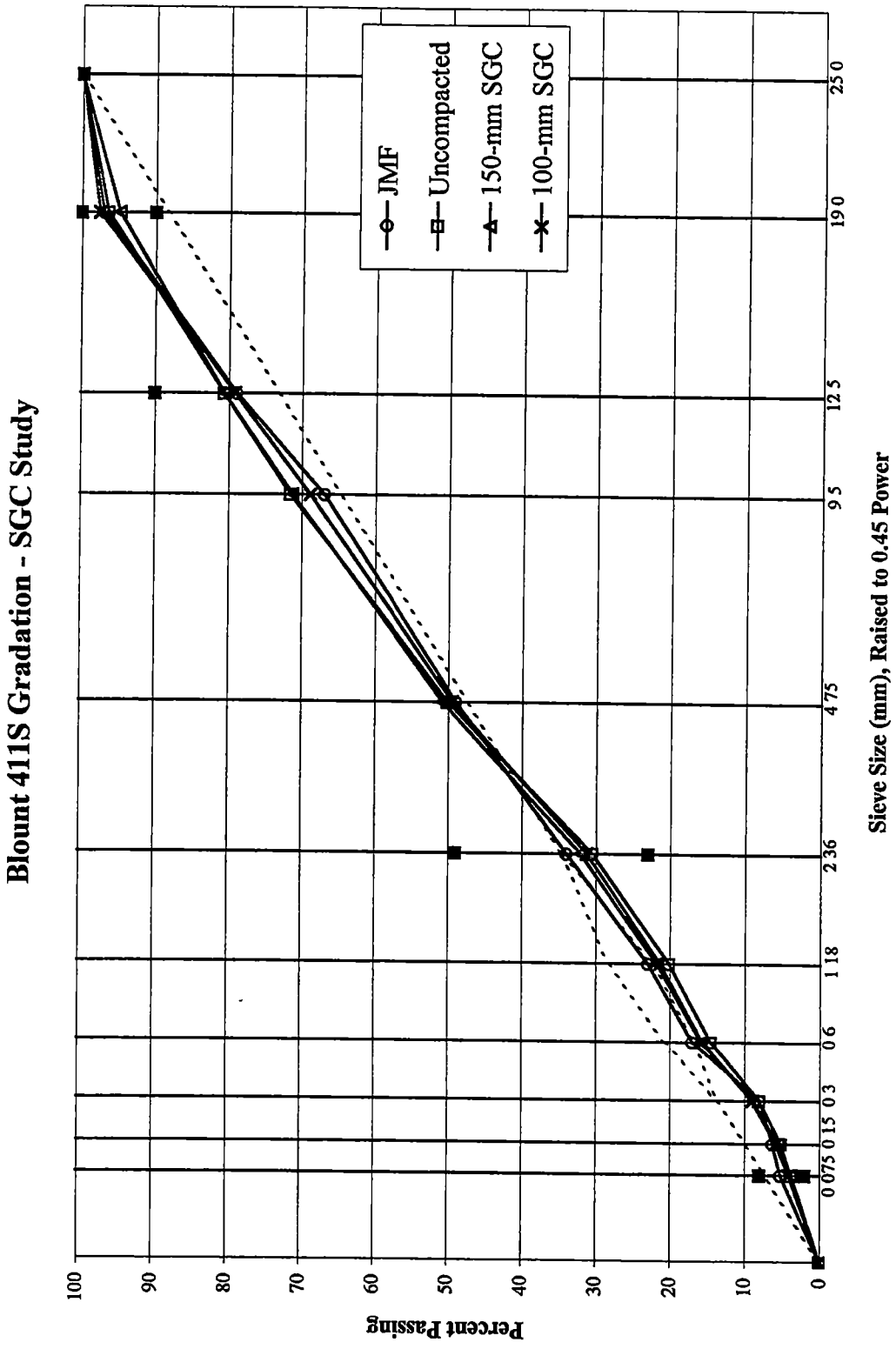
Aggregate Degradation

University of Tennessee, Knoxville

County	Blount
Mix Type	Blount 307 S
Project Number	05002-4219-04(5267)
Contractor	APAC-Harrison Const.

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	97	96.5	94 8	97 6
12 5 mm (1/2")	79	80 7	80 7	79 2
9 5 mm (3/8")	67	71 6	71.3	68 9
4 75 mm (#4)	49	50 1	50 8	49 4
2 36 mm (#8)	34	30 5	32 1	31 3
1 18 mm (#16)	23	20.1	21 8	21 3
0 6 mm (#30)	17	14.5	15 8	15 6
0 3 mm (#50)	8	8 0	8 8	9 0
0 15 mm (#100)	6	5 2	5 5	5 8
0 075 mm (#200)	5	3 8	3 7	4 1

Asphalt Content	4 40%	4 74%	4 83%	4 50%
% Dust	5 20%	3.78%	3 69%	4 14%


Blount 411S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Blount**
Mix Type:	**411 S**
TDOT Project No.:	**05002-4219-04**
Contract No.:	**5267**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 8/10/98

Mix Design No DV-1(98)246
Project Ref No SP County BLOUNT Region I
Proj No 05002-4219-04 Contract No 5267
Type BCHM S P /12 5mm 411S Sec No
Contractor APAC-HARRISON CONST Subcontractor
State Rt S R. 35 & 447 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/1/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
GRANITE #7	19mm- 075mm	Vulcan Materials, ENKA, N C	61 04
#10	9 5mm- 075mm	Vulcan Materials, Maryville	21 59
NATL SAND	9 5mm- 075mm	Highland Sand, Crab Orchard	9 39
BAGHOUSE FINES	150mm- 075mm	Harrison Asphalt Plant, Maryville	1 88
Asphalt Cement	PG 76-22	Marathon/Ashland, Knoxville	6 10
Anti-Strip	TYPE PAVE BOND	DOSAGE RATE 0 5	100
% Fractured Faces on +4 Material	NA	% Glassy Particles on +4 Material	NA

SCREEN	Ttl Passing	Requested Percent		AGGREGATE ANALYSIS TOTAL PERCENT PASSING #7 Percent	#10 Percent	NATL SAND Percent	BH FINES Percent	CALC MIX %
				65 0	23 0	10 0	2 0	100 0
% A.C		6.00			NCAT Furnace Corr Factor			
	Compaction Temp		157C		LOI	12		
	Mixing Temp		171C		Theo	2 513		
	Control Points	Restricted Zone	Mix Blend					
25mm								
19mm	100		100 0	100 0	100 0	100 0	100 0	100 0
12 5mm	90/100		95 0	93 0	100 0	100 0	100 0	95 5
9 5mm			79 0	68 0	100 0	100 0	100 0	79 2
4 75mm			50 0	26 0	92 0	99 0	100 0	50 0
2 36mm	28/58	39 1	29 0	9 0	56 0	86 0	100 0	29 3
1 18mm		25 6/31 6	20 0	5 0	31 0	81 0	100 0	20 5
600mm		19 1/23 1	16 0	4 0	20 0	70 0	100 0	16 2
300mm		15 5	8 0	3 0	14 0	12 0	100 0	8 4
150mm			6 4	2 0	12 0	4 0	98 9	6 4
075mm	2-10		5 4	1 5	10 0	2 0	98 3	5 4

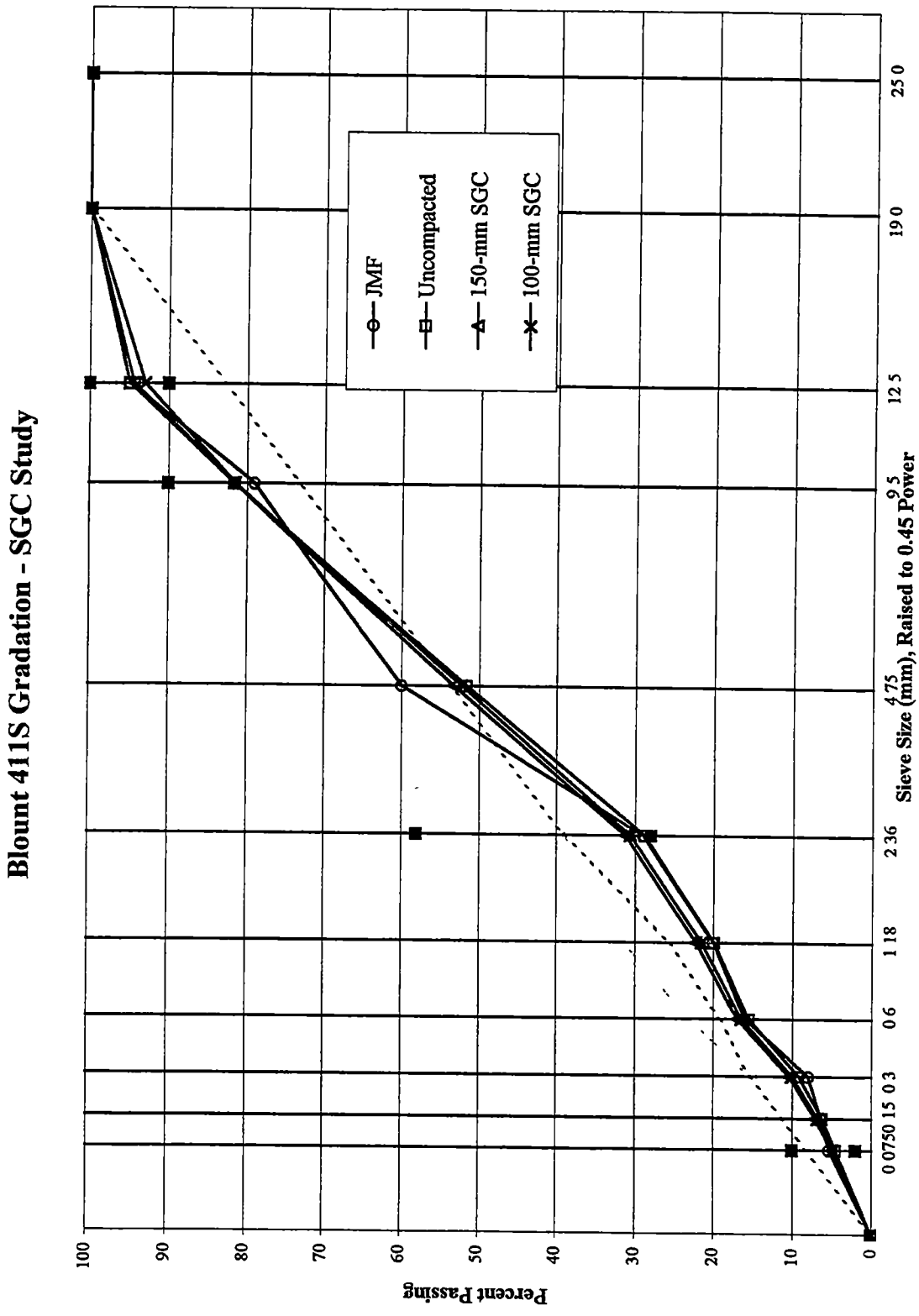
Requested (APAC-TN) Harrison Div — Contractor
Approved — Region Construction Engineer
Approved — Region Materials Engineer
Approved

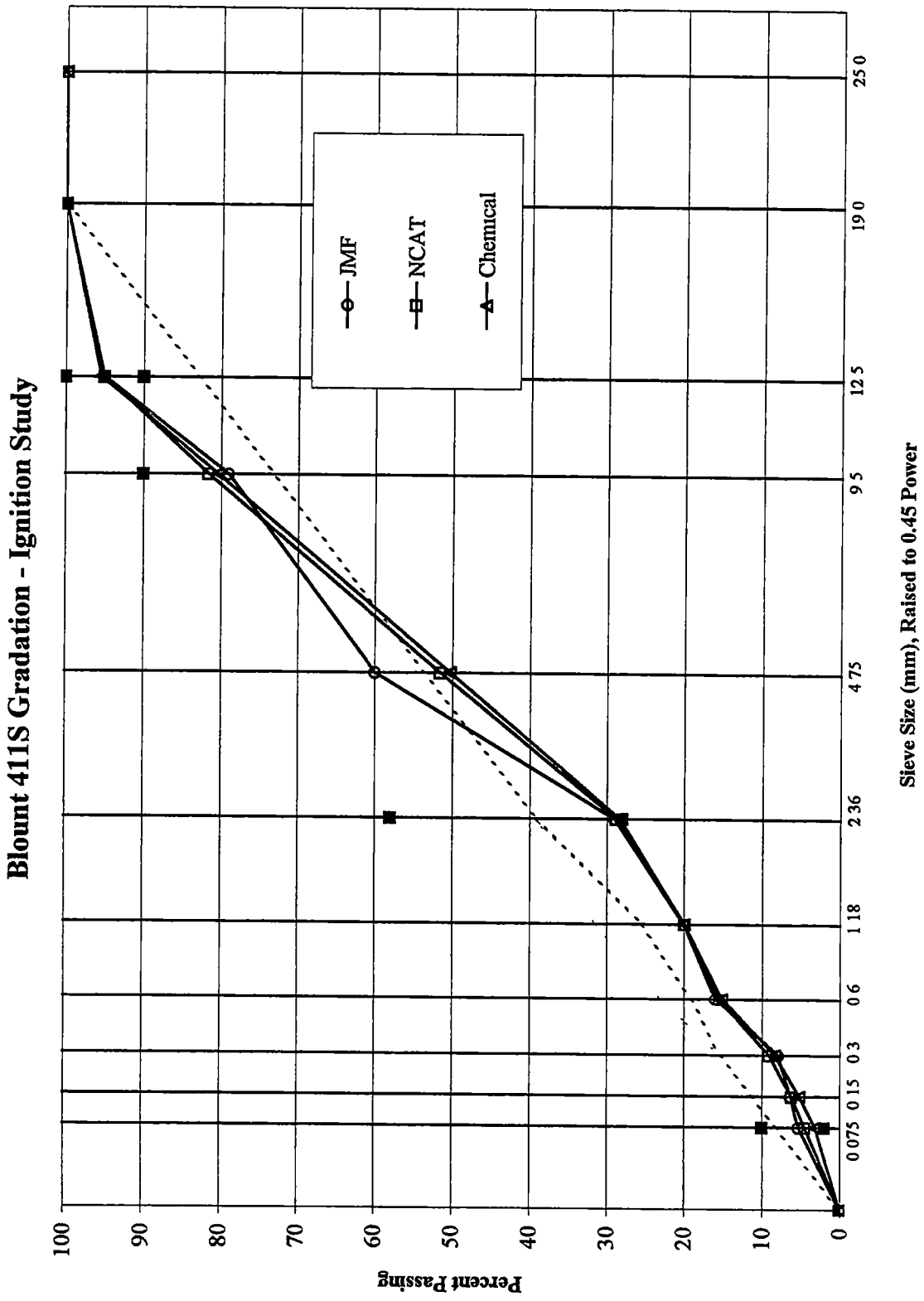
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Blount
Mix Type: 411 S
Project Number: 05002-4219-04(5276)
Contractor: APAC-Harrison Con

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100.0	100 0	100 0
12 5 mm (1/2")	95	95 4	94 9	94 5	93 1
9 5 mm (3/8")	79	80 4	81 6	81 6	81 5
4 75 mm (#4)	60	50 3	51 6	53 2	52 2
2 36 mm (#8)	29	28 4	28 8	31 3	30 6
1 18 mm (#16)	20	20 0	19.9	22 2	21 5
0 6 mm (#30)	16	15 2	15 5	17 0	16 5
0 3 mm (#50)	8	8 4	9 2	10 4	10 0
0 15 mm (#100)	6	5 2	6 2	7 1	6 8
0 075 mm (#200)	5	3 2	4 6	5 1	4 9
Asphalt Content	6 00%	5 88%	6 07%	5 82%	5 54%
% Dust	5 40%	3 22%	4 59%	5 06%	4 91%


Blount 411S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 0750 15 0 3 0 6 1 18 2 36 4 75 9 5 12 5 19 0 25 0
Sieve Size (mm), Raised to 0.45 Power


Blount 411S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0075
015
03
06
118
236
475
95
125
190
250
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Blount-Loudon**
Mix Type:	**307 BM/2**
TDOT Project No.:	**05001-3264-14**
Contract No.:	**4858**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 2/16/98

Project Ref No DS-NH 33(12) County Blount & Loudon Region I
Proj No 05001-3264-14 (53005-3212-14) Contract No 4858
Type BCHM-BM/2 Sec No 307-BM/2 Article
Contractor APAC - TN,Harrison Subcontractor
State Rt 411- South **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/1/97

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
#56, Limestone	12 5mm-75um	Vulcan Materials, Maryville	34 49
#8, Limestone	9 5mm-75 um	Vulcan Materials, Maryville	14 37
Natural Sand	9 5mm-75um	Highland Sand, Crab Orchard	25 87
RAP	12 5mm-75um	Harrison Stockpile	19 16
Asphalt Cement	MAC AC	Southern States, Knoxville	4 20
Anti-Strip	TYPE PAVE BOND	DOSAGE RATE 0 5	
% Fractured Faces on +4 Material	NA	% Glassy Particles on +4 Material	NA

100 PERCENT MINERAL AGGREGATE				AGGREGATE ANALYSIS TOTAL PERCENT PASSING					
SCREEN	Trl Passing	Requested Percent		#56 Percent	#8 Percent	Sand Percent	RAP Percent	Filler Percent	Calculated Mix
% A.C	4 2-6 2	4 20	336 F	36 0	15 0	27 0	20 0	2 0	100 0
RAP A.C	4 5				NCAT Furnace Corr Factor				
	Compaction Temp		156 C		LOI				
	Mixing Temp		169 C		Theo 2 603				
2"									
1 1/2"	100		100 0	100 0	100 0	100 0	100 0	100 0	100 0
1 1/4"			0 0						0 0
1"			0 0						0 0
3/4"	81/93		91 0	75 0	100 0	100 0	100 0	100 0	91 0
1/2"			0 0						0 0
3/8"			63 0	11 0	84 0	100 0	87 0	100 0	63 0
#4	40/56		44 0	5 0	6 0	98 0	64 0	100 0	44 0
#8	28/43		36 5	4 0	5 0	87 0	44 0	100 0	36 5
#16									
#30	13/25		25 0	2 0	1 0	65 0	23 0	100 0	25 0
#50	9/19		10 3	2 0	1 0	14 0	18 0	100 0	10 3
#100	6/10		6 6	1 00	1 00	5 00	13 90	100 0	6 6
#200	2 5/6 5		4 8	0 50	0 20	1 60	10 60	100 0	4 8

Requested (APAC-TN) Harrison Div
Contractor

Approved
Region Construction Engineer

Approved
Region Materials Engineer

Approved
Engineer of Materials and Tests

Gradation Comparison Sheet

Aggregate Degradation

University of Tennessee, Knoxville

County: Blount/Loudon

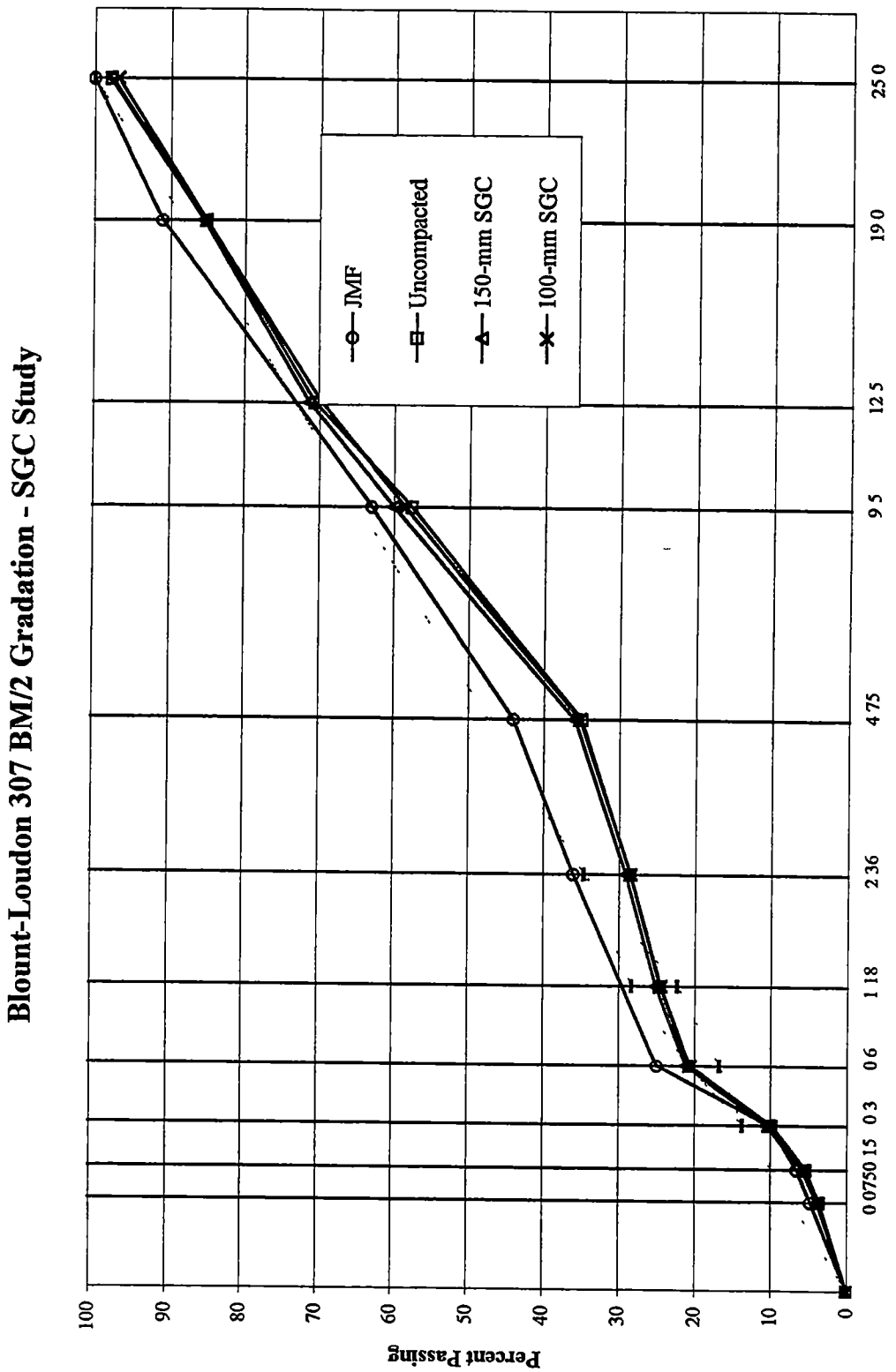
Mix Type: 307 BM/2

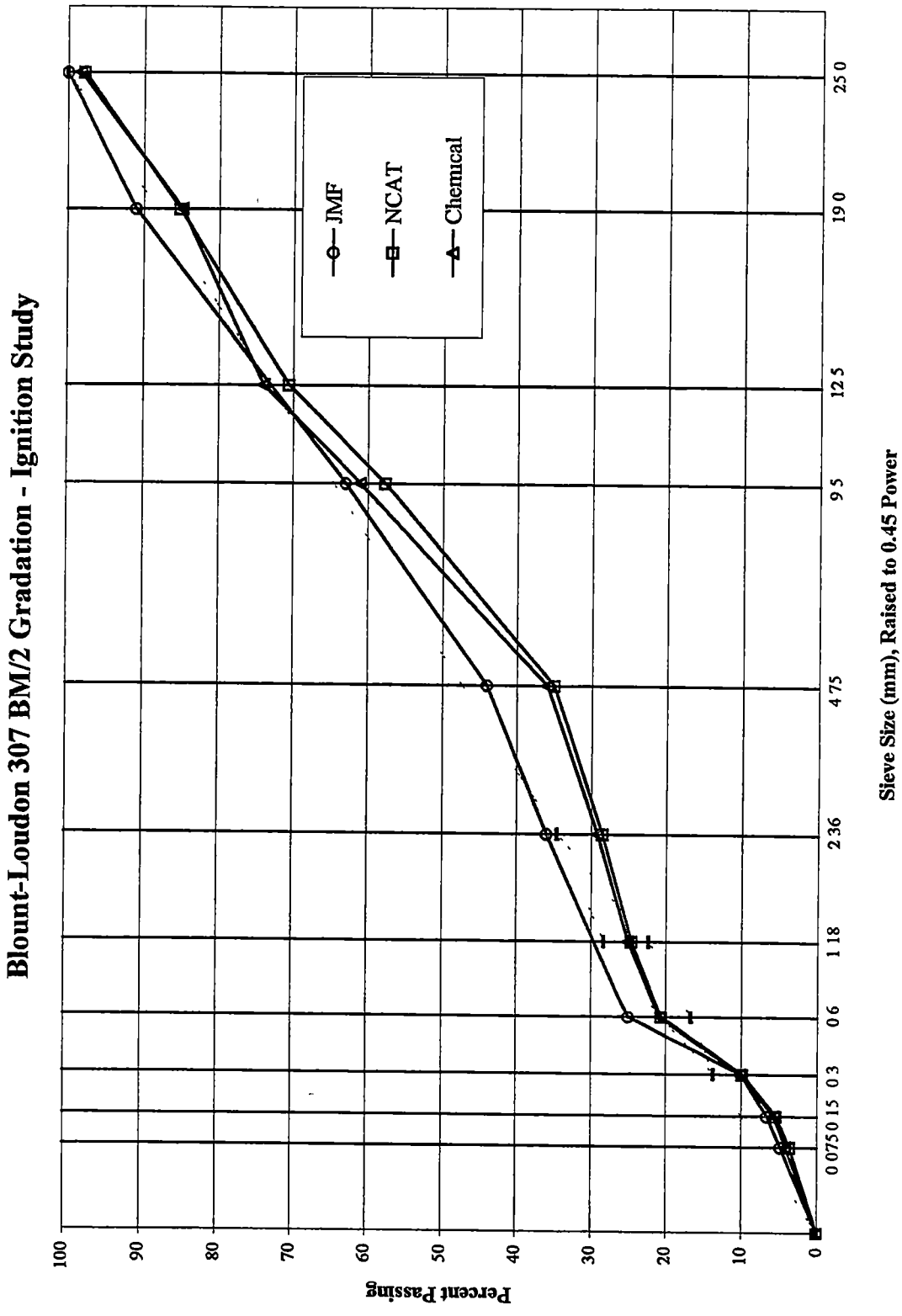
Project Number: 05001-3264-14(4858)

Contractor: APAC-TN Harrison Con

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	98 3	97 8	97 9	96 9
19 mm (3/4")	91	84 9	85 1	85 5	85 2
12 5 mm (1/2")		73.9	70 6	71 3	69 7
9 5 mm (3/8")	63	61 0	57.7	60 1	58 6
4 75 mm (#4)	44	35 9	35.0	35 9	35 3
2 36 mm (#8)	36	29 1	28 5	29 1	28 4
1 18 mm (#16)		25 0	24 6	25 1	24 5
0 6 mm (#30)	25	20 8	20 6	21 1	20 6
0 3 mm (#50)	10	10 2	9 9	10 5	10 2
0 15 mm (#100)	7	5 7	5 4	5 9	5 7
0 075 mm (#200)	5	4 1	3 6	3 9	3 8

Asphalt Content	4 20%	3 55%	4 19%	4 07%	3 88%
% Dust	4 80%	4 14%	3 64%	3 92%	3 84%


Blount-Loudon 307 BM/2 Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075 0.15 0.3 0.6 1.18 2.36 4.75 9.5 12.5 19.0 25.0
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC


Blount-Loudon 307 BM/2 Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Davidson**
Mix Type:	**411 D**
TDOT Project No.:	**19002-3169-44**
Contract No.:	**5168**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 4/17/98

Project Ref No IM-24-1(75)55 County Davidson Region III
Proj No 19002-3169-44 Contract No 5168
Type ACS(HM) Sec No 411-D Article
Contractor APAC - TN, Inc Subcontractor
State Rt I-24 **TOTAL MIX INCLUDING BITUMEN** Date of Letting

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A	5/8" -Pan	American Limestone, Springfield, TN	42 62
Screenings	3/8" -Pan	Vulcan, Danley, TN	23 68
Sand	3/8" -Pan	Ingram, Nashville, TN	28 41
Asphalt Cement	PG - 76-22	Ergon, Nashville, TN	5 30
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE 0 3	100
% Fractured Faces on +4 Material	100	% Glassy Particles on +4 Material	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	Screenings Percent	Sand Percent	Filler Percent	Calculated Mix
		Percent			45 0	25 0	30 0		100 0
% A.C	5 3-7 0	5 30			NCAT Furnace Corr Factor				
Temp	275-325	300	280-320		**LOI:** 19 5				
	Compaction Temp				**Theo:** 2 442				
	Mixing Temp								
5/8"	100	100			100	100 0	100		100
1/2"	95-100	98 0			95 0	100 0	100 0		97 8
3/8"	80-93	87 0			72 0	100 0	100 0		87 4
No 4	54-76	61 0			20 0	92 0	96 0		60 8
No 8	35-57	45 0			5 0	62 0	91 0		45 1
No 30	17-29	27 0			2 9	30 0	61 0		27 1
No 50	10-18	11 0			2 8	22 5	12 0		10 5
No 100	3-10	6 0			2 3	18 5	1 0		6 0
No 200	0-6 5	4 9			1 9	15 8	0 4		4 9

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

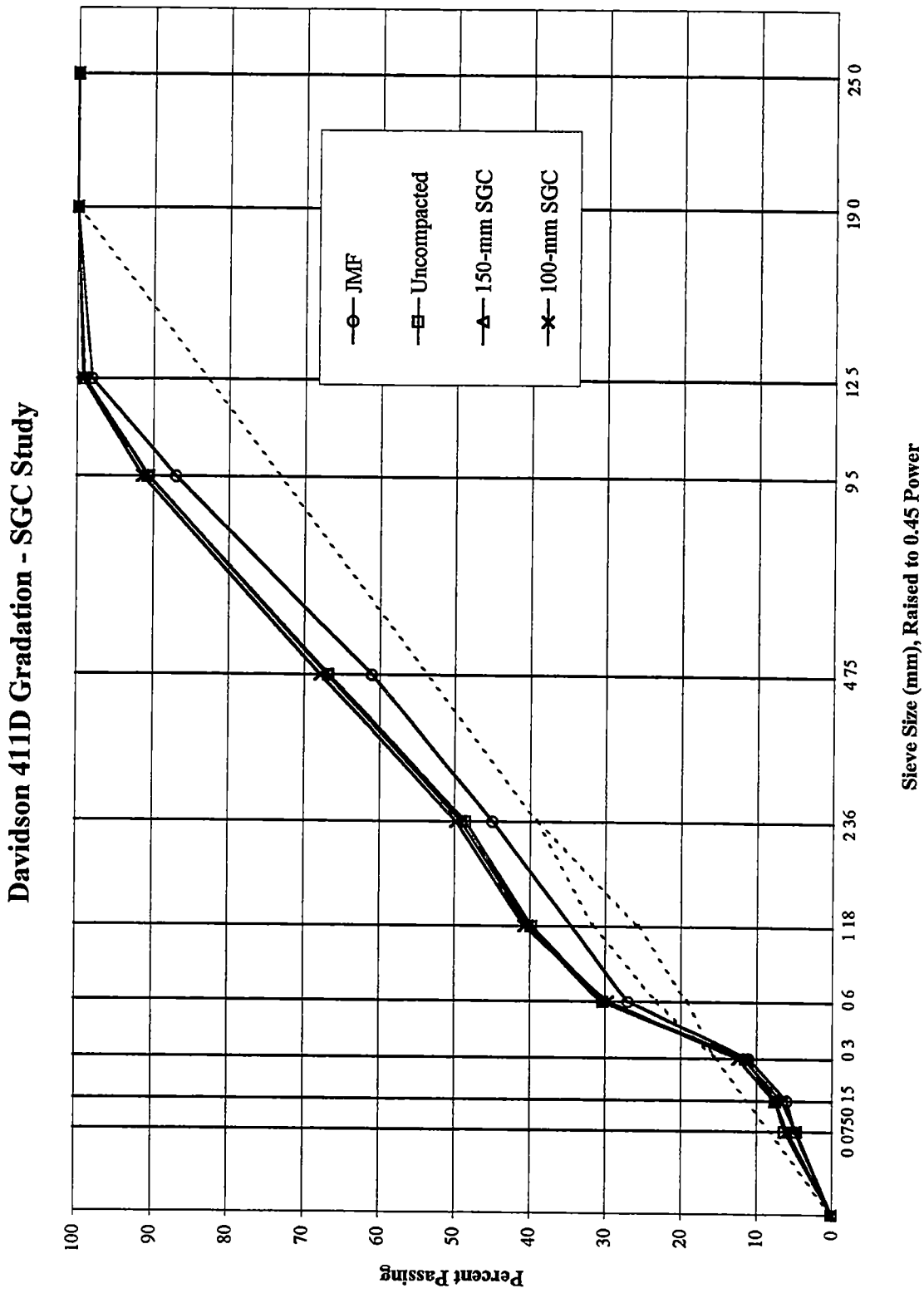
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Davidson
Mix Type: 411 D
Project Number: 19002-3169-44(5168)
Contractor: APAC-TN, Inc

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0
12 5 mm (1/2")	98	99 0	98 9	99 2
9 5 mm (3/8")	87	90 7	90 6	91 4
4 75 mm (#4)	61	66 8	66 9	67 9
2 36 mm (#8)	45	48 6	49 2	49 8
1 18 mm (#16)		39.8	40 3	40 8
0 6 mm (#30)	27	30 3	30 6	29 7
0 3 mm (#50)	11	11 4	11 7	12 4
0 15 mm (#100)	6	7 4	6 6	7 5
0 075 mm (#200)	5	6 3	4 7	6 0

Asphalt Content	5 30%	6 01%	5 83%	5 75%
% Dust	4 90%	6 27%	4 74%	5 95%


Davidson 411D Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Davidson**
Mix Type:	**411 D w/ Latex**
TDOT Project No.:	**19036-3215-14**
Contract No.:	**3556**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 2/12/98

Project Ref No _____ County Davidson Region III
Proj No 19036-3215-14 Contract No 3556
Type HCS (HM) Sec No 411D Latex Article _____
Contractor Alman Construction Co Subcontractor APAC, TN
State Rt 12 **TOTAL MIX INCLUDING BITUME** Date of Letting

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A	5/8" -Pan	Burns Stone, Dickson, TN	42 44
Screenings	3/8" -Pan	Vulcan Materials, River Rd , TN	23 58
Sand	3/8" -Pan	Hunter Marins, Nashville, TN	28 29
Asphalt Cement	PG -64-22	Southern States Nashville, TN	5 20
Asphalt Cement	Latex	Ultrapave Dalton, GA	3% Solids
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE 0 3	100
% Fractured Faces on +4 Material	100	% Glassy Particles on +4 Material	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A. Percent	Med C A. Percent	Screenings Percent	Sand Percent	Filler Percent	Calculated Mix
		Percent			45 0	25 0	30 0		100 0
% A.C	5 3-7 0	5 70			NCAT Furnace Corr Factor				
Temp	275-325	300	280-320		**LOI:**	19 5			
5 7 % Asphalt includes 3% Latex Solids					**Theo:**	2 416			
5 7 Divided by 7 = 8 14 total Latex									
5/8"	100	100			100	100 0	100		100
1/2"	95-100	97 0			94 0	100 0	100 0		97 3
3/8"	80-93	86 0			69 0	100 0	100 0		86 1
No 4	54-76	56 0			11 0	90 0	95 0		56 0
No 8	35-57	43 0			1 9	62 0	90 0		43 4
No 30	17-29	27 0			1 7	30 0	62 0		26 9
No 50	10-18	10 0			1 5	24 0	12 0		10 3
No 100	3-10	5.7			1 2	19.6	1 0		5 7
No 200	0-6 5	4 3			0 9	15 0	0 4		4 3

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

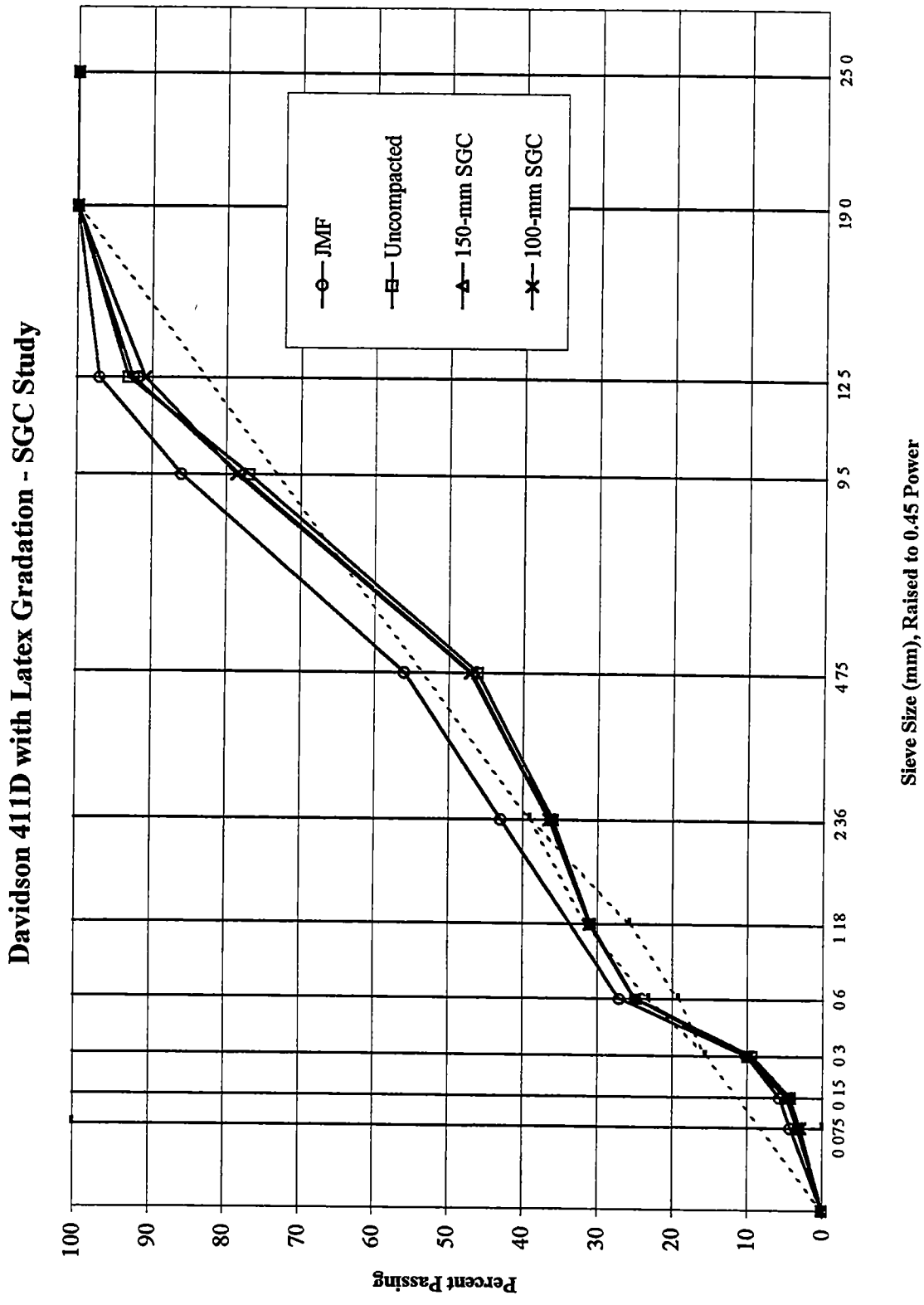
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Davidson
Mix Type: 411 D Latex
Project Number: 19036-3215-14(3556)
Contractor: APAC-TN

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0
12 5 mm (1/2")	97	93 1	92 5	90 9
9 5 mm (3/8")	86	77 0	78 3	78 6
4 75 mm (#4)	56	46 2	46 9	47 1
2 36 mm (#8)	43	36 0	36 4	36 5
1 18 mm (#16)		30 9	31 1	31 1
0 6 mm (#30)	27	24 9	24 9	24 8
0 3 mm (#50)	10	9 4	10 2	9 9
0 15 mm (#100)	6	4 3	4 8	4 3
0 075 mm (#200)	4	3 1	3 4	3 0

Asphalt Content	5 70%	5 75%	5 72%	5 45%
% Dust	4 30%	3 09%	3 39%	2 99%


Davidson 411D with Latex Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075 0 15 0 3 0 6 1 18 2 36 4 75 9 5 12 5 19 0 25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Davidson-Wilson**
Mix Type:	**307 BM**
TDOT Project No.:	**19041-3262-04**
Contract No.:	**4352**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 2/5/98

Project Ref No _____ County Davidson/WilsonRegion III
Proj No 19014-3262-04 Contract No 4352
Type BPMB-HM Sec No 307BM Article 307
Contractor LOJAC Ent. Subcontractor
State Rt Lebanon Rd **TOTAL MIX INCLUDING BITUMEN** Date of Letting

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	1"-Pan	Vulcan Mtls , Hermitage, TN	19 16
Med C A	3/4"-Pan	Vulcan Mtls , Hermitage, TN	28 74
Screenings	3/8" -Pan	Vulcan Mtls , Hermitage, TN	14 37
Sand	3/8" -Pan	Ingram Mtls , Nashville, TN	14 37
Filler RAP	3/4"-Pan	LOJAC Ent , Hermitage, TN	20 06
A C and Pen	AC-20 Mod-lite polymer	Marathon Ashland Oil, Nashville, TN	3 30
% Fractured Faces on +4 Material	ASH PB Lite	% Glassy Particles on +4 Mater 0 39	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	Screenings Percent	Sand Percent	Filler Percent	Calculated Mix
		Percent		20 0	30 0	15 0	15 0	20 0	100 0
% A.C	4 2-6 2	4 20			NCAT Furnace Corr Factor				
Temp	275-325	310	290-330		**LOI:**				
					Theo: 2 520				
1"	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
3/4"	85-100	98 0	92 3-100	91 0	100 0	100 0	100 0	99 0	98 0
1/2"									
3/8"	59-79	73 0	67 3-78 7	19 0	69 0	100 0	100 0	90 0	72 5
No 4	42 6	49 0	45-53	8 5	14 0	93 0	99 0	69 0	48 5
No 8	29-47	36 0	32 7-39 3	5 0	5 0	63 0	94 0	50 0	36 1
No 30	13-27	22 0	18 7-25 3	2 0	3 0	28 0	63 0	33 0	21 6
No 50	36727 0	10 0	6 7-13 3	1 8	2 0	20 0	13 0	22 0	10 3
No 100	4-10	7 1	5 5-8 7	1	1 5	19 0	1 5	17	7 1
No 200	0-6 5	5 8	4 2-7 4	0 2	1 3	16 0	0 5	14 0	5 8

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

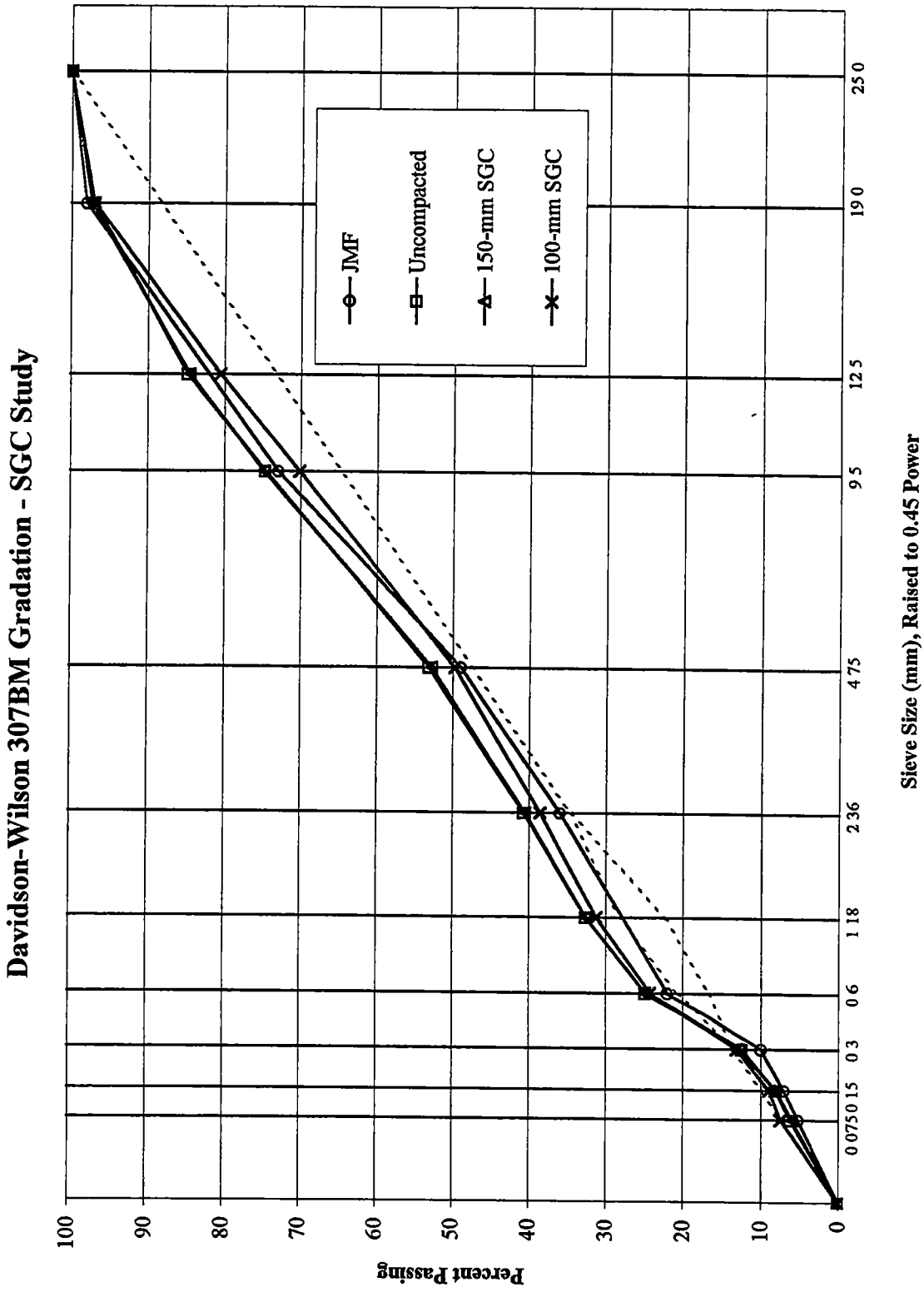
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Davidson/Wilson
Mix Type: 307 BM(RAP)
Project Number: 19041-3262-04(4352)
Contractor: Loiac Enterprises

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	98	97 0	97 3	97 0
12 5 mm (1/2")		84 8	84 5	80 5
9 5 mm (3/8")	73	74 6	74.8	70 2
4 75 mm (#4)	49	53 1	52 7	49 7
2 36 mm (#8)	36	40 7	40 6	38 6
1 18 mm (#16)		32 6	32 6	31 2
0 6 mm (#30)	22	24 9	24 9	24 3
0 3 mm (#50)	10	12 4	12 8	13 1
0 15 mm (#100)	7	8 1	8 1	8 9
0 075 mm (#200)	5	6 2	6 1	7 5

Asphalt Content	4 20%	4 60%	4 36%	4 00%
% Dust	5 20%	6 24%	6 07%	7 48%


Davidson-Wilson 307BM Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC

Appendix A

Project Summary

County:	**Dickson**
Mix Type:	**307 BM**
TDOT Project No.:	**22007-4233-04**
Contract No.:	**5120**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 2/12/98

Project Ref No SP County Dickson Region III
Proj No 22007-4233-04 Contract No 5120
Type BPMB-HM Sec No 307-BM(R) Article 3 16
Contractor Eubank Paving Subcontractor
State Rt HWY 48 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 2/6/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	1"-1/4"	Burns Stone, Dickson, TN	38 00
Block MTL	1/4"-Pan	Burns Stone, Dickson, TN	19 00
Soft SCR	1/4"-Pan	Burns Stone, Dickson, TN	9 50
Sand	3/8"-Pan	SANGRAVL, New Johnsonville	9 50
RAP	1"-Pan	Eubank Paving, Dickson, TN	20 26
Asphalt-Cement	PG-64-22	Marathon/Ashland Oil Nashville, TN	3 74
Anti-Strip	Type Pavebond Lite	Dosage Rate 0 5	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100%

Screen	Total Passing Master Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	Screenings Percent	Sand Percent	Rap Percent	Calculated Mix
				40 0	20 0	10 0	10 0	20 0	
% A.C	4 2-6 2	5 00	4 65-5 35		NCAT Furnace Corr Factor				
Temp	275-325 F	300 F	280-320 F		**LOI:**				
					Theo:		2 446		
1"	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
3/4"	85-100	94 0	88 3-99 7	86 0	100 0	100 0	100 0	100 0	94 4
5/8"									
1/2"									
3/8"	59-79	73 0	67 3-78 7	37 0	100 0	100 0	100 0	90 0	72 8
No 4	42-61	54 0	50 0-58 0	8 0	88 0	96 0	97 0	68 0	53 7
No 8	29-47	31 0	27 7-34 3	4 0	21 0	68 0	83 0	52 0	31 3
No 30	13-27	17 0	13 7-20 3	3 0	6 0	33 0	59 0	29 0	17 4
No 50	7-20	11 0	7 7-14 3	2 0	5 0	24 0	21 0	22 0	10 7
No 100	4-10	6 70	5 10-8 30	1 0	5 0	19 0	4 0	15 0	6 7
No 200	0-6 5	5 38	3 78-6 98	0 7	4 0	16 0	1 0	13 0	5 4

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

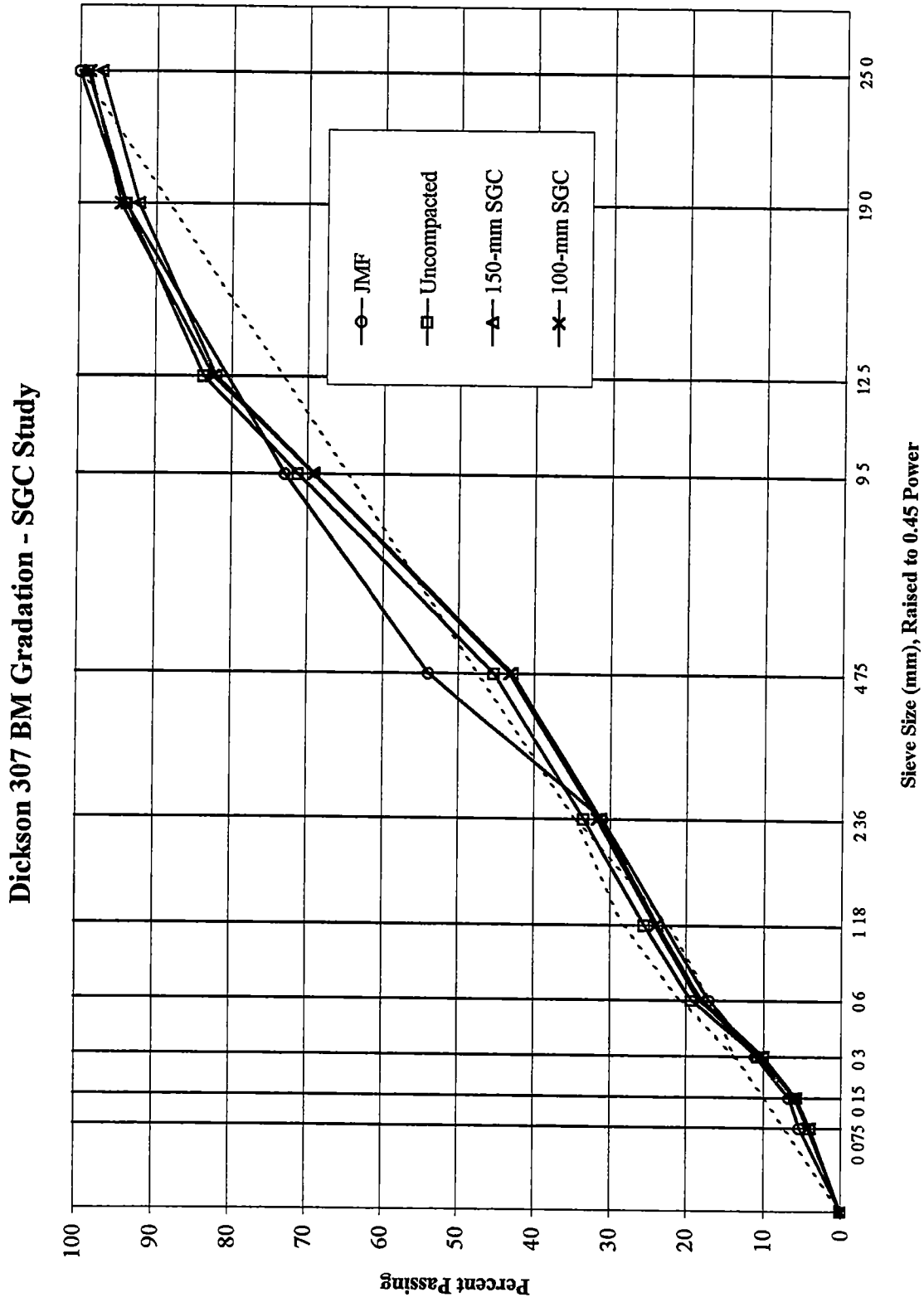
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Dickson
Mix Type: 307 BM
Project Number: 22007-4233-04(5120)
Contractor: Eubank Paving

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	99 0	97.1	98 7
19 mm (3/4")	94	93 9	92 2	94 6
12 5 mm (1/2")		83 7	82 0	82 4
9 5 mm (3/8")	73	71 3	69 1	69 2
4 75 mm (#4)	54	45 3	42 9	43 3
2 36 mm (#8)	31	33 5	31 2	31 7
1 18 mm (#16)		25 5	23 8	24 1
0 6 mm (#30)	17	19 3	17 9	18 2
0 3 mm (#50)	11	10 7	10 0	10 4
0 15 mm (#100)	7	5 8	5 8	6 0
0 075 mm (#200)	5	4 0	4 0	4 2

Asphalt Content	5 00%	5 54%	5 05%	4 95%
% Dust	5 38%	4 00%	4 00%	4 25%


Dickson 307 BM Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
Uncompacted
150-mm SGC
100-mm SGC
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Dickson**
Mix Type:	**411 D**
TDOT Project No.:	**22007-4233-04**
Contract No.:	**5120**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 3/4/98

Project Ref No SP County Dickson Region III
Proj No 22007-4233-04 Contract No 5120
Type ACS-HM Sec No 411-D Article 01 01-01 02
Contractor Eubank Paving Subcontractor
State Rt HWY 48 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 2/6/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	5/8"-1/4"	Burns Stone, Dickson, TN	37 64
Med C A	1/4"-Pan	Burns Stone, Dickson, TN	16 00
Screenings	1/4"-Pan	Burns Stone, Dickson, TN	16 94
Sand	3/8"-Pan	SANGRAVL, New Johnsonville	23 53
Asphalt-Cement	PG-64-22	Marathon/Ashland Oil Nashville, TN	5 90
Anti-Strip Type Pavebond Lite		Dosage Rate 0 5	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100%

Screen	Total Passing Master Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	Screenings Percent	Sand Percent	Filler Percent	Calculated Mix
				40 0	17 0	18 0	25 0		
% A.C	5 3-7 0	5 90	5 55-6 25		NCAT Furnace Corr Factor				
Temp	275-325 F	300 F	280-320 F		**LOI:**		17 8		
					Theo:		2 399		
1"									
3/4"									
5/8"	100 0	100 0	100 0	100 0	100 0	100 0	100 0		100 0
1/2"	95-100	98 0	92 3-100	95 0	100 0	100 0	100 0		98 0
3/8"	80-93	89 0	83 3-94 7	73 0	100 0	100 0	100 0		89 2
No 4	54-76	63 0	59-67	13 0	96 0	96 0	97 0		63 1
No 8	35-57	46 0	42 7-49 3	4 0	65.0	68 0	83 0		45 6
No 30	17-29	26 0	22 7-29 3	3 0	25 0	33 0	59 0		26 1
No 50	10-18	13 0	19 7-26 3	2 0	17 0	24 0	21 0		13 3
No 100	3-10	7 11	5 51-8 71	1 2	13 0	19 0	4 0		7 1
No 200	0-6 5	5 15	3 55-6 75	0 8	10 0	16 0	1 0		5 2

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

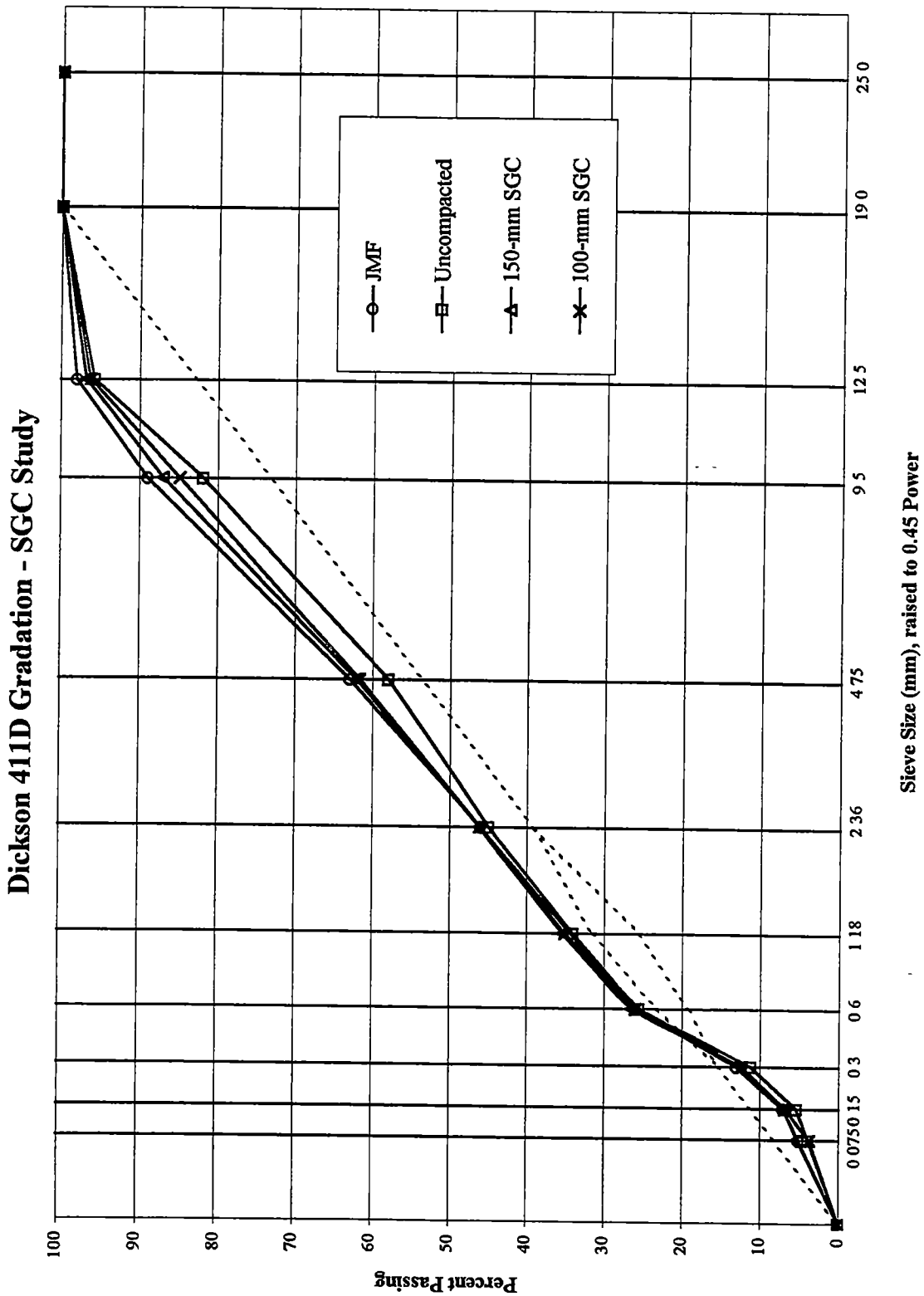
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Dickson
Mix Type: 411 D
Project Number: 22007-4233-04(5120)
Contractor: Eubank Asphalt Paving

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0
12 5 mm (1/2")	98	95 7	96 8	96 2
9 5 mm (3/8")	89	81 9	87 0	84 9
4 75 mm (#4)	63	57 9	62 1	61 7
2 36 mm (#8)	46	44 9	46 1	46 1
1 18 mm (#16)		34 1	35 4	35.1
0 6 mm (#30)	26	25 5	26 5	25 9
0 3 mm (#50)	13	11 2	12 4	12 3
0 15 mm (#100)	7	5 4	7 0	6 8
0 075 mm (#200)	5	3 8	5 2	3 7

Asphalt Content	5 90%	5 67%	5 92%	5 88%
% Dust	5 15%	3 83%	5 17%	3 74%


Dickson 411D Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), raised to 0.45 Power

Appendix A

Project Summary

County:	**Dyer**
Mix Type:	**307 S**
TDOT Project No.:	**23002-4233-04**
Contract No.:	**5285**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/1/98

Project Ref No SP County Dyer Region IV
Proj No 23002-4223-04 Contract No 5285
Type Superpave 19mm Sec No 307-S Article SP 307-S
Contractor Ford Construction Co. Subcontractor N/A
State Rt 3 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 7/24/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A #57	1 1/4 - #200	Vulcan Materials Co , Gilbertsville, KY	25 60
Med C A #7	5/8 - #200	Ford Construction Co Troy, TN	25 60
Screenings MFG	3/8 - #200	Ford Construction Co Troy, TN	14 22
Sand #10	3/8 - #200	Vulcan Materials Co , Gilbertsville, KY	19 91
Filler RAP	1/2 - #200	HWY 51 Bypass, Ripley, TN	9 48
A C PG76	PG76-22	Ergon Asphalt Co Memphis, TN	5 20
Anti-Strip	TYPE. 88	DOSAGE RATE 0 50%	
	Perma Tac	Latex N/A %RAP AC 0 61	
		%VIR AC 4 59	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Mat 0	100

SCREEN	Ttl. Passing Design Range	Requested Percent	Tolerance Percent	C A % #57-R	Med C A #7-GR	SCRNS MFG-SND	Sand #10-R	Filler RAP	Calculated Mix
		Percent		27 0	27 0	15 0	21 0	10 0	100 0
Temp		340 00	320 360		NCAT Furnace Corr Factor				
% A C		5 2	Test Results Recommended		**LOI:**				
			A.C Content						
			Blk Grv 2 298						
			Eff Grv 2 584		**Theo:** 2 396				
25mm	100 0	100 0	Stab 4133	100 0	100 0	100 0	100 0	100 0	100 0
19mm	90-100	96 0	Flow 18 5	84 0	100 0	100 0	100 0	100 0	95 7
16mm		90 0	Voids 4 1	62 0	100 0	100 0	100 0	99 0	89 6
12 5mm	MAX-90	82 0	VMA 15 7	37 0	98 0	100 0	100 0	99 0	82 4
9 5mm		72 0	V Filled 74	14 0	83 0	100 0	100 0	96 0	71 5
4 75mm		49 0	Dust-AC 1 1	4 0	38 0	69 0	96 0	71 0	49 0
2 36mm	23-49	31 0	Unit WT 143 39	2 0	18 0	35 0	72 0	53 0	31 1
600um		15 0	Moisture Damage	1 0	6 0	16 0	38 0	30 0	15 3
300um		11 0	Avg. Dry 140 4	1 0	5 0	12 0	28 0	12 0	10 5
150um		8 0	Avg. Cnd. 129 4	1 00	4 00	8 0	21 00	7 00	7 70
75um	2-8	5 8	TSR 92 2	1 00	3 00	6 00	16 00	5 00	5 80

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

Gradation Comparison Sheet

Aggregate Degradation

University of Tennessee, Knoxville

County: Dyer

Mix Type: 307 S

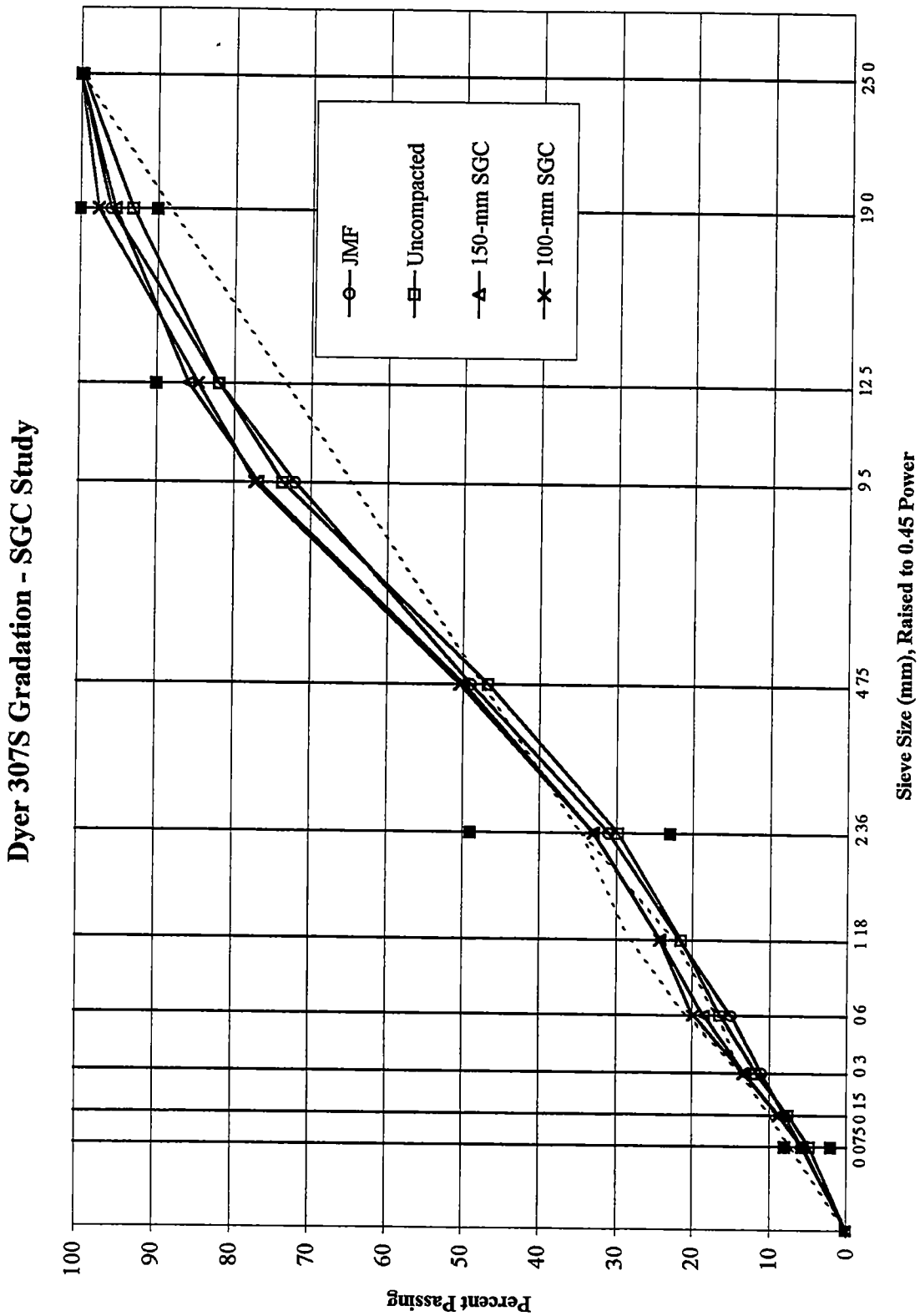
Project Number: 23002-4223-04 (5285)

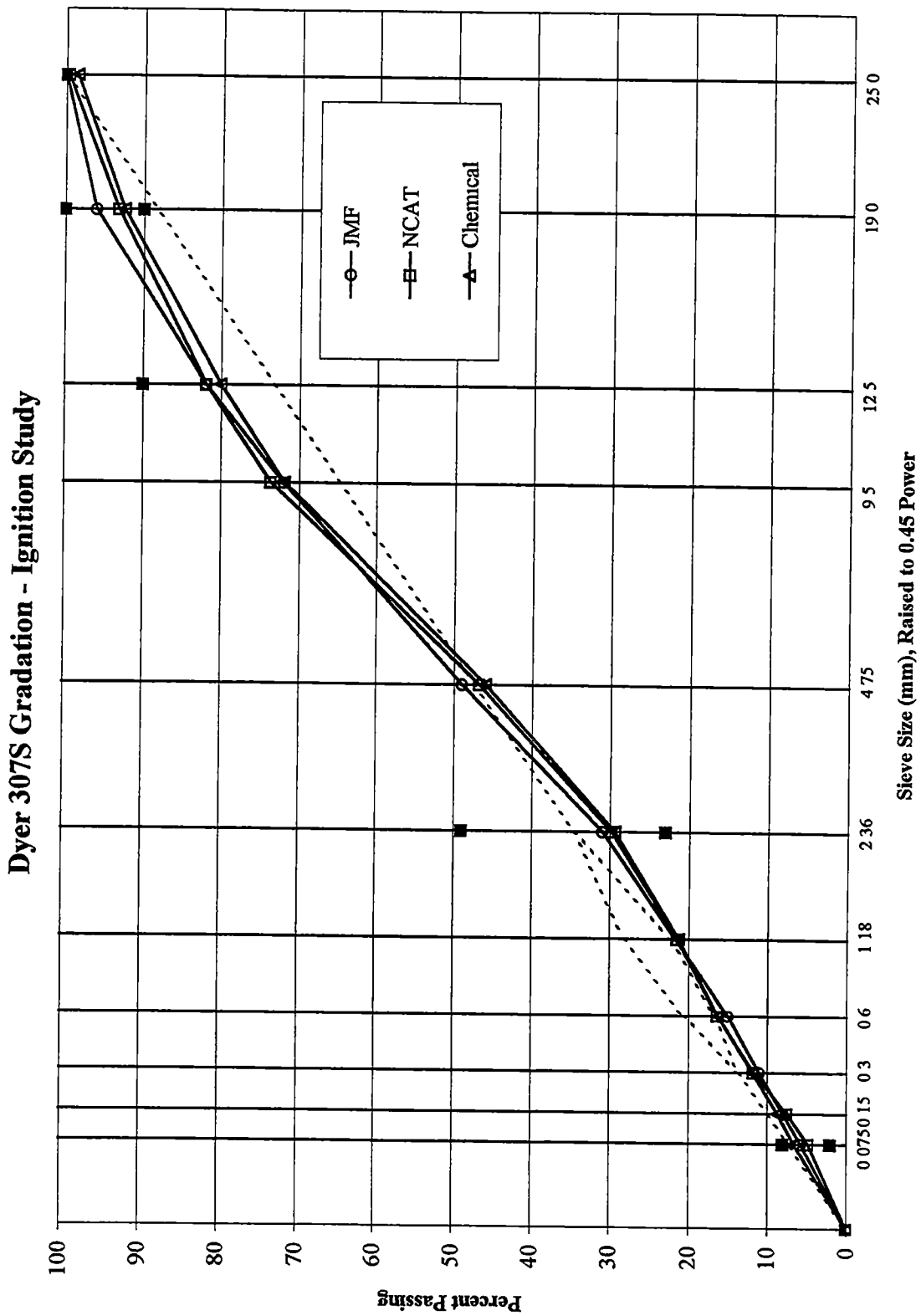
Contractor: Ford Construction

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100 0	98 5	99 6	100 0	100 0
19 mm (3/4")	96 0	92 4	93 2	95 4	97 6
12 5 mm (1/2")	82 0	80 0	81 9	85 9	84 7
9 5 mm (3/8")	72 0	71 8	73 6	76 8	77 3
4 75 mm (#4)	49 0	45 9	46 7	49 9	50 4
2 36 mm (#8)	31 0	29 4	29 8	33 0	33 0
1 18 mm (#16)		21 3	21 4	24 2	24 3
0 6 mm (#30)	15 0	16 2	16 3	18 5	19 9
0 3 mm (#50)	11 0	11 8	11 7	13 3	13 3
0 15 mm (#100)	8 0	8 7	7 6	8 7	8 8
0 075 mm (#200)	5 8	6 7	4 8	5 6	5 7

* Chemically Extracted

Asphalt Content	5 20%	4 82%	5 82%	5 97%	5 81%
% Dust	5 80%	6 71%	4 83%	5 64%	5 69%


Dyer 307S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power


Dyer 307S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Dyer**
Mix Type:	**411 S**
TDOT Project No.:	**23002-4233-04**
Contract No.:	**5285**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/14/98

Project Ref No SP County Dyer Region IV
Proj No 23002-4223-04 Contract No 5285
Type Superpave 12 5mm Sec No 411-S Article SP 411-S
Contractor Ford Construction Co Subcontractor N/A
State Rt 3 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 7/24/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A #7	5/8 - #200	Ford Construction Co Troy, TN	61 30
SCRNS #10	3/8 - #200	Vulcan Materials Co , Gilbertsville, KY	18 86
Sand MFG	3/8 - #200	Ford Construction Co Troy, TN	9 43
Filler AG L	3/8 - #200	Fredonia Valley Quarry, Fredonia, KY	4 72
A C Erg	PG76-22	Ergon Asphalt Co Memphis, TN	5 70
Anti-Strip	TYPE 87	DOSAGE RATE 0 50%	
	Perma Tac	Latex N/A Rap AC N/A VIR AC 5 7	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C.A. % #57-R	Med. C.A. #7-GR	SCRNS #10-R	MFG SND	Filler AG L -F	Calculated Mix
		Percent			65 0	20 0	10 0	5 0	100 0
Temp		340 00	320 360		NCAT Furnace Corr Factor			0 7	
% A C		5 7	Test Results Recommended		**LOI** 11				
			A.C Content						
			Blk Grv 2 178						
			Eff. Grv 2 507		**Theo:** 2 396				
25mm			Stab 4525						
19mm	100 0	100 0	Flow 20		100 0	100 0	100 0	100 0	100 0
16mm		100 0	Voids 6 0		100 0	100 0	100 0	100 0	100 0
12 5mm	90-100	99 0	VMA 18 1		98 0	100 0	100 0	100 0	98 7
9 5mm	MAX -90	90 0	V Filled 66 7		85 0	100 0	100 0	100 0	90 3
4 75mm		56 0	Dust-AC 1 2		38 0	96 0	69 0	99 0	55 8
2 36mm	28-58	35 0	Unit WT 135 90		18 0	72 0	35 0	97 0	34 5
600um		17 0	Moisture Damage		6 0	38 0	16 0	76 0	16 9
300um		13 0	Avg Dry 124 7		5 0	28 0	12 0	57 0	12 9
150um		10 0	Avg Cnd 118		4 00	21 0	8 00	44 00	9 80
75um	2-10	6 8	TSR 94 6		2 00	16 00	6 00	33 00	6 80

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

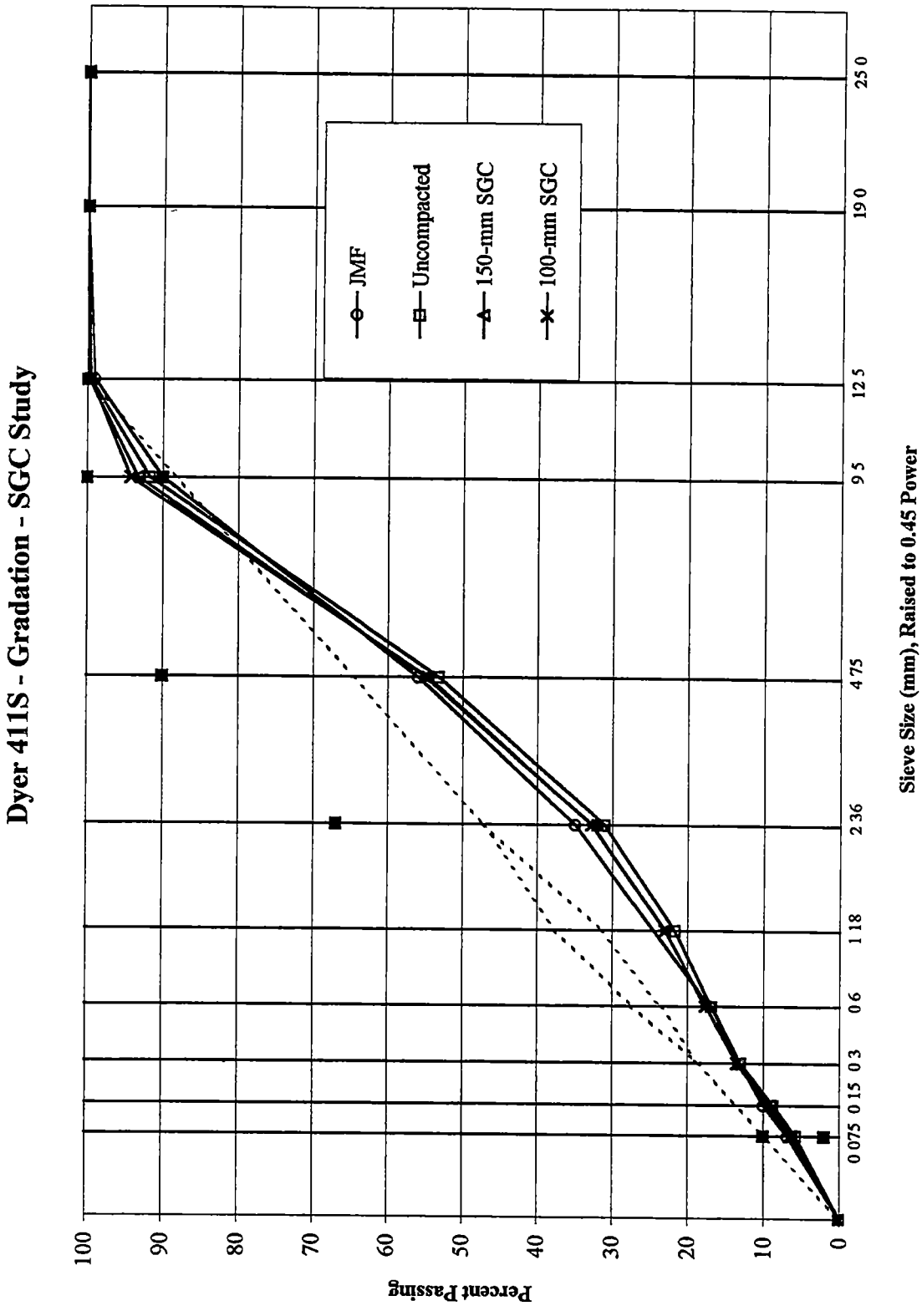
Gradation Comparison Sheet

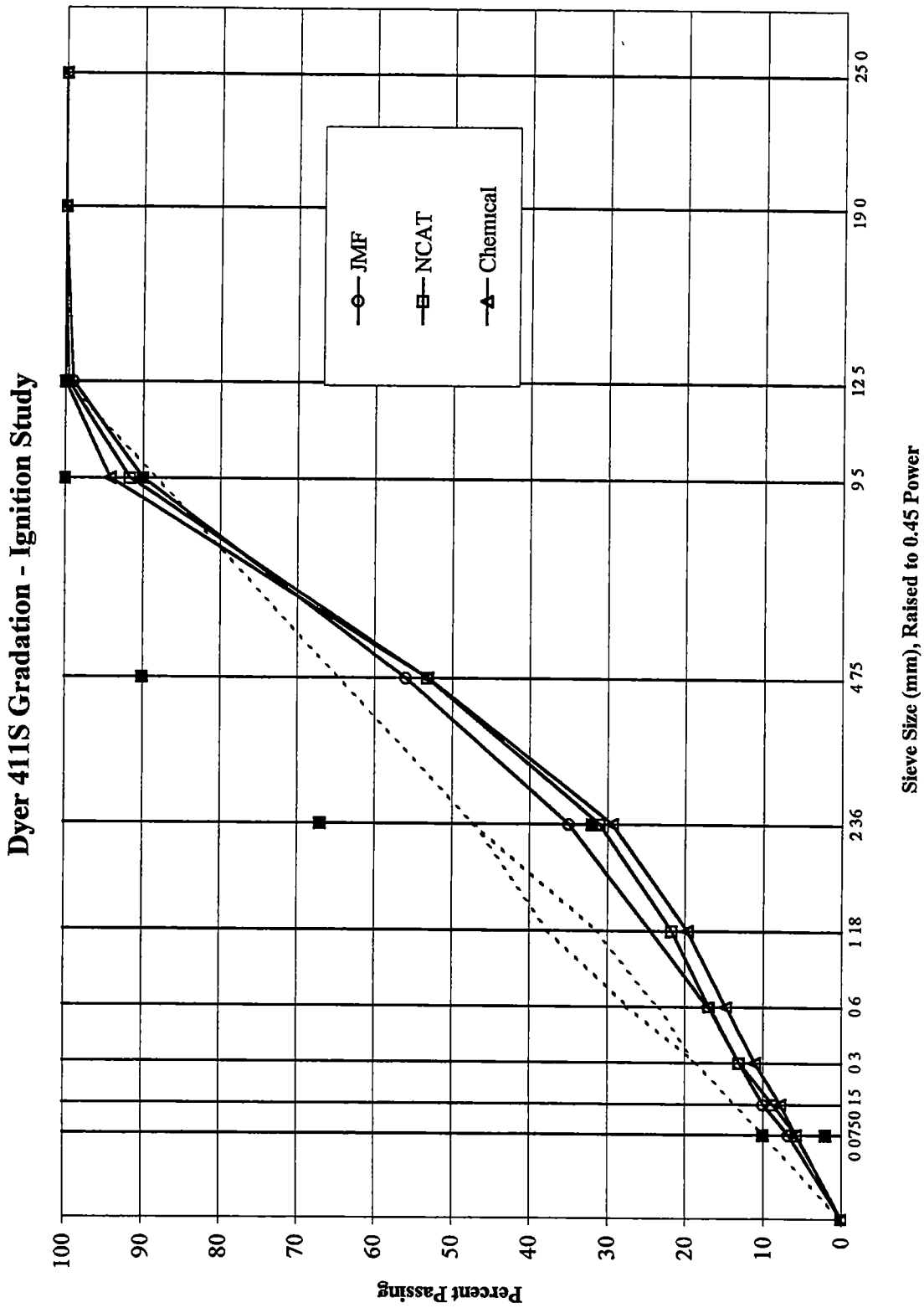
Aggregate Degradation
University of Tennessee, Knoxville

County: Dyer
Mix Type: 411 S
Project Number: 23002-4223-04 (5285)
Contractor: Ford Construction

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0	100 0
12 5 mm (1/2")	99	99 9	99 6	99 8	99 5
9 5 mm (3/8")	90	94 2	91 7	93 2	94 3
4 75 mm (#4)	56	53 1	53 2	55 0	54 7
2 36 mm (#8)	35	29 4	31 1	32 8	32 8
1 18 mm (#16)		19 6	21 7	22 9	23 0
0 6 mm (#30)	17	14 7	16 8	17 6	17 6
0 3 mm (#50)	13	11 0	13 0	13 3	13 5
0 15 mm (#100)	10	7 8	8 8	9 2	9 4
0 075 mm (#200)	7	5 8	5 7	6 3	6 5

Asphalt Content	5 70%	6 18%	6 48%	6 45%	6 42%
% Dust	6 80%	5 79%	5 75%	6 25%	6 47%


Dyer 411S - Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075 0 15 0 3 0 6 1 18 2 36 4 75 9 5 12 5 19 0 25 0
Sieve Size (mm), Raised to 0.45 Power


Dyer 411S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075 0 15 0 3 0 6 1 18 2 36 4 75 9 5 12 5 19 0 25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Giles**
Mix Type:	**307 BM/2**
TDOT Project No.:	**28001-8162-44**
Contract No.:	**5122**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 5/1/98

Project Ref No ME-65-1(58)0 County Giles Region III
Proj No 28001-8162-44 Contract No 5122
Type (BPMB-HM) Sec No 307-BM2 Article 03 16
Contractor Dement Construction Co Subcontractor N/A
State Rt TOTAL MIX INCLUDING BITUMEN Date of Letting 2/6/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A #56	30mm-Pan	Rogers Group Pulaski, TN	18 96
Med C A #7	19mm-Pan	Rogers Group Pulaski, TN	33 18
Screenings #10	9 5mm-Pan	Rogers Group Pulaski, TN	17 06
Sand	9 5mm-Pan	Adamsville Sand & Gravel Adamsville, TN	7 58
Filler RAP	19mm-Pan	Dement Construction Co Pulaski, TN	19 08
Asphalt-Cement	PG-64-22	Ergon Inc Nashville, TN RAP Has 5 6%AC	4 13
Anti-Strip Type	Perma Tac Plus	Dosage Rate 0 3	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100%

Screen	Total Passing Master Range	Requested Percent	Tolerance Percent	C A. Percent	Med C A Percent	Screenings Percent	Sand Percent	Filler Percent	Calculated Mix
				#56-RGP	#7-RGP	#10-RGP	Sand AS	RAP-DC	
Temp	0	149 00	138 - 16	20 0	35 0	18 0	8 0	19 0	100 0
A C %	4 2-6 2	5 2	Test Results		NCAT Furnace Corr Factor				
			Recommended		MAX. SP. GRV.		2 481		
			A C Content						
30mm	100	100	Blk Grv 2 382	100 0	100 0	100 0	100 0	100 0	100 0
25mm			Eff Grv 2 689						
19mm	81-93	85 0	Stab 3157 8	25 0	100.0	100.0	100 0	100 0	85 0
16mm			Flow						
12 5mm			Voids 3 9903						
9 5mm	57-73	67 0	Dust-AC 0 9	5 0	66 0	100 0	100 0	89 0	67 0
4 75mm	40-56	41 0	Unit WT 148 63	4 0	6 0	92 0	94 0	73 0	40 9
2 36mm	28-43	28 0	Moisture Damage	3 0	3 0	60 0	77 0	51 0	28 3
600um	13-25	16 0	Information	2 5	2 5	25 0	57 0	29 0	15 9
300um	9-19	10.0	Avg Dry 220 3	2 0	2 0	19 0	19 0	21 0	10 0
150um	6-10	6 0	Avg Cnd 188 9	1 5	1 5	15 0	3 0	14 0	6 4
75um	2 5-6 5	4 90	TSR 85 7	1 0	1 0	13 0	1 0	10 0	4 9

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Contractor

Approved _____
Region Construction Engineer

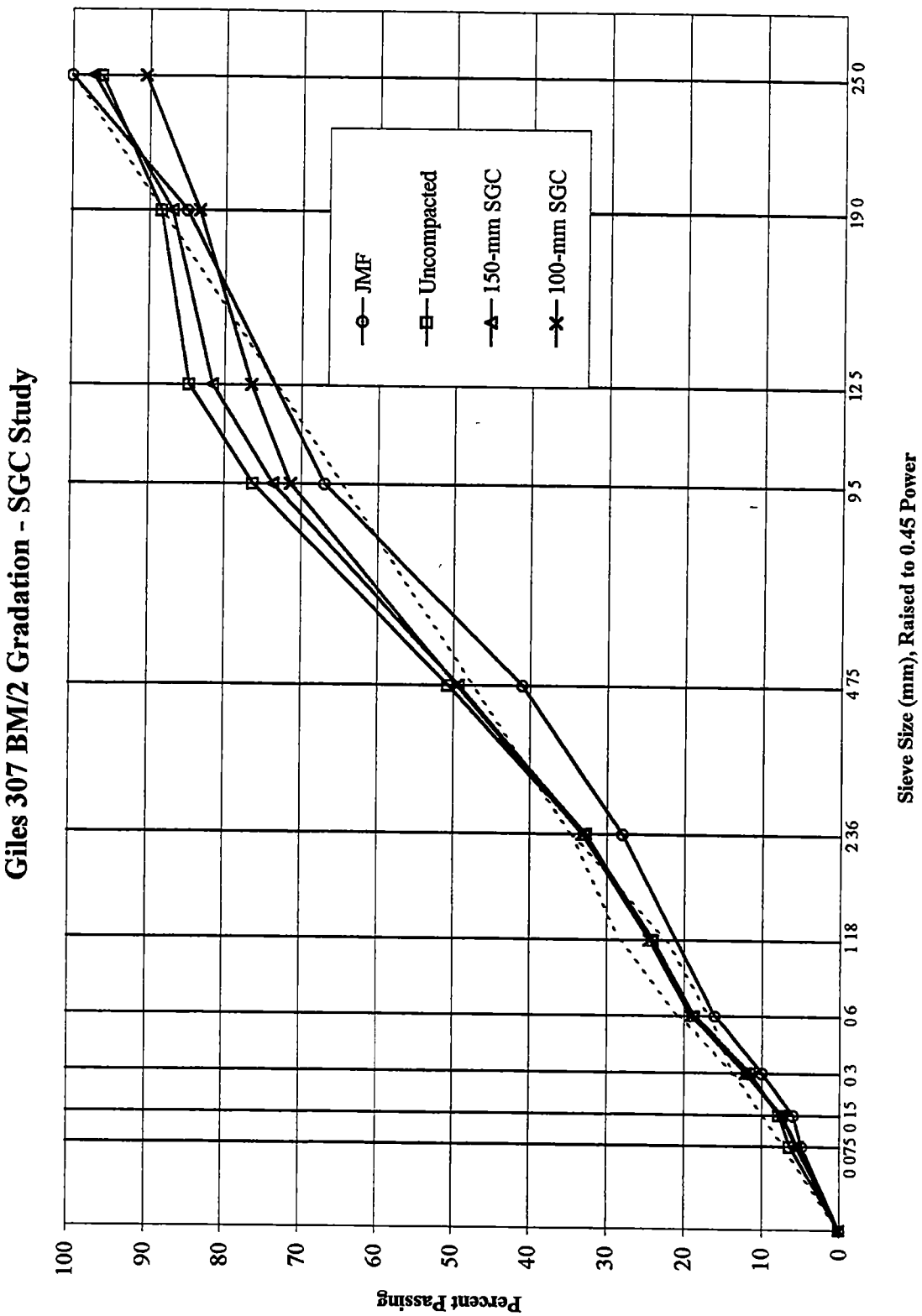
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Giles
Mix Type: 307 BM/2
Project Number: 28001-8162-44(5122)
Contractor: Dement Const Co

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	96 1	97 1	90 5
19 mm (3/4")	85	88 4	86 9	83 4
12 5 mm (1/2")		84 7	81 6	76 5
9 5 mm (3/8")	67	76 3	73 7	71 4
4 75 mm (#4)	41	50 7	49 4	49 5
2 36 mm (#8)	28	32 9	32 8	33 1
1 18 mm (#16)		24 0	24 2	24 5
0 6 mm (#30)	16	18 6	18 9	19 0
0 3 mm (#50)	10	11 5	12 1	12 1
0 15 mm (#100)	6	7 8	7 6	7 5
0 075 mm (#200)	5	6 4	5.6	5 4

Asphalt Content	5 20%	5 65%	5.25%	5 14%
% Dust	4 90%	6 42%	5 60%	5 39%


Giles 307 BM/2 Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
Uncompacted
150-mm SGC
100-mm SGC
0075 0 15 0 3 0 6 1 18 2 36 4 75 9 5 12 5 19 0 25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Grundy**
Mix Type:	**307 BM/2**
TDOT Project No.:	**31006-4227-04**
Contract No.:	**5295**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 7/14/98

Project Ref No _____ County Grundy II
Proj No 31006-4227-04 Contract No 5295
Type _____ Sec No 307BM _____
Contractor Thomas Bros Construction Subcontractor _____
State Rt S R 127 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	3/4" - #8	Dunlap Stone Inc Dunlap, TN	23 94
Med C A	1/2" - #8	Dunlap Stone Inc Dunlap, TN	23 94
Screenings	1/4" - #200	Dunlap Stone Inc Dunlap, TN	28 72
Sand	1/4" - #200	Dunlap Stone Inc Dunlap, TN	19 15
Asphalt Cement	PG 64-22	Shell Oil Co Chattanooga, TN	4 25
Anti-Strip	TYPE LP Pavebond Lite	DOSAGE RATE 0 5	100
% Fractured Faces on +4 Material	NA	% Glassy Particles on +4 Material	NA

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	AGGREGATE ANALYSIS TOTAL PERCENT PASSING C A.	Med. C A.	Screenings	Sand	CALC MIX
		Percent		25 0	25 0	30 0	20 0	
% A.C	4 2-6 2	4 25			NCAT Furnace Corr Factor			
	Temp	300			LOI:			
	Compaction Temp	280-290			The 2 508			
	Mixing Temp							
25mm	100			100 0	100 0	100 0	100 0	100 0
19mm	85-100			100 0	100 0	100 0	100 0	100 0
16mm								
12 5mm								
9 5mm	59-79	69 8		4 3	75 0	100 0	100 0	69 8
4 75mm	42-61	49 8		2 0	8 0	95 0	94 0	49 8
2.36mm	29-47	37 8		1 7	3 0	66 0	84 0	37 8
600um	13-27	23 5		1.5	2	30	68	23 5
300um	7-20	12 9		1	1 5	22	28 4	12 9
150um	4-10	5 82		1	1	15	4 1	5 82
75um	0-6 5	4 05		0 8	0 7	11 5	1 1	4 05

Requested _____
Contractor

Approved _____

Approved _____
Region Materials Engineer

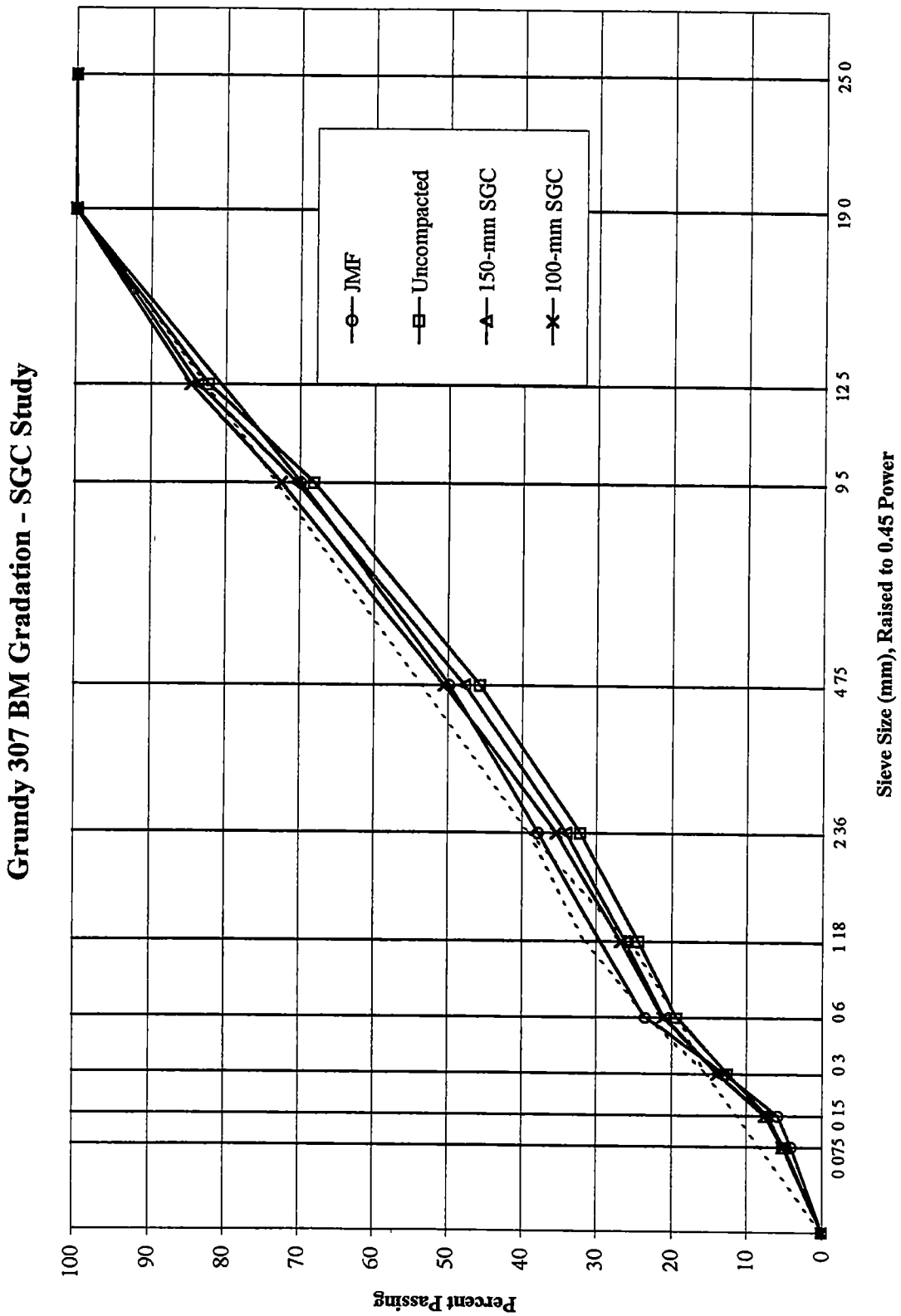
Approved _____
Region Construction Engineer

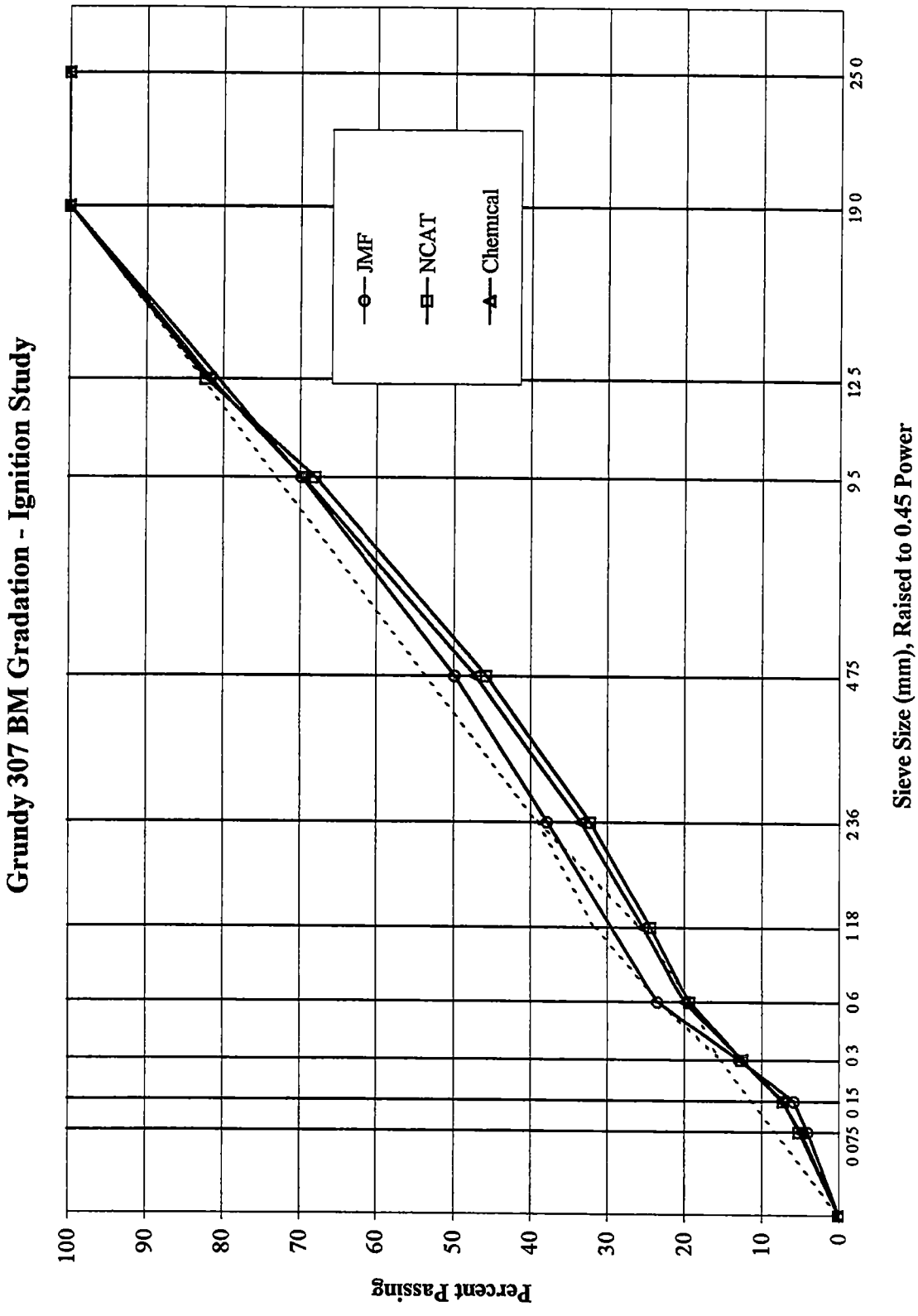
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Grundy
Mix Type: 307 BM/2
Project Number: 31006-4227-04(5295)
Contractor: Thomas Brothers Const

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	99 9	100 0
12 5 mm (1/2")		81 7	82.3	83 7	84 7
9 5 mm (3/8")	70	69 7	68 1	70 4	72 5
4 75 mm (#4)	50	47 2	45 7	47 7	50 5
2 36 mm (#8)	38	33 4	32 1	34 0	35 3
1 18 mm (#16)		25 3	24 4	26 2	26 7
0 6 mm (#30)	24	19 9	19 3	20 9	21 1
0 3 mm (#50)	13	12 5	12 5	13 8	13 9
0 15 mm (#100)	6	7 3	7 2	7 5	7 5
0 075 mm (#200)	4	4 9	5 1	5 0	5 2
Asphalt Content	4 25%	5 42%	4 92%	4 82%	4 81%
% Dust	4 05%	4 90%	5 13%	5 00%	5 23%


Grundy 307 BM Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power


Grundy 307 BM Gradation - Ignition Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
NCAT
Chemical
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Grundy**
Mix Type:	**411 D**
TDOT Project No.:	**31006-4227-04**
Contract No.:	**5295**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 7/16/98

Project Ref No _____ County Grundy Region II
Proj No 31006-4227-04 Contract No 5295
Type _____ Sec No 411 MO1 01 _____
Contractor Thomas Bros Construction Subcontractor _____
State Rt S R 127 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	5/8" - #200	Vulcan Sand & Gravel, Chattanooga, TN	51 37
Med C A			
Screenings	1/4" - #200	Dunlap Stone Inc Dunlap, TN	18 68
Sand	1/4" - #200	Dunlap Stone & Sand Plant, Dunlap, TN	18 68
Lime	#4 - #200	Dunlap Stone Inc Dunlap, TN	4 67
Asphalt Cement	PG 64-22	Shell Oil Co Chattanooga, TN	6 60
Anti-Strip	TYPE LP Pavebond Lite	DOSAGE RATE 0 5	100
% Fractured Faces on +4 Material	88	% Glassy Particles on +4 Material	NA

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	AGGREGATE ANALYSIS TOTAL PERCENT PASSING C.A.	Med. C A.	Screenings	Sand	Percent	CALC MIX
		Percent		55 0		20 0	20 0	5.0	
% A.C	5 3-7 0	6 60			NCAT Furnace Corr Factor				
	Temp 150 C				**LOI:** 10%				
	Compaction Temp				**Theo:** 2 292				
	Mixing Temp								
25mm									
19mm									
16mm	100			100 0		100 0	100 0	100 0	100 0
12 5mm	95-100			96 0		100 0	100 0	100 0	97 8
9 5mm	80-93			79 0		100 0	100 0	100 0	88 5
4 75mm	54-76			47 0		96 0	94 0	100 0	68 9
2 36mm	35-57			29 0		66 0	84 0	95 0	50 7
600um	17-29			11		29	68	62	28 6
300um	10-18			8		20	28	46	16 3
150um	3-10			5 2		15 5	4 1	32 8	8 42
75um	0-6 5			3 1		11 5	1 1	23 5	5 4

Requested _____

Approved _____ Contractor

Approved _____
Region Materials Engineer

Approved _____
Region Construction Engineer

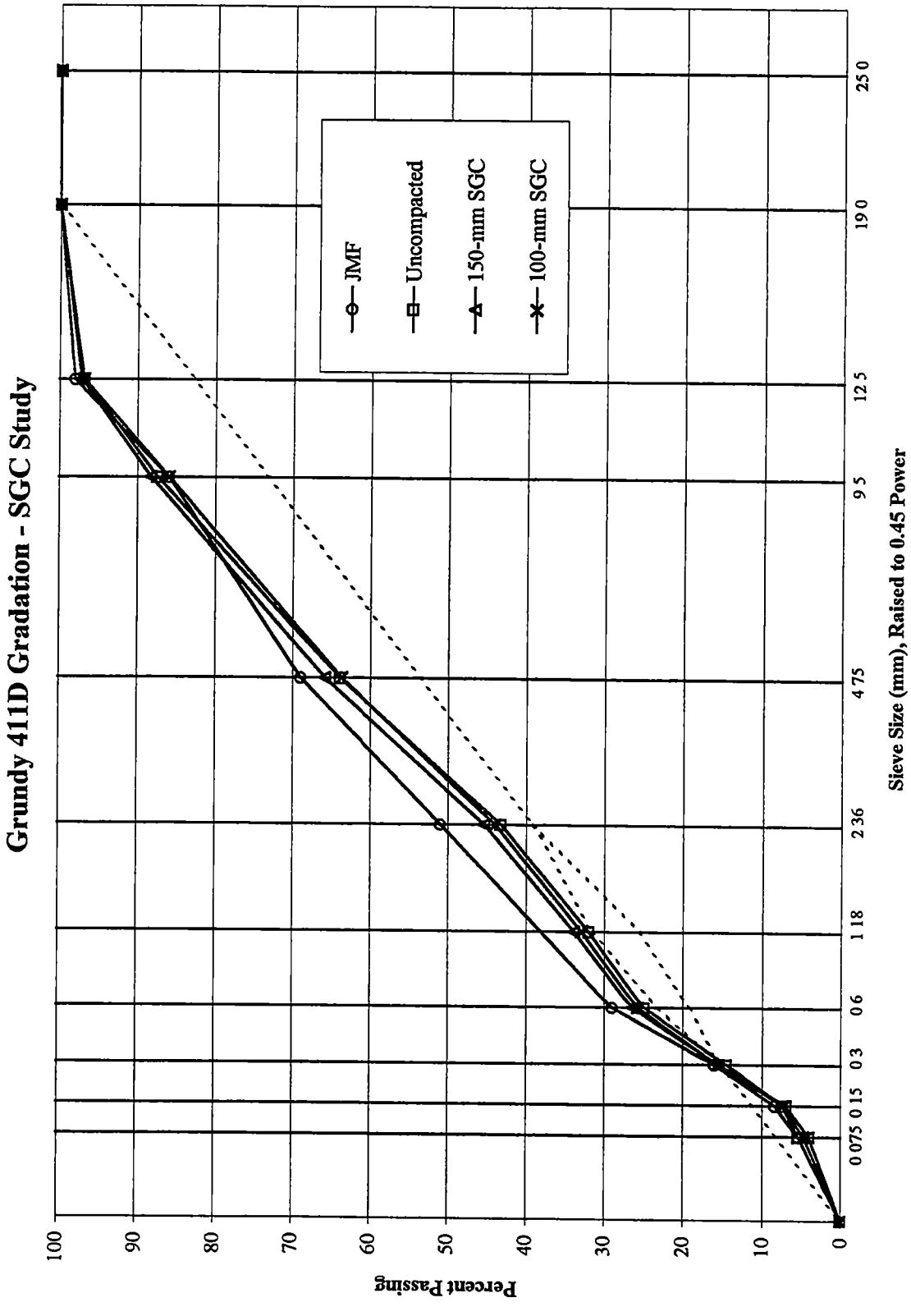
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Grundy
Mix Type: 411 D
Project Number: 31006-4227-04(5295)
Contractor: Thomas Brothers Const

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100.0	100 0
12 5 mm (1/2")	98	96 8	97 1	96 8
9 5 mm (3/8")	86	87 4	88 3	86 0
4 75 mm (#4)	69	63 9	65 9	63 7
2 36 mm (#8)	51	43 3	45 4	44 0
1 18 mm (#16)		32 0	33 9	32 9
0 6 mm (#30)	29	24 9	26 4	25 7
0 3 mm (#50)	16	14 5	15 5	15 6
0 15 mm (#100)	8	7 4	7 0	7 4
0 075 mm (#200)	5	5 4	4 1	4 7

Asphalt Content	6 60%	7 27%	7 22%	6 92%
% Dust	5 40%	5 37%	4 09%	4 70%


Grundy 411D Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075 0 15 0 3 0 6 1 18 2 36 4 75 9 5 12 5 19 0 25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Jackson**
Mix Type:	**307 BM**
TDOT Project No.:	**44004-4235-04**
Contract No.:	**5185**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Dtae 4/16/98

Project Ref No _____ County Jackson Region II
Proj No 44004-4235-04 Contract No 5185
Type BPMB-HM Sec No 307-BM/RAP Article 307m-03 15
Contractor Highway Materials Subcontractor N/A
State Rt SR 56 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 3/20/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A #57	25mm-pan	Rogers Group, Algood, TN	38 16
Med C A 1/2"	12 7mm-pan	Rogers Group, Algood, TN	14 31
Screenings, B D	4 75-pan	Rogers Group, Algood, TN	9 54
Sand	4 75-pan	Highways, Inc Monterey, TN	19 08
RAP	25mm-pan	Highways, Inc Algood, TN	14 31
Asphalt Cement	PG 64-22	Ergon-Nashville, TN	4 50
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE	0
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	0

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	AGGREGATE ANALYSIS TOTAL PERCENT PASSING: C A Percent	Med C A. Percent	Screenings Percent	Sand Percent	RAP Percent	Calculated Mix
		Percent		40 0	15 0	10 0	20 0	15 0	100 0
% A C	4 2-6 2	4 60			NCAT Furnace Corr Factor				
Temp	275-325	300F			LOI:				
	Compaction Temp	280-290			Theo: 2 501				
	Mixing Temp	295-305							
25mm	100	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
19mm	85-100	93 0	87 3-98 7	85 0	100 0	100 0	100 0	95 0	93 0
16mm									
12 7mm									
9 5mm	59-79	63 0	57 3-68 7	24 0	63 0	100 0	100 0	90 0	63 0
4 75mm	42-61	43 0	39-47	7 0	10 0	94 0	98 0	66 0	43 0
2 36mm	29-47	35 0	31 7-38 3	5 0	5 0	58 0	93 0	53 0	35 0
600um	13-27	24 0	20 7-27 3	4 0	5 0	24 0	75 0	31 0	24 0
300um	7-20	11 0	7 7-14 3	4 0	4 0	18 0	25 0	20 0	11 0
150um	4-10	6 0	4 4-7 6	3 0	4 0	14 0	3 0	15 0	6 0
75um	0-6 5	3 9	2 3-5 5	2 0	2 0	10 0	1 0	10 0	3 9

Requested _____

Approved _____ Contractor

Approved _____
Region Materials Engineer

Approved _____
Region Construction Engineer

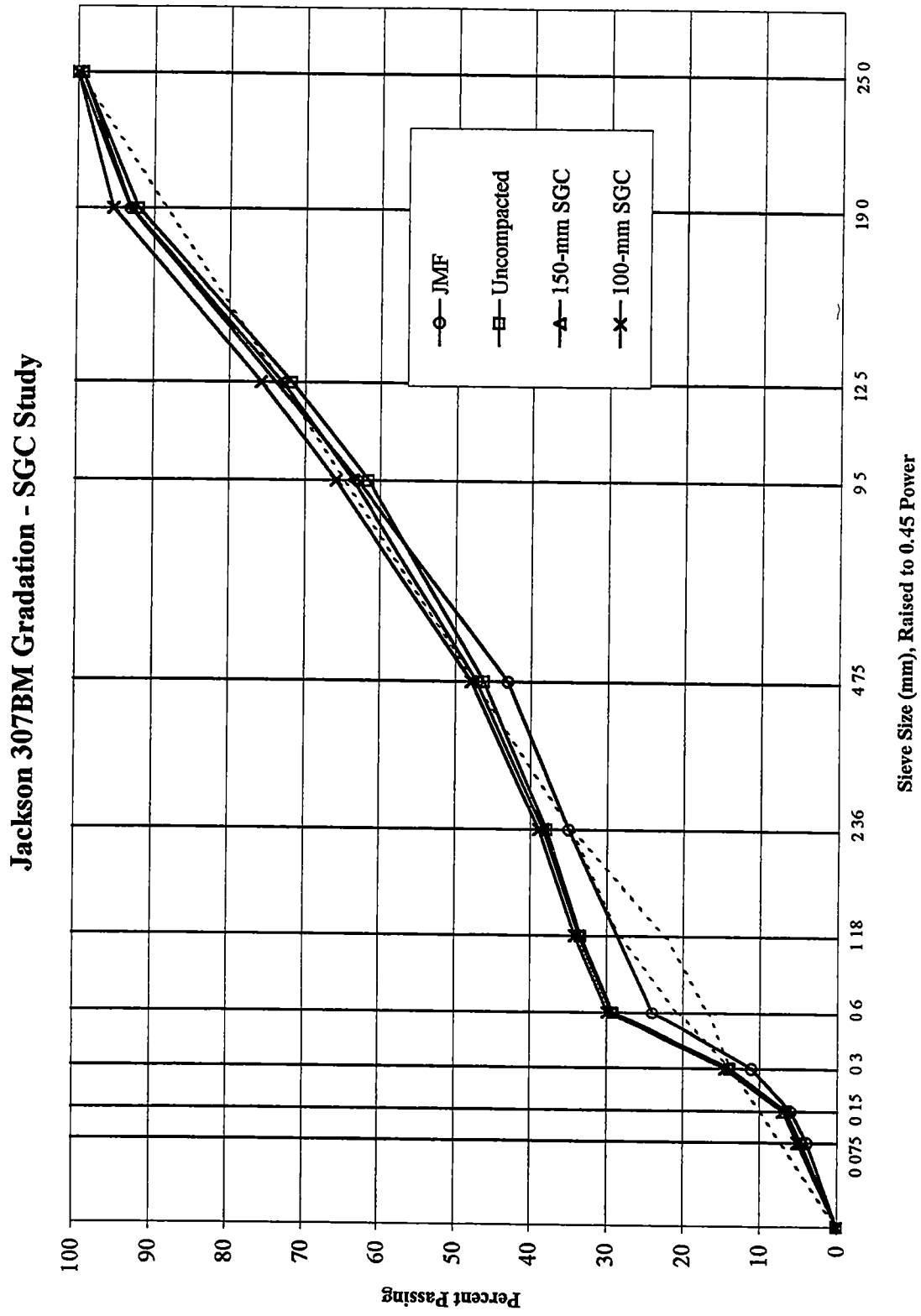
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Jackson
Mix Type: 307 BM
Project Number: 44004-4235-04(5185)
Contractor: Highway Materials

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	99 4	99 3	100 0
19 mm (3/4")	93	92 0	93 0	95 2
12 5 mm (1/2")		71 7	73 0	75 7
9 5 mm (3/8")	63	61 5	63 5	65 8
4 75 mm (#4)	43	46 2	47 2	47 8
2 36 mm (#8)	35	37 9	38 3	38 9
1 18 mm (#16)		33 4	33 7	34 1
0 6 mm (#30)	24	29 1	29 3	29 8
0 3 mm (#50)	11	13 9	14 1	14 5
0 15 mm (#100)	6	6 6	6 7	7 0
0 075 mm (#200)	4	4 7	4 7	5 1

Asphalt Content	4 60%	4 53%	4 51%	4 48%
% Dust	3 90%	4 74%	4 69%	5 07%


Jackson 307BM Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
Uncompacted
150-mm SGC
100-mm SGC
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Madison**
Mix Type:	**307 BM/2**
TDOT Project No.:	**57007-4231-04**
Contract No.:	**5305**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 4/15/98

Project Ref No SP County Madison Region IV
Proj No 57007-4231-04 Contract No 5305
Type BPMB-HM Sec No 307-BM2 Article
Contractor Ford Construction Co Jackson Subcontractor N/A
State Rt 5 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C.A #5	11/2 - #200	Vulcan Materials Co , Parsons, TN	19 06
Med C.A #7	5/8 - #200	Vulcan Materials Co , Parsons, TN	28 59
SCRNS #10	3/8 - #200	Vulcan Materials Co , Parsons, TN	14 30
Sand	#4 - #200	Dement Sand Co , Jackson, TN	19 06
Filler RAP	1/2 - #200	State Route 365 & 100(RAP AC 5 5% 0 83	14 30
A C Erg	PG76-22	Ergon Asphalt Co Memphis, TN	4 70
Anti-Strip	TYPE Perma Tac	DOSAGE RATE 0 30%	100

% Fractured Faces on +4 Material % Glassy Particles on +4 Material 100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A % #5 V	Med. C A #7-V	SCRNS #10-P	Sand% Sand-D	Filler RAP	Calculated Mix
		Percent		20 0	30 0	15 0	20 0	15 0	100 0
Temp		340 00	320 360		NCAT Furnace Corr Factor				
%A C	4 2-6 2	4 7	Test Results Recommended		**LOI:**				
			A.C Content		**Theo:**	2 472			
			Blk Grv 2.378						
1 1/4"	100 0	100 0	Eff. Grv 2.661	100 0	100 0	100 0	100 0	100 0	100 0
1"			Stab 3133						
3/4"	81-93	85 0	Flow 10 82	25 0	100 0	100 0	100 0	100 0	85 0
5/8"			Voids 3 8025						
1/2"			VMA 14 8						
3/8"	57-73	66 0	V Filled 74 4	3 0	53 0	100 0	100 0	95 0	65 8
No 4	40-56	49 0	Dust-AC 1 2	2 0	11 0	91 0	100 0	79 0	49 2
No 8	28-43	41 0	Unit WT 148 38	2 0	4 0	64 0	100 0	62 0	40 5
No 30	13-25	24 0	Moisture Damage	2 0	3 0	34 0	59 0	39 0	24 1
No 50	9-19	12 0	Avg Dry 189	2 0	3 0	27 0	15 0	21 0	11 5
No 100	6-10	7 0	Avg Cnd 143 5	2 0	3.0	21 0	3 0	12 0	6 9
No 200	2 5-6 5	5 5	TSR 75 9	2 0	3 0	16 0	2 0	9 0	5 5

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

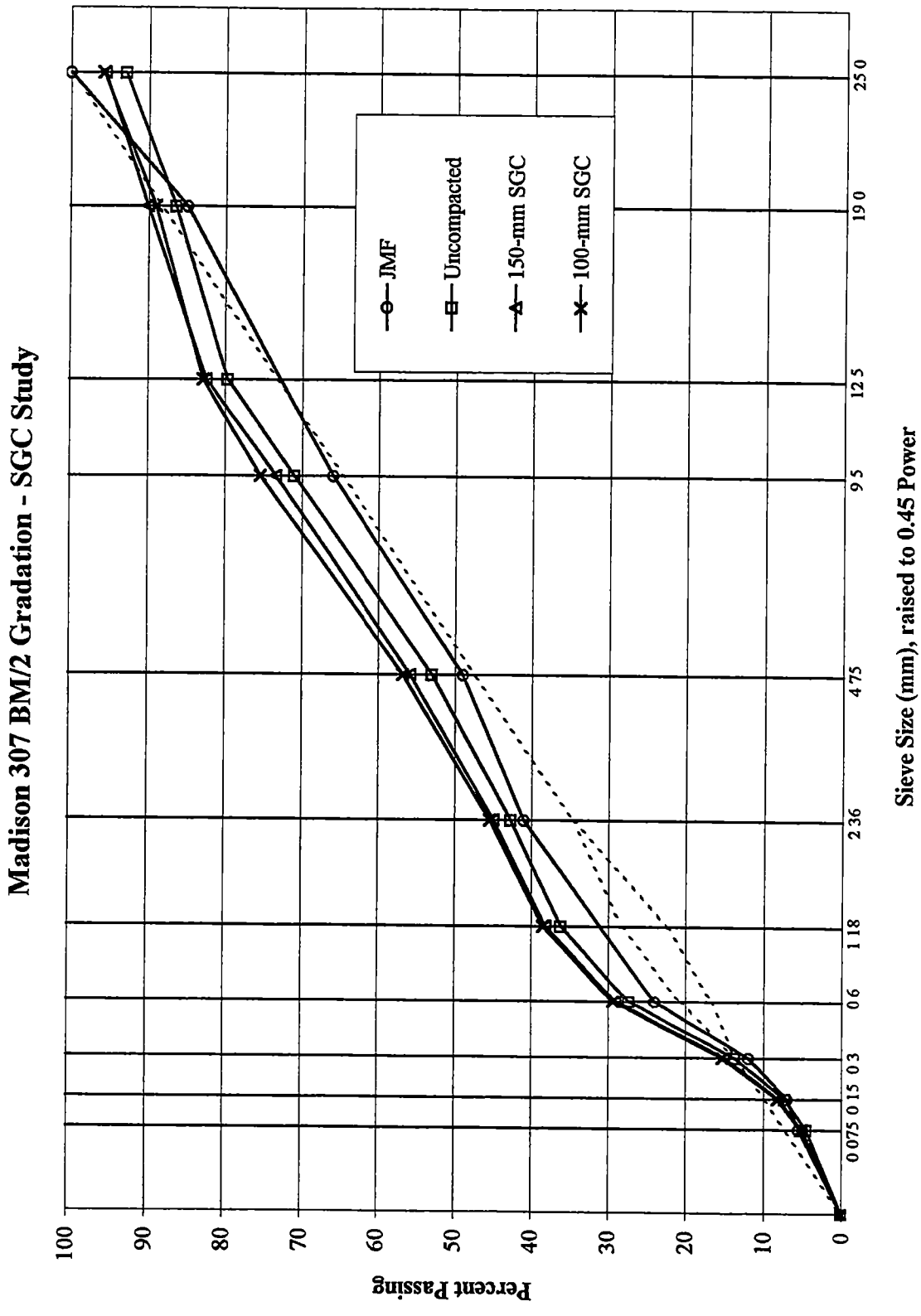
Gradation Comparison Sheet

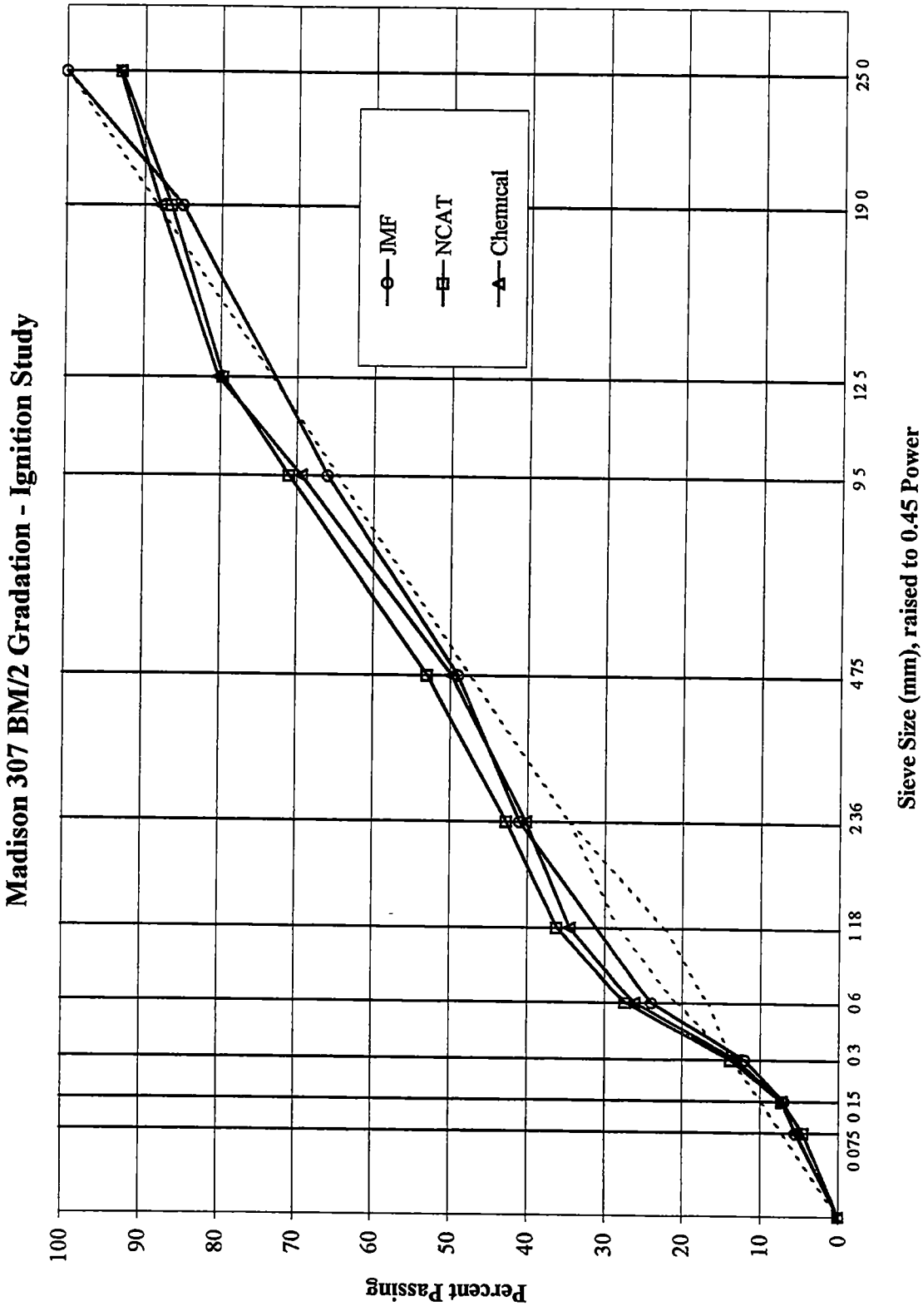
Aggregate Degradation
University of Tennessee, Knoxville

County: Madison
Mix Type: 307 BM/2
Project Number: 57007-4231-04(5305)
Contractor: Ford Construction Co

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	93 1	92 9	95 6	95 8
19 mm (3/4")	85	88 0	86 5	90 1	89 0
12 5 mm (1/2")		80 3	79 6	82 4	82 9
9 5 mm (3/8")	66	69 4	71 0	73 4	75 4
4 75 mm (#4)	49	49 8	53 0	55 8	56 8
2 36 mm (#8)	41	40 2	42 7	45 0	45 5
1 18 mm (#16)		34 5	36 2	38 2	38 5
0 6 mm (#30)	24	26 1	27 3	29 0	29 4
0 3 mm (#50)	12	13 0	13 7	15 1	15 3
0 15 mm (#100)	7	7 3	7 2	8 1	8 2
0 075 mm (#200)	6	5 5	4 6	5 1	5 2

Asphalt Content	4 70%	5 27%	4 89%	4 88%	4 83%
% Dust	5 50%	5 46%	4 56%	5 11%	5 24%


Madison 307 BM/2 Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075 0.15 0.3 0.6 1.18 2.36 4.75 9.5 12.5 19.0 25.0
Sieve Size (mm), raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC


Madison 307 BM/2 Gradation - Ignition Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
NCAT
Chemical
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), raised to 0.45 Power

Appendix A

Project Summary

County:	**Madison**
Mix Type:	**307 S w/ Fibers**
TDOT Project No.:	**57012-4209-04**
Contract No.:	**5306**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/1/98

Project Ref No	SP	County	Madison	Region	IV
Proj No	57012-4209-04	Layer	Binder	Contract No	5306
Type	BPMB-HM	Sec No	307-S w/ Fiber	Article	307M10 11
Contractor	Dement Construction	Subcontractor			
State Rt	412	TOTAL MIX INCLUDING BITUMEN		Date of Letting	6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
#57's	1"-Pan	Vulcan Materials Co , Parsons, TN	19 06
#7's	3/4"-Pan	Vulcan Materials Co , Parsons, TN	33 36
Block #10's	3/8" -Pan	Vulcan Materials Co , Parsons, TN	19 06
Screw Sand	3/8" -Pan	Vulcan Materials Co , Holladay, TN	14 30
RAP	3/4" -Pan	Dement Construction, Jackson, TN	10 12
Asphalt Cement	PG76-22	Koch Materials, Memphis, TN	4 12
Anti-Strip	TYPE Agg-Grip	DOSAGE RATE 0 50%	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100

SCREEN	Ttl. Passing Design Range	Requested Percent	Tolerance Percent	#57's Percent	#7's Percent	Block #10's Percent	Screw Sand Percent	RAP Percent	Calculated Mix
		Percent		20 0	35 0	20 0	15 0	10 0	100 0
Temp		310 F			NCAT Furnace Corr Factor			N/A	
%A C		4 7			**LOI:** N/A				
					Theo: 2 505				
2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1 1/2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1"	100 0	100 0		100 0	100 0	100 0	100 0	100 0	100 0
3/4"	90-100	99 0		95 0	100 0	100 0	100 0	100 0	99 0
1/2"		85 0		35 0	95 0	100 0	100 0	96 0	84 9
3/8"		65 0		7 0	57 0	100 0	100 0	90 0	65 4
No 4		39 0		2 0	7 0	75 0	94 0	71 0	39 1
No 8	23-49	23 0		1 0	5 0	14 0	82 0	55 0	22 6
No 16		15 0		1 0	3 0	8 9	52 0	41 0	14 9
No 30		11 0		1 0	2 5	6 4	33 0	33 0	10 6
No 50		8 0		1 0	2 0	5 8	22 0	21 0	7 5
No 100		4 7		1 0	2 0	5 2	10 0	13 0	4 7
No 200	2-8	3 5		1 0	2 0	4 4	6 0	8 4	3 5

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

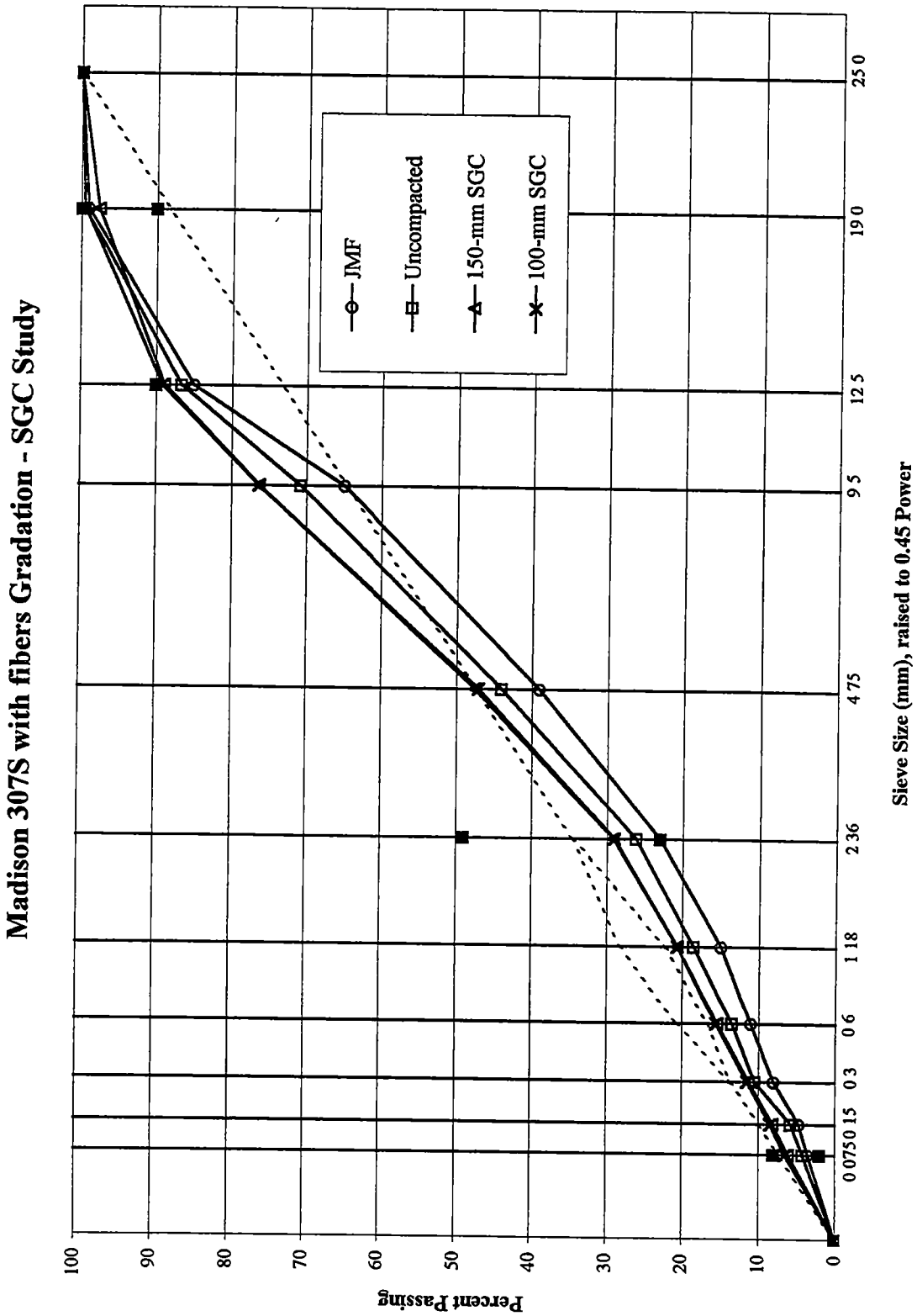
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Madison
Mix Type: 307 S w/Fibers
Project Number: 57012-4209-04(5306)
Contractor: Dement Construction

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	99	99 5	97 6	99 5
12 5 mm (1/2")	85	86 7	88 9	89 2
9 5 mm (3/8")	65	70 8	76 2	76 3
4 75 mm (#4)	39	44 0	47 5	47 0
2 36 mm (#8)	23	26 1	29 2	29 0
1 18 mm (#16)	15	18 6	20 7	20 6
0 6 mm (#30)	11	13 5	15 5	15 6
0 3 mm (#50)	8	10 5	11 2	11 4
0 15 mm (#100)	5	5 8	8 1	8 4
0 075 mm (#200)	4	4 2	6 1	6 5

Asphalt Content	4.70%	4 97%	5 26%	4 93%
% Dust	3 50%	4 20%	6 14%	6 51%


Madison 307S with fibers Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), raised to 0.45 Power

Appendix A

Project Summary

County:	**Madison**
Mix Type:	**411 S w/ Fibers**
TDOT Project No.:	**57012-4209-04**
Contract No.:	**5306**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/23/98

Project Ref No	SP	County Madison		Region	IV
Proj No	57012-4209-04	Layer	Surface	Contract No	5306
Type	ACS-HM	Sec No	SP411-S w/Fibers	Article	
Contractor	Dement Construction		Subcontractor		
State Rt	412	TOTAL MIX INCLUDING BITUMEN		Date of Letting	6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
D Rock	5/8" Pan	Adamsville Sand & Gravel, Adamsville, TN	60 78
Block #10's	3/8" Pan	Vulcan Materials Co , Parsons, TN	9 35
Screw Sand	3/8" Pan	Vulcan Materials Co , Holladay, TN	14 03
Dement Sand	#4 Pan	Dement Construction, Denmark, TN	9 35
Asphalt Cement	PG76-22	Koch Materials, Memphis, TN	6 50
Anti-Strip	TYPE Agg-Grip	DOSAGE RATE 0 50%	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	D Rock %	Block #10's %	Screw Sand %	Dement Sand %	0 Percent	Calculated Mix
		Percent		65 0	10 0	15 0	10 0		100 0
Temp		310 F			NCAT Furnace Corr Factor			0 8	
%A C		6 5			**LOI:**	10 9			
					Theo:	2 313			
2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1 1/2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1"		100 0		100 0	100.0	100 0	100 0	100 0	100 0
3/4"	100 0	100 0		100 0	100 0	100 0	100 0	100 0	100 0
1/2"	90-100	94 0		90 0	100 0	100 0	100 0	100 0	93 5
3/8"		86 0		78 0	100 0	100 0	100 0	100 0	85 7
No 4		54 0		34 0	75 0	94 0	100 0	100 0	53 7
No 8	28-58	38 0		22 0	14 0	82 0	98 0	100 0	37 8
No 16		26 0		14 0	8 9	52 0	83 0	100 0	26 1
No 30		17 0		9 0	6 4	33 0	60 0	100 0	17 4
No 50		9 0		6 0	5 8	22 0	16 0	100 0	9 4
No 100		5 1		4 0	5 2	10 0	5 0	100 0	5 1
No 200	2-8	3 6		3 1	4 4	6 0	2 1	100 0	3 6

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

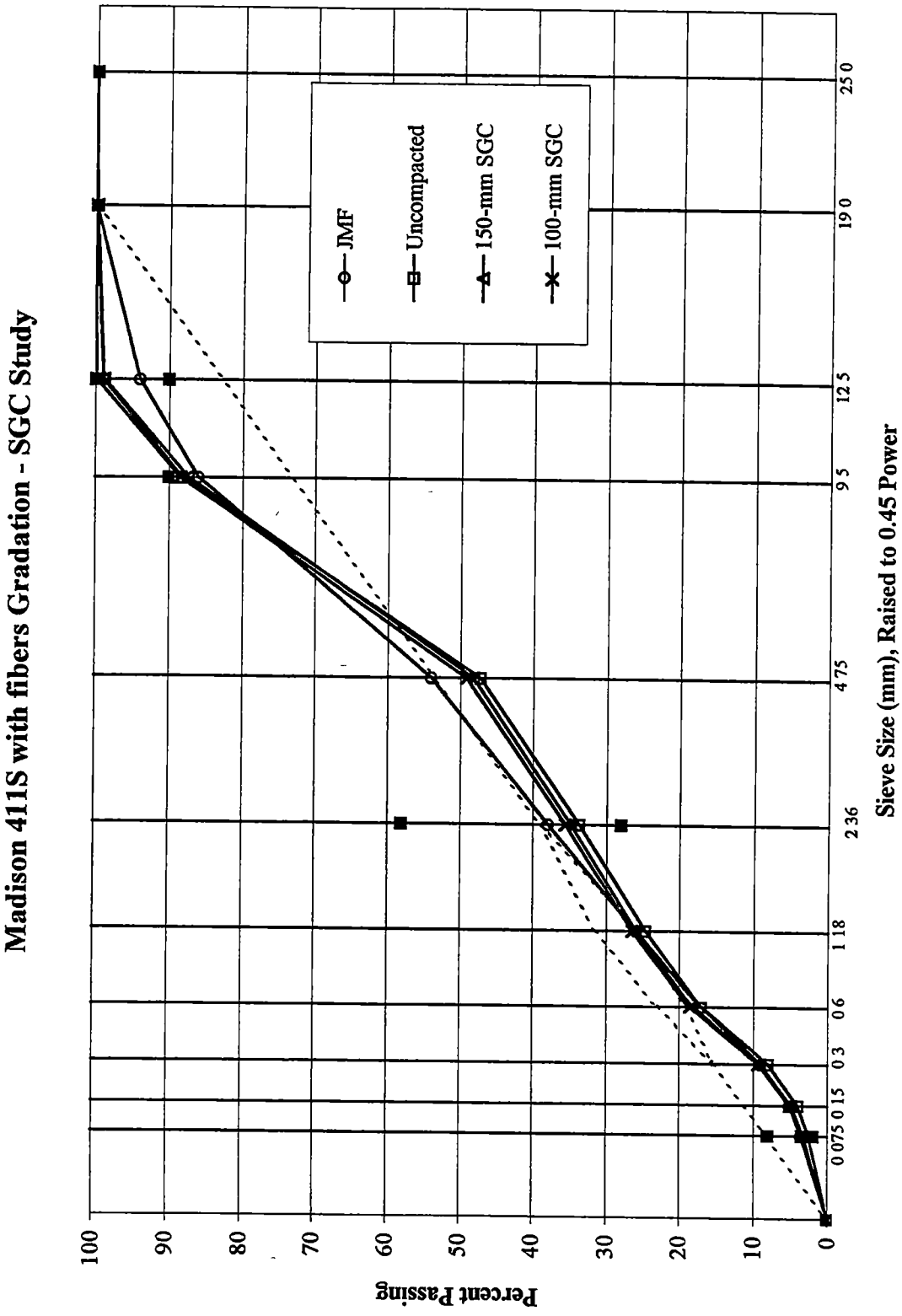
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County	Madison
Mix Type	411S W/ Fibers
Project Number	57012-4209-04(5306)
Contractor	Dement Construction

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	99 8	100 0
12 5 mm (1/2")	94	99 0	98 9	99 8
9 5 mm (3/8")	86	88 3	87 4	88 5
4 75 mm (#4)	54	47 3	48 2	49 2
2 36 mm (#8)	38	33 7	34 9	35 6
1 18 mm (#16)	26	24 7	26 0	26 5
0 6 mm (#30)	17	17 0	18 2	18 5
0 3 mm (#50)	9	8 0	9 1	9 3
0 15 mm (#100)	5	4 0	4 9	5 0
0 075 mm (#200)	4	2 6	3 3	3 4

Asphalt Content	6 50%	6 94%	6 83%	6 89%
% Dust	3 60%	2 56%	3 26%	3 42%


Madison 411S with fibers Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Madison**
Mix Type:	**411 S**
TDOT Project No.:	**57012-4209-04**
Contract No.:	**5306**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/17/98

Project Ref No	SP	County	Madison	Region	IV
Proj No	57012-4209-04	Layer	Surface	Contract No	5306
Type	ACS-HM	Sec No	SP411-S	Article	
Contractor	Dement Construction	Subcontractor			
State Rt	412	**TOTAL MIX INCLUDING BITUMEN**		Date of Letting	6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
D Rock	5/8" Pan	Adamsville Sand & Gravel, Adamsville, TN	61 30
Block #10's	3/8" Pan	Vulcan Materials Co , Parsons, TN	9 43
Screw Sand	3/8" Pan	Vulcan Materials Co , Holladay, TN	14 15
Dement Sand	#4 Pan	Vulcan Materials Co , Holladay, TN	9 43
Asphalt Cement	PG76-22	Koch Materials, Memphis, TN	5 70
Anti-Strip	TYPE Agg-Grip	DOSAGE RATE 0 50%	

% Fractured Faces on +4 Material 72 1 % Glassy Particles on +4 Material N/A 100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	D Rock %	Block #10's %	Screw Sand %	Dement Sand %	0 Percent	Calculated Mix
		Percent		65 0	10 0	15 0	10 0		100 0
Temp		310 F			NCAT Furnace Corr Factor			0 76	
%A C		5 7			**LOI:**	10 9			
Compaction Temp		300-315			**Theo:**	2 320			
Mixing Temp		325-340							
2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1 1/2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
3/4"	100 0	100 0		100 0	100 0	100 0	100 0	100 0	100 0
1/2"	90-100	94 0		90 0	100 0	100 0	100 0	100 0	93 5
3/8"		86 0		78 0	100 0	100 0	100 0	100 0	85 7
No 4		54 0		34 0	75 0	94 0	100 0	100 0	53 7
No 8	28-58	38 0		22 0	14 0	82 0	98 0	100 0	37 8
No 16		26 0		14 0	8 9	52 0	83 0	100 0	26 1
No 30		17 0		9 0	6 4	33 0	60 0	100 0	17 4
No 50		9 0		6 0	5 8	22 0	16 0	100 0	9 4
No 100		5 1		4 0	5 2	10 0	5 0	100 0	5 1
No 200	2-8	3 6		3 1	4 4	6 0	2 1	100 0	3 6

Requested _____ Approved _____
Region Materials Engineer

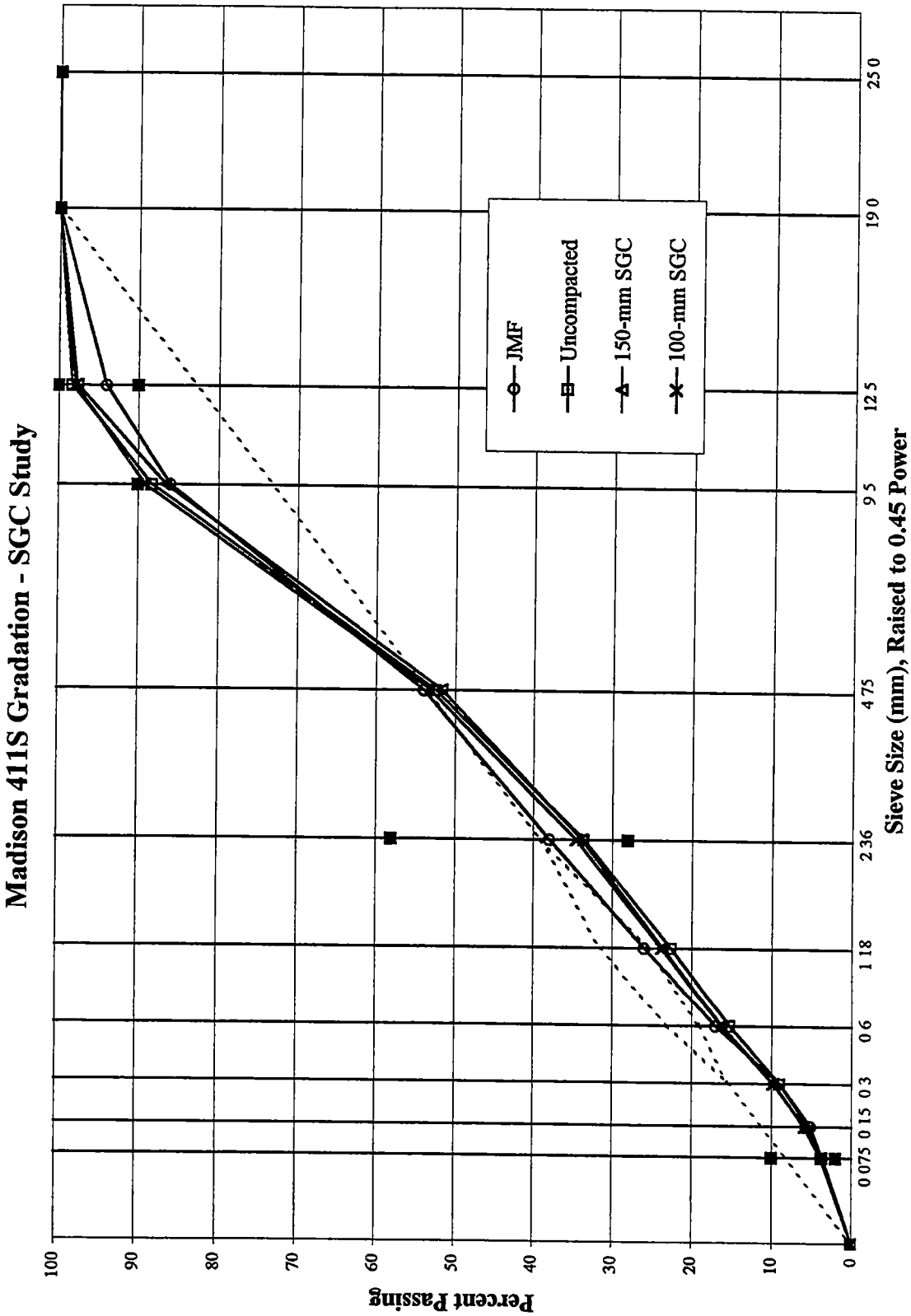
Approved _____ Approved _____
Contractor Region Construction Engineer

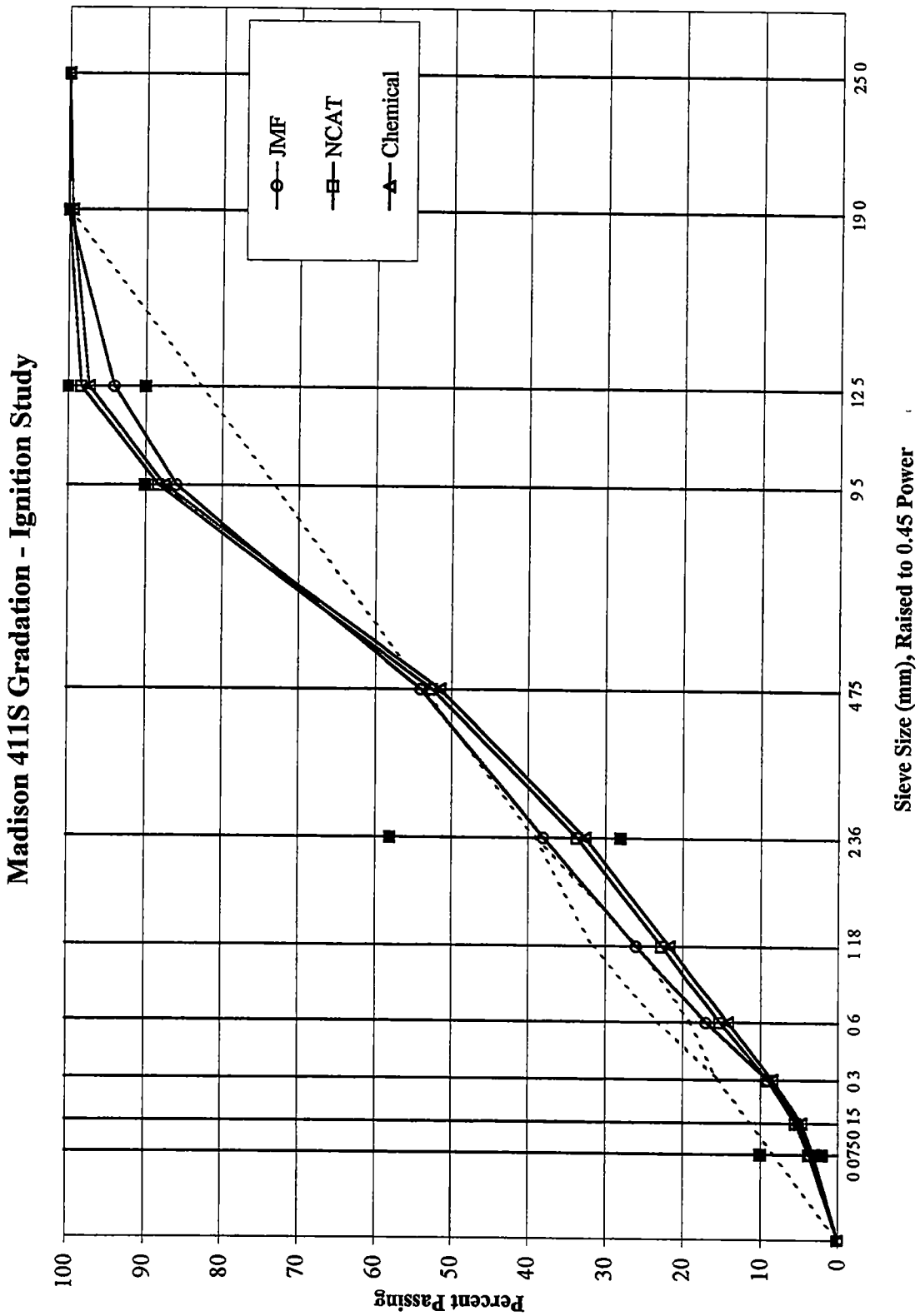
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Madison
Mix Type: 411 S
Project Number: 57012-4209-04(5306)
Contractor: Dement Construction

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	99 5	100 0	100 0	100 0
12 5 mm (1/2")	94	97 3	98 3	97 6	97 9
9 5 mm (3/8")	86	87 6	88 3	86 6	89 2
4 75 mm (#4)	54	51 5	52 5	51 7	53 2
2 36 mm (#8)	38	32 6	33 6	33 8	34 6
1 18 mm (#16)	26	21 7	22 7	23 7	23 8
0 6 mm (#30)	17	14 2	15 2	16 2	16 3
0 3 mm (#50)	9	8 5	9 0	9 8	9 8
0 15 mm (#100)	5	4 7	5.5	5 9	5 8
0 075 mm (#200)	4	3 2	3 7	3 9	3 8
Asphalt Content	5 70%	3 50%	5 76%	5 60%	5 63%
% Dust	3 60%	3 19%	3 72%	3 89%	3 77%


Madison 411S Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC


Madison 411S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075 0.15 0.3 0.6 1.18 2.36 4.75 9.5 12.5 19.0 25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Maury**
Mix Type:	**411 S**
TDOT Project No.:	**60002-4270-04**
Contract No.:	**5308**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 6/18/98

Project Ref No SP County Maury Region III
Proj No 60002-4270-04 Layer Surface Contract No 5308
Type ACS-HM Sec No 411-S Article 01 01-01 02
Contractor Lojac Ent Subcontractor
State Rt **TOTAL MIX INCLUDING BITUMEN** Date of Letting

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
"D" Rock	5/8"-Pan	Burns Stone, Burns, TN	51 81
Hard #10's	3/8"-Pan	Burns Stone, Burns, TN	18 84
Soft #10's	3/8"-Pan	Vulcan, Franklin, TN	14 18
Washed Scr	1/4"-Pan	Columbia Rock, Columbia, TN	9 42
Asphalt-Cement	PG-64-22	Ergon, Nashville, TN	5 80
Anti-Strip Type Pavebond Lite		Dosage Rate 0 30%	
% Fractured Faces on +4 Material N/A		% Glassy Particles on +4 Material N/A	100%

Screen	Total Passing Master Range	Requested Percent	Tolerance Percent	"D" Rock Percent	Hard #10's Percent	Soft #10's Percent	Washed Scr Percent	Filler Percent	Calculated Mix
				55 0	20 0	15 0	10 0	0 0	100 0
Temp		300 F			NCAT Furnace Corr Factor			N/A	
%AC		5 8			**LOI:** 26				
					Theo: 2 425				
2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1 1/2"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
3/4"		100 0		100 0	100 0	100 0	100 0	100 0	100 0
1/2"		98 0		97 0	100 0	100 0	100 0	100 0	98 4
3/8"		84 0		70 0	100 0	100 0	100 0	100 0	83 5
#4		49 0		11 0	97 0	91 0	99 0	98 0	49 0
#8		33 0		4 0	68 0	61 0	76 0	93 0	32 6
#16		22 0		3 0	48 0	40 0	48 0	75 0	22 1
#30		14 0		2 5	28 0	30 0	29 0	62 0	14 4
#50		10 00		2 0	20 0	25 0	12 0	12 0	10 1
#100		7 80		1 8	15 0	20 0	8 0	2 0	7 8
#200		6 10		1 7	12 0	15 0	5 0	1 0	6 1

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

Gradation Comparison Sheet

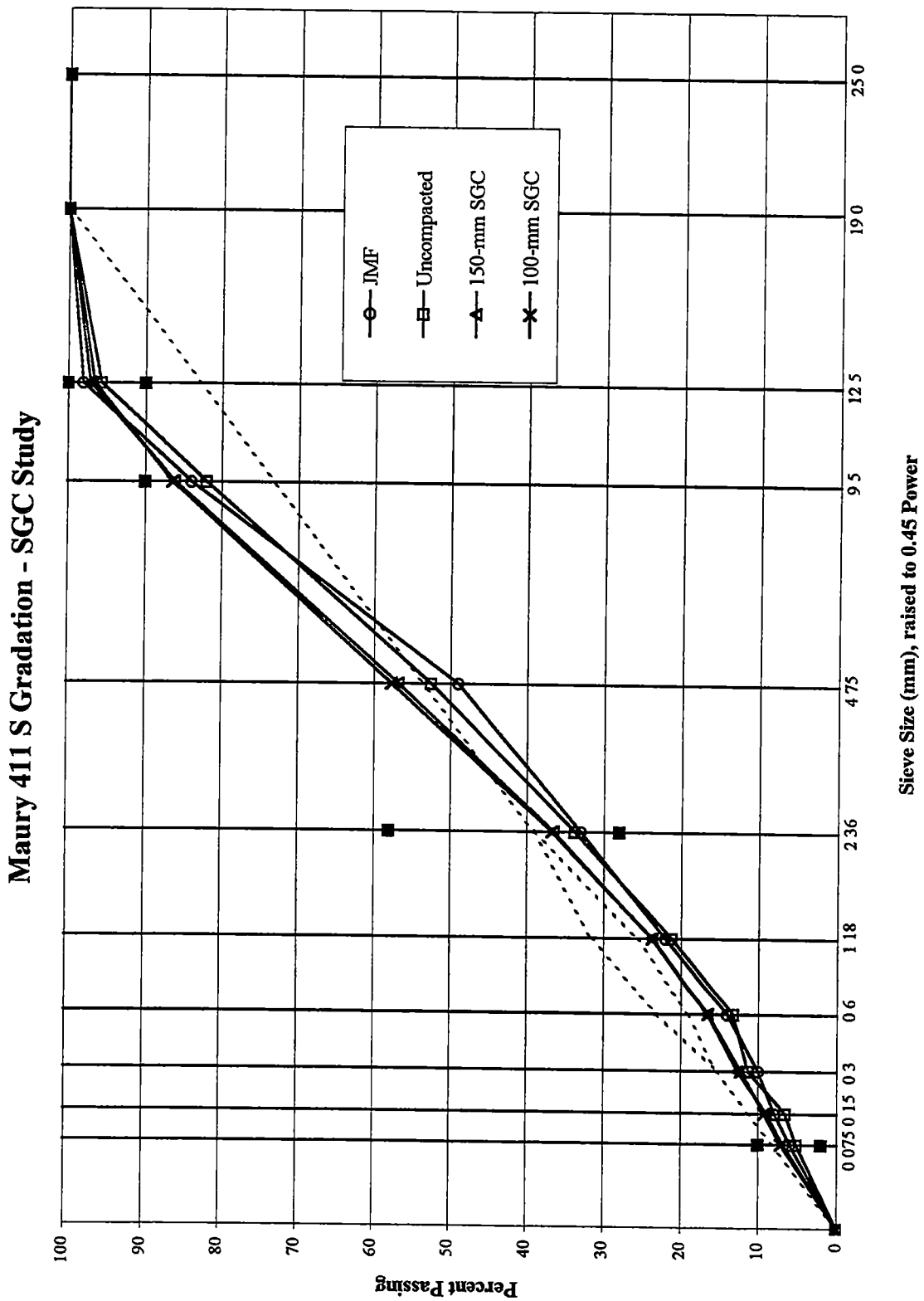
Aggregate Degradation
University of Tennessee, Knoxville

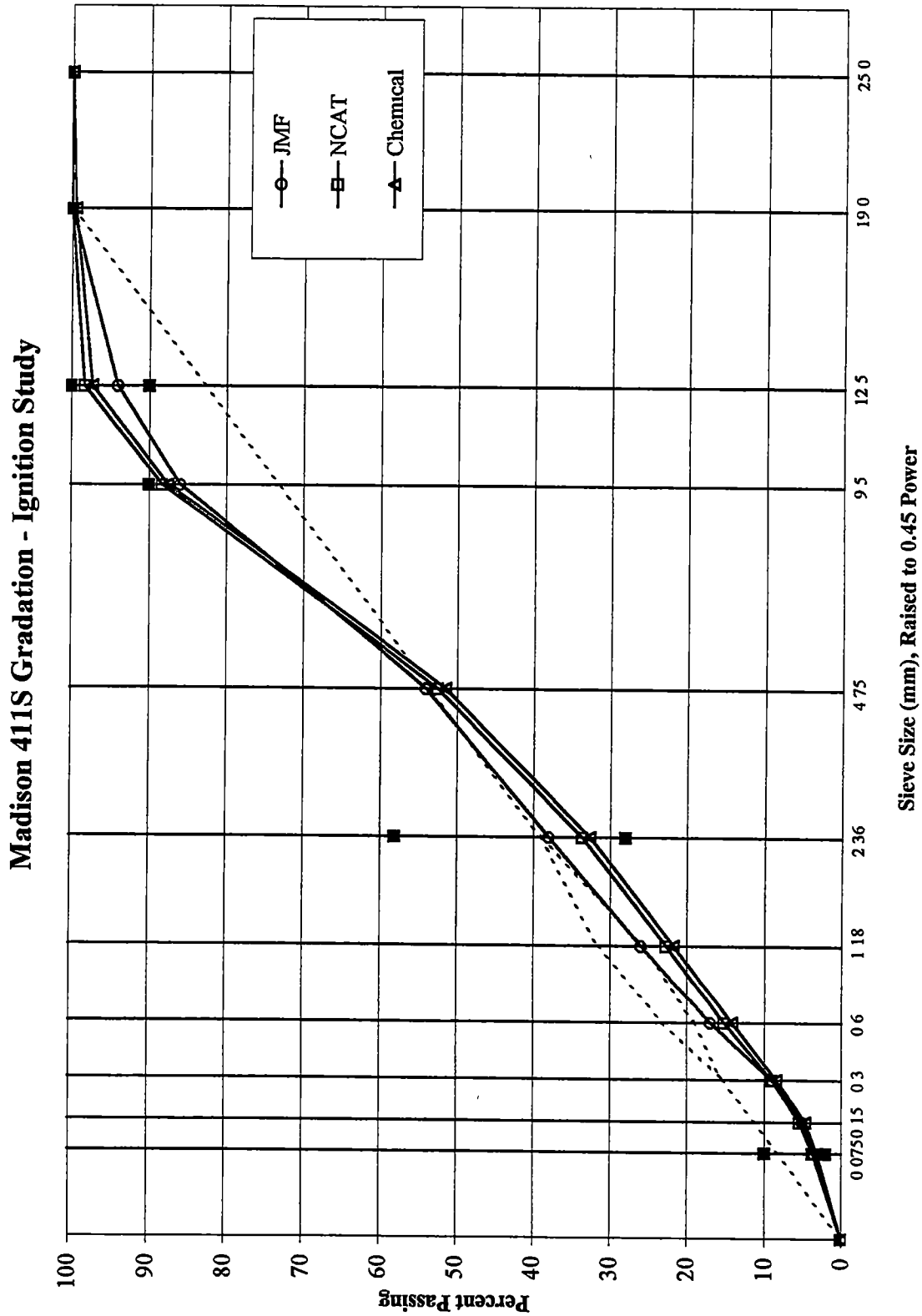
County: Maury
Mix Type: 411 S
Project Number: 60002-4270-04(5308)
Contractor: Lojac Enterprises

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0	100 0
12 5 mm (1/2")	98	95 3	95 6	97 1	96 5
9 5 mm (3/8")	84	82 9	82 0	86 2	86 4
4 75 mm (#4)	49	53 1	52 6	56 9	57 7
2 36 mm (#8)	33	33 2	33 8	36 5	36 8
1 18 mm (#16)	22	20 6	21 2	23 8	23 7
0 6 mm (#30)	14	14 1	13 2	16 6	16 5
0 3 mm (#50)	10	10 5	11 3	12 6	12 2
0 15 mm (#100)	8	8 3	6 6	9 0	9 3
0 075 mm (#200)	6	6 8	5 2	6 9	7 2

* Chemically Extracted

Asphalt Content	5 80%	5 65%	6 24%	6 45%	6 44%
% Dust	6 00%	6 80%	5 17%	6 88%	7 18%


Maury 411 S Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC


Madison 411S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**McMinn**
Mix Type:	**307 S**
TDOT Project No.:	**54016-4219-04**
Contract No.:	**5191**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 8/7/98

Project Ref No SP County McMinn Region II

Proj No 54016-4219-04 Contract No 5191

Type ERR Sec No 307-S Binder Article

Contractor Renfro Cont Subcontractor

State Rt SR 305 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 3/20/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	#57's	Vulcan Mtls , Athens, TN	23 85
Med C A	#7's	Vulcan Mtls , Athens, TN	28 62
Screenings	#10's	Vulcan Mtls , Athens, TN	20 99
M Sand	3/8"-Pan	Vulcan Mtls , Athens, TN	21 94
Asphalt Cement	PG 64-22	Amoco Oil, Chattanooga, TN	4 60
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE 0 5	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	AGGREGATE ANALYSIS TOTAL PERCENT PASSING: C A. Percent	Med. C A. Percent	Screenings Percent	Mfg Sand Percent	River Sand Percent	Calculated Mix
		Percent		25 0	30 0	22 0	23 0	0 0	
% A.C		4 60			NCAT Furnace Corr Factor				
Temp		315			LOI:				
	Compaction Temp	280-290			Theo: 2 542				
	Mixing Temp	310-320							
50mm		100 0		100 0	100 0	100 0	100 0	100 0	100 0
37 5mm		100 0		100 0	100 0	100 0	100 0	100 0	100 0
25mm		100 0		100 0	100 0	100 0	100 0	100 0	100 0
19mm		93 1		72 3	100 0	100 0	100 0	100 0	93 1
12 5mm		81 9		30 0	98 0	100 0	100 0	100 0	81 9
9 5mm		71 2		18 2	72 0	100 0	100 0	100 0	71 2
4 75mm		47 2		4 0	7 0	96 0	100 0	100 0	47 2
2 35mm		37 3		1 3	2 0	70 0	91 0	100 0	37 3
1 18mm		22 6		1 0	1 5	40 0	57 0	100 0	22 6
600um		14 1		0 9	1 0	30 0	30 5	100 0	14 1
300um		9 2		0 7	0 8	23 0	16 1	100 0	9 2
150um		5 7		0 6	0 5	16 0	8 1	100 0	5 7
75um		4 4		0 4	0 1	14 0	5 0	100 0	4 4

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

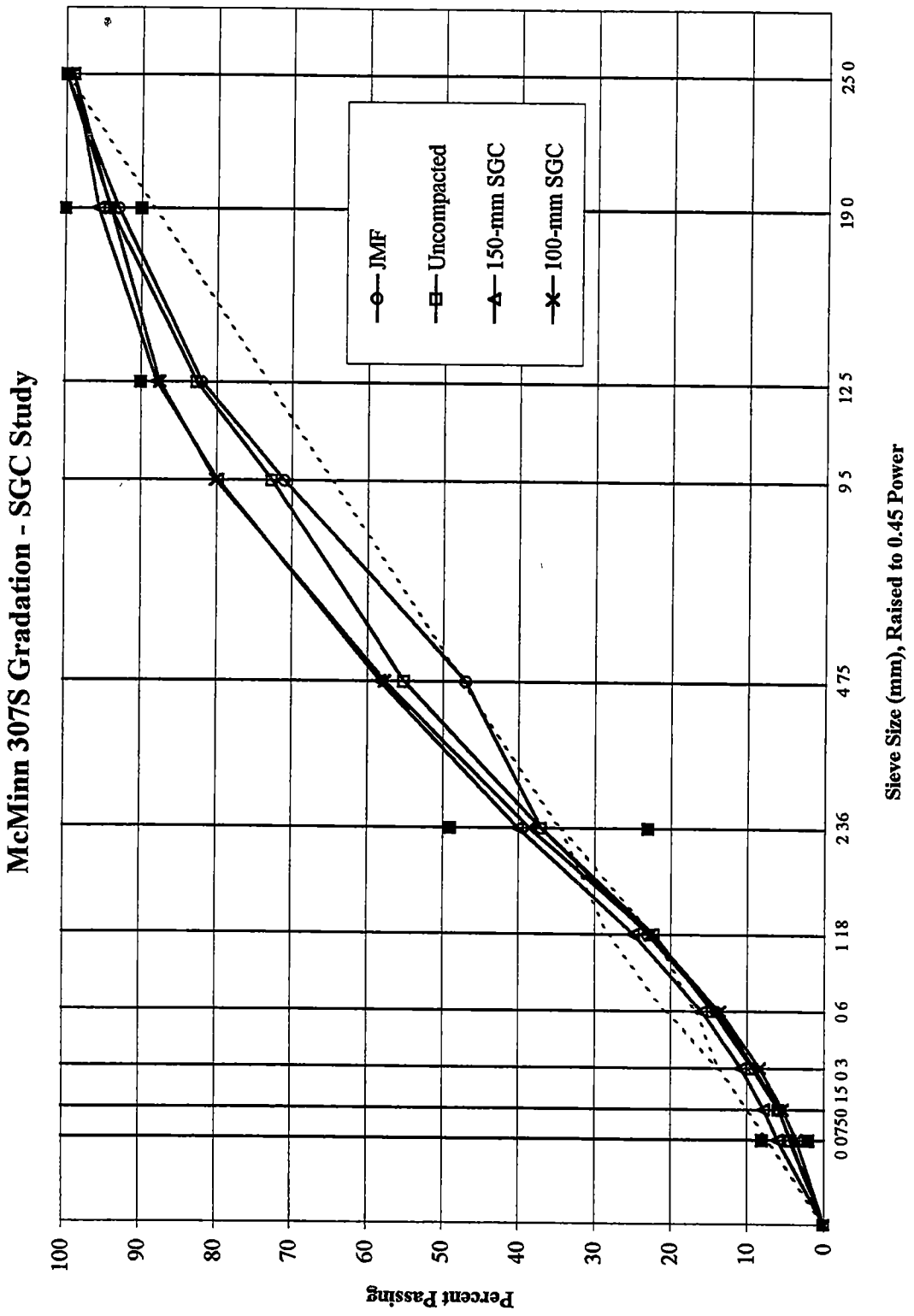
Gradation Comparison Sheet

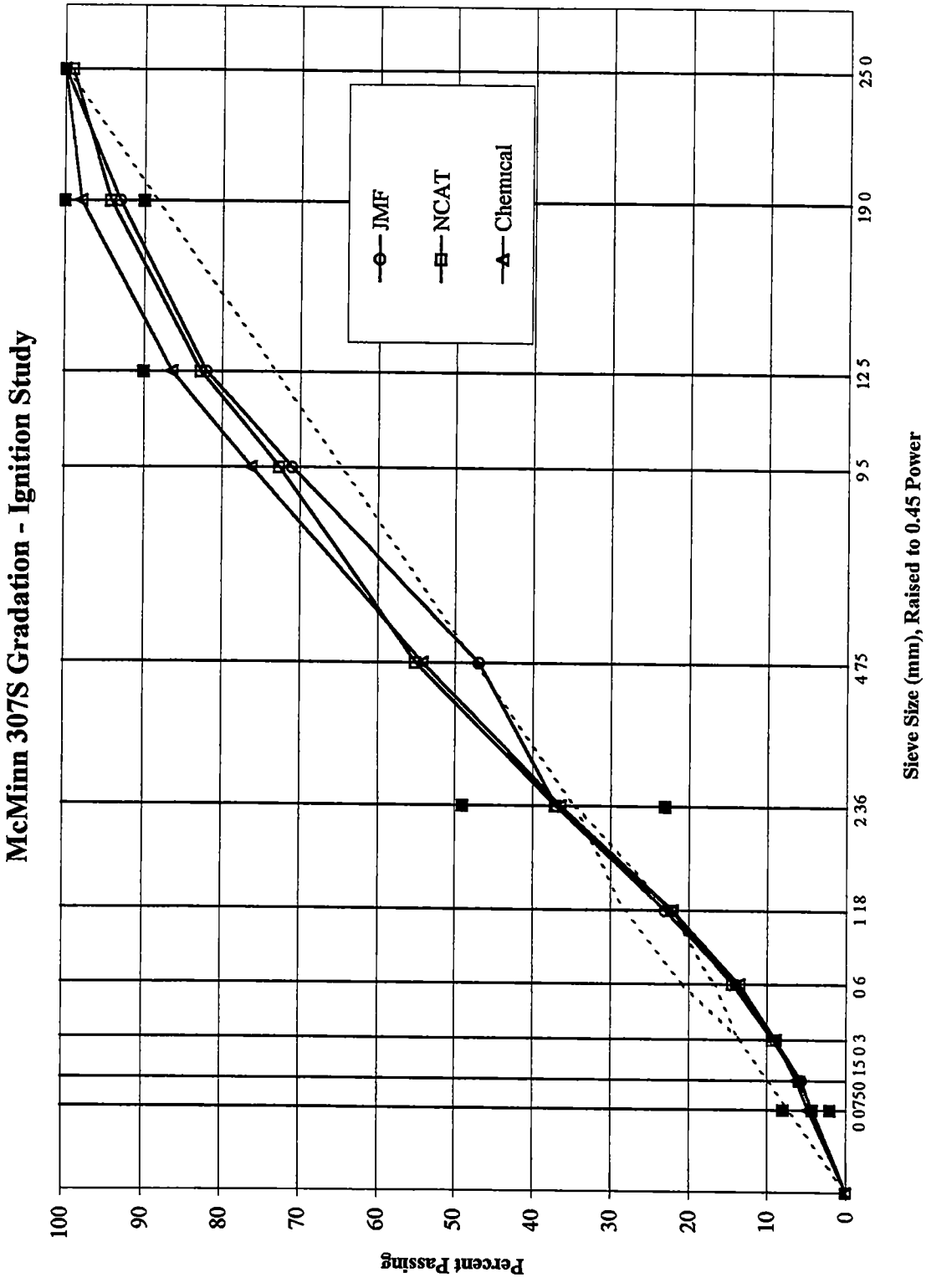
Aggregate Degradation
University of Tennessee, Knoxville

County: McMinn
Mix Type: 307S
Project Number: 54016-4219-04(5191)
Contractor: Renfro

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	99 0	99 0	100 0
19 mm (3/4")	93	97 9	94 2	95 6	94 0
12 5 mm (1/2")	82	86 4	82 7	88 0	87 6
9 5 mm (3/8")	71	76 3	72 7	79 8	80 1
4 75 mm (#4)	47	54 2	55 1	58 3	57 7
2 36 mm (#8)	37	36 5	37 0	40 1	38 6
1 18 mm (#16)	23	22 1	22 2	24 8	22 7
0 6 mm (#30)	14	13 6	14 4	15 9	13 5
0 3 mm (#50)	9	8 9	9 3	10 8	8 4
0 15 mm (#100)	6	6 3	5 9	7 8	5 4
0 075 mm (#200)	4	4 8	4 3	6 0	3 6

Asphalt Content	4 60%	4 43%	4 22%	4 46%	4 21%
% Dust	4 40%	4 84%	4.27%	6 01%	3 57%


McMinn 307S Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
Uncompacted
150-mm SGC
100-mm SGC
0 0750 15 0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power


McMinn 307S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**McMinn**
Mix Type:	**411 S**
TDOT Project No.:	**54016-4219-04**
Contract No.:	**5191**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 8/7/98

Project Ref No	SP	County	McMinn	Region	II
Proj No	54016-4219-04			Contract No	5191
Type	411M10 01	Sec No	411-S Surface	Article	
Contractor	Renfro Cont		Subcontractor		
State Rt	S R 305	**TOTAL MIX INCLUDING BITUMEN**		Date of Letting	3/20/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			0 00
Med C A	5/8"-Pan	Vulcan Sand & Gravel, Chattanooga, TN	60 52
Screenings	3/8"-Pan	Vulcan Mtls , Athens, TN	13 96
M Sand	3/8"-Pan	Vulcan Mtls , Athens, TN	9 31
R Sand	3/8"-Pan	Vulcan Sand & Gravel, Chattanooga, TN	9 31
Asphalt Cement	PG 64-22	Amoco Oil, Chattanooga, TN	6 90
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE 0 5	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	AGGREGATE ANALYSIS TOTAL PERCENT PASSING: C A. Percent	Med C A Percent	Screenings Percent	Mfg Sand Percent	River Sand Percent	Calculated Mix
		Percent			65 0	15 0	10 0	10 0	
% A.C		6 90			NCAT Furnace Corr Factor				
Temp		315			**LOI:** 10 5				
	Compaction Temp	280-290			**Theo:** 2 263				
	Mixing Temp	310-320							
50mm		100 0			100 0	100 0	100 0	100 0	100 0
37 5mm		100 0			100 0	100 0	100 0	100 0	100 0
25mm		100 0			100 0	100 0	100 0	100 0	100 0
19mm		100 0			100 0	100 0	100 0	100 0	100 0
12 5mm		98 1			97 0	100 0	100 0	100 0	98 1
9 5mm		87 0			80 0	100 0	100 0	100 0	87 0
4 75mm		62 8			44 0	96 0	100 0	98 0	62 8
2 35mm		44 9			25 0	70 0	91 0	90 0	44 9
1 18mm		31 0			18 0	40 0	57 0	76 0	31 0
600um		20 1			10 0	30 0	30 5	60 0	20 1
300um		11 1			7 0	23 0	16 1	15 0	11 1
150um		7 2			6 0	16 0	8 1	1 0	7 2
75um		5 3			4 0	14 0	5 0	0 5	5 3

Requested_____ Approved_____
Region Materials Engineer

Approved_____ Approved_____
Contractor Region Construction Engineer

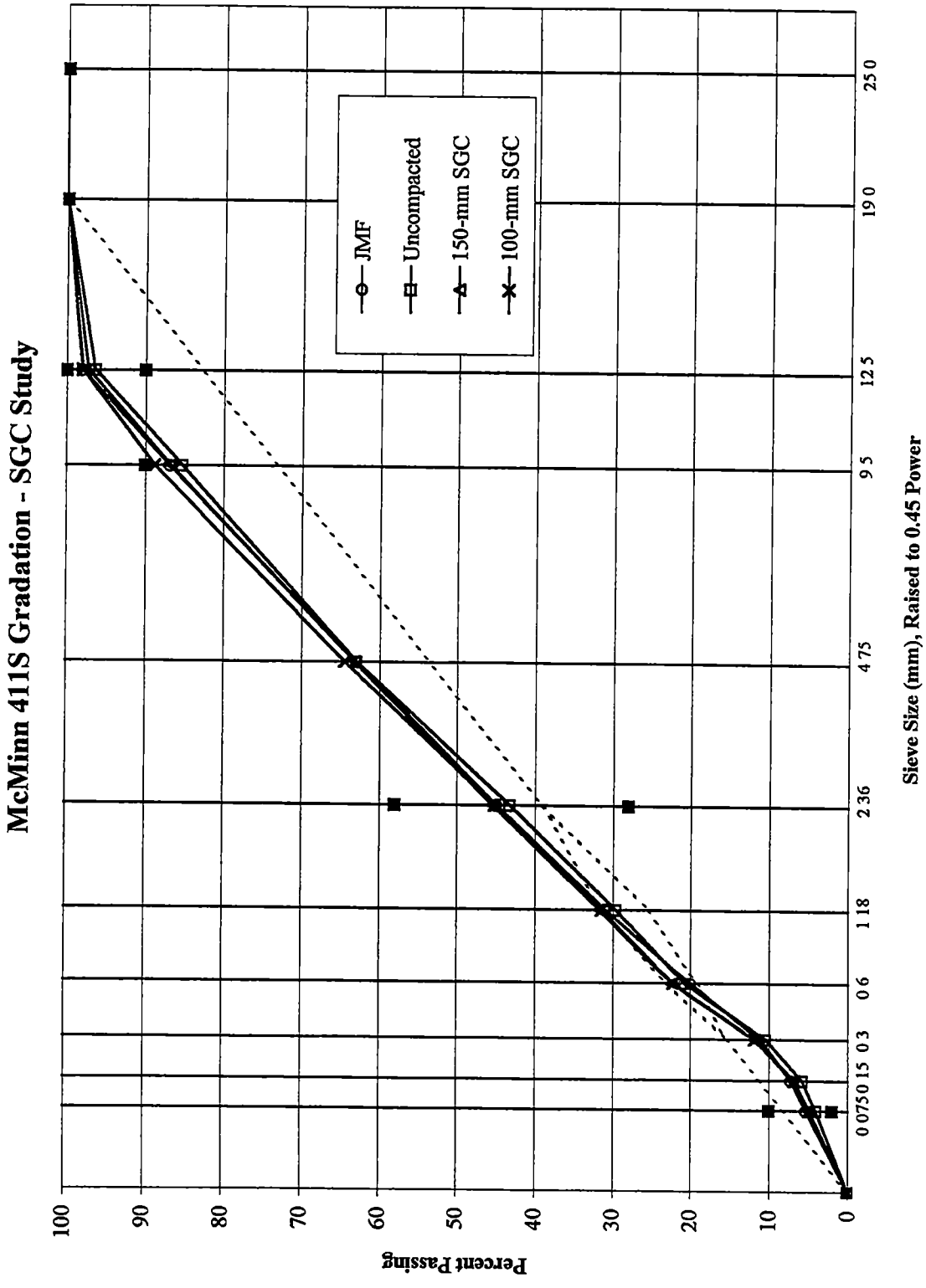
Gradation Comparison Sheet

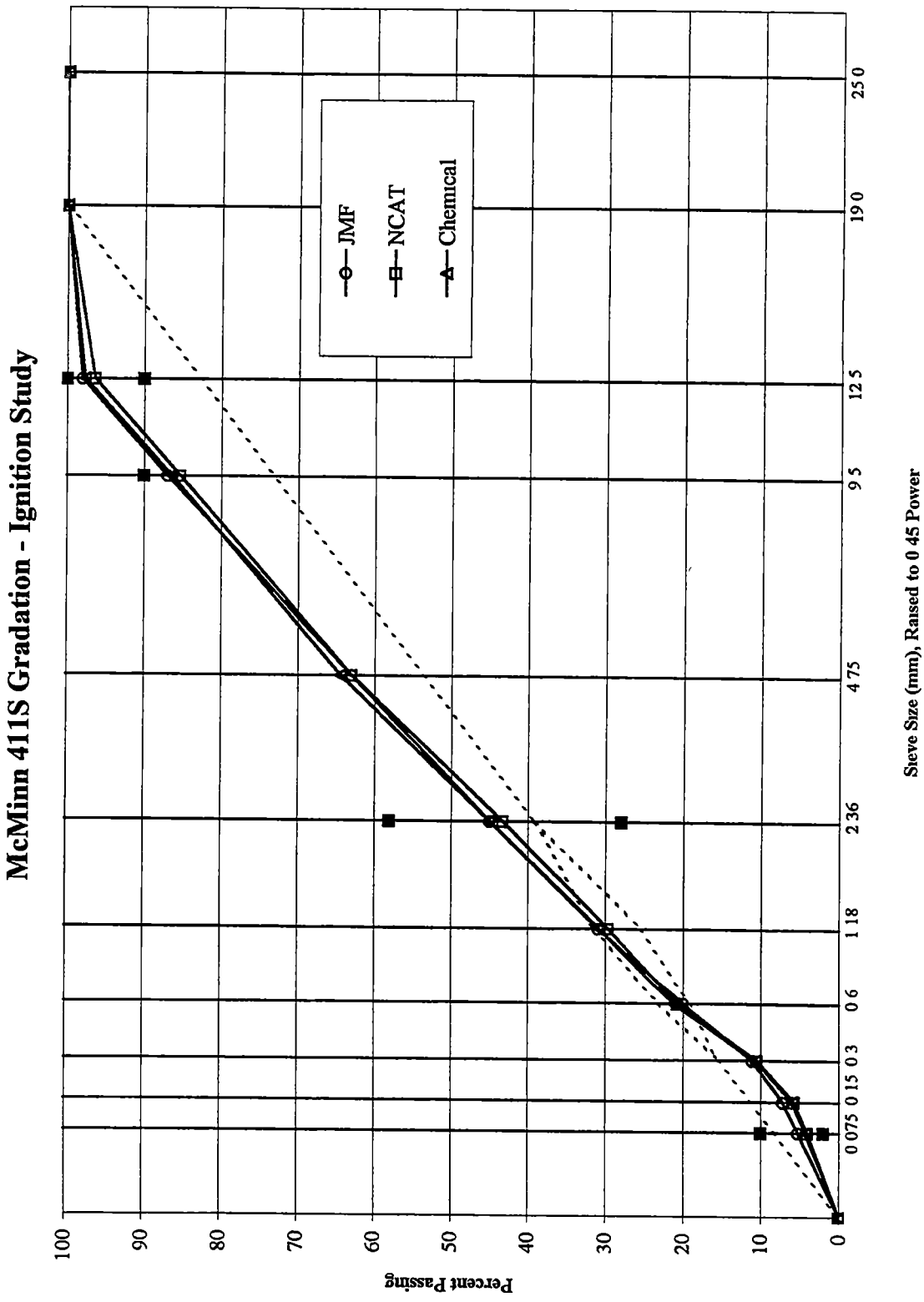
Aggregate Degradation
University of Tennessee, Knoxville

County McMinn
Mix Type 411 S
Project Number 54016-4219-04(5191)
Contractor Renfro

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0	100 0
12 5 mm (1/2")	98	97 7	96 4	97 3	98 0
9 5 mm (3/8")	87	86 4	85 4	86 9	88 9
4 75 mm (#4)	63	64 4	63 0	63 2	64 5
2 36 mm (#8)	45	45 0	43 3	45 5	45 2
1 18 mm (#16)	31	30 9	29 7	31 7	31 5
0 6 mm (#30)	20	21 2	20 7	22 4	22 3
0 3 mm (#50)	11	10 6	10 4	11 8	11 8
0 15 mm (#100)	7	5 9	5 8	6 9	6 8
0 075 mm (#200)	5	4 3	4 1	5 0	4 9

Asphalt Content	6 90%	6 23%	7 07%	7 15%	7 06%
% Dust	5 30%	4 33%	4 06%	4 98%	4 89%


McMinn 411S Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC


McMinn 411S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0 45 Power

Appendix A

Project Summary

County:	**Montgomery**
Mix Type:	**307 S**
TDOT Project No.:	**63001-4235-04**
Contract No.:	**5382**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/21/08

Project Ref No 63-011-4235-04 County Montgomery Region III
Proj No 63011-4235-04 Contract No 5382
Type BPMB-HM Sec No 307-S Article
Contractor McIntosh Construction Subcontractor
State Rt 48/13 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 7/24/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
#57 Stone	25 4mm-Pan	Vulcan Materials, Clarksville, TN	33 32
5/8" D-Rock	19 0mm-Pan	Vulcan Materials, Clarksville, TN	19 04
#10 Screenings	9 5mm-Pan	Vulcan Materials, Clarksville, TN	19 04
Mfg Sand	9 5mm-Pan	Vulcan Materials, Clarksville, TN	23 80
Asphalt Cement	PG 64-22	Marathon-Ashland Nashville, TN	4 80
Anti-Strip	TYPE Kling Beta LO	DOSAGE RATE 0 50%	
% Fractured Faces on +4 Material		% Glassy Particles on +4 M 0	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	#57 Stone	5/8" D Rock	#10 Screen	Mfg. Sand	Filler Percent	Calculated Mix
		Percent		35 0	20 0	20 0	25 0		
Temp	159-166 C	166 00			NCAT Furnace Corr Factor				
% A C	4 2-6 2	4.8			**LOI:**				
					Theo:				
25 4mm	100 0	100 0		100 0	100 0	100 0	100 0		100 0
19mm	90-100	96 0		88 5	100 0	100 0	100 0		96 0
12 5mm				32 6	87 1	100 0	100 0		73 8
9 5mm				13 4	53 0	100 0	100 0		60 3
4 75mm				1 5	2 5	74 1	95 9		39 8
2 36mm	23-49	30 0		0 9	1 8	42 7	81 7		29 6
1 18mm				0 7	1 6	34 2	47 8		19 4
600um				0 7	1 5	20 6	27 2		11 5
300um				0 7	1 5	18 4	13 2		7 5
150um				0 57	1 31	17 7	3 92		4 98
75um	2-8	3 0		0 50	1 15	10 20	2 04		2 96

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

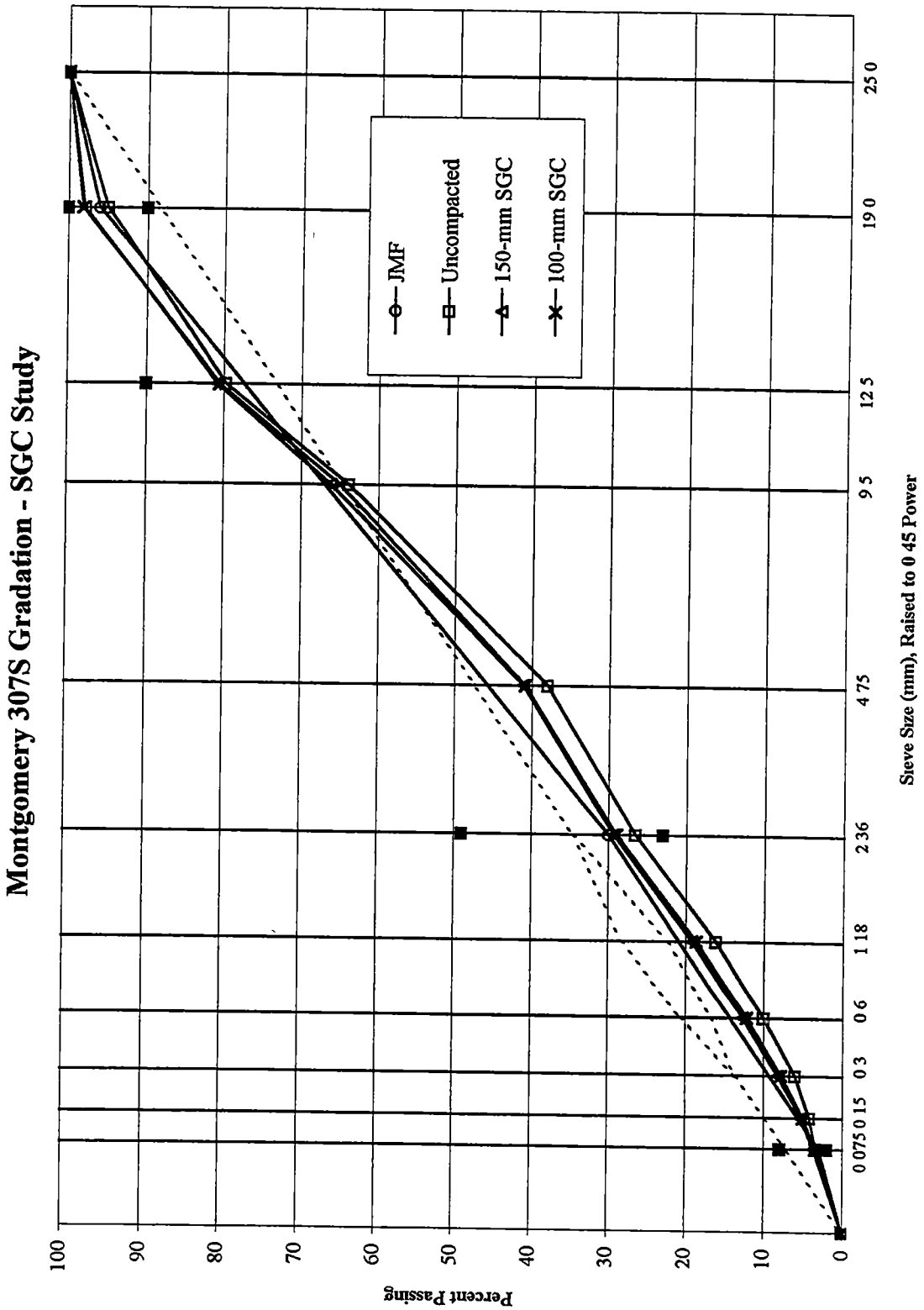
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County	Montgomery
Mix Type	307 S
Project Number	63011-4235-04(5382)
Contractor	McIntosh Construction

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	96	95 0	97 9	98 1
12 5 mm (1/2")		79 7	80 8	80 6
9 5 mm (3/8")		63 9	66 2	65 0
4 75 mm (#4)		37 9	41 1	40 8
2 36 mm (#8)	30	26 5	29 4	29 0
1 18 mm (#16)		16 1	19 2	18 6
0 6 mm (#30)		10 0	12 6	12 1
0 3 mm (#50)		6 1	8 3	7 9
0 15 mm (#100)		4 2	5 3	5 0
0 075 mm (#200)	3	3 4	3 7	3 5

Asphalt Content	4 80%	5 24%	5 13%	4 88%
% Dust	3 00%	3 41%	3 65%	3 50%


Montgomery 307S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0 45 Power

Appendix A

Project Summary

County:	**Pickett**
Mix Type:	**411 S**
TDOT Project No.:	**67950-3503-04**
Contract No.:	**5313**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 9/4/98

Project Ref No _____ County Pickett Region II
Proj No 67950-3503-04 Layer Surface Contract No 5313
Type A C S -H M Sec No 411M-D Article 411M-01, 01, 02
Contractor Highway Materials Subcontractor N\A
State Rt **TOTAL MIX INCLUDING BITUMEN** Date of Letting 9/11/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A	16mm-pan	Livingston Limestone, Livingston, TN	57 06
Screenings	4 75mm-pan	Livingston Limestone, Livingston, TN	9 51
Nat Sand	4 75mm-pan	Highways Inc Monterey, TN	14 27
M S	4 75mm-pan	Livingston Limestone, Livingston, TN	14 25
Asphalt Cement	PG 64-22	Southern States/Marathon Nashville, TN	4 90
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE	0 3
% Fractured Faces on +4 Material		% Glassy Particles on +4 Mate N\A	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	AGGREGATE ANALYSIS TOTAL PERCENT PASSING: C A Percent	Med C A Percent	Screenings Percent	Nat Sand Percent	M S Percent	Calculated Mix
		Percent			60 0	10 0	15 0	15 0	100 0
% A.C		4 90			NCAT Furnace Corr Factor				
Temp	275-325	300F			**LOI:**	27%			
	Compaction Temp	280-290			**Theo:**	2 494			
	Mixing Temp	295-305							
31 5mm									
25mm									
19mm									
16mm	100	100 0			100 0	100 0	100 0	100 0	100 0
12 7mm	95-100	94 0			90 0	100 0	100 0	100 0	94 0
9 5mm	80-93	79 0			65 0	100 0	100 0	100 0	79 0
4 75mm	54-76	52 0			22 0	93 0	98 0	99 0	52 1
2 36mm	35-57	36 0			7 0	63 0	93 0	78 0	36 2
1 18mm		29 0			5 0	44 0	90 0	55 0	29 2
600um	17-29	21 0			4 0	31 0	75 0	30 0	21 3
300um	10-18	10 0			3 0	22 0	24 0	16 0	10 0
150um	3-10	4 8			2 0	16 0	3 0	8 0	4 8
75um	0-6 5	3 2			2 0	11 0	1 0	5 0	302 0

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

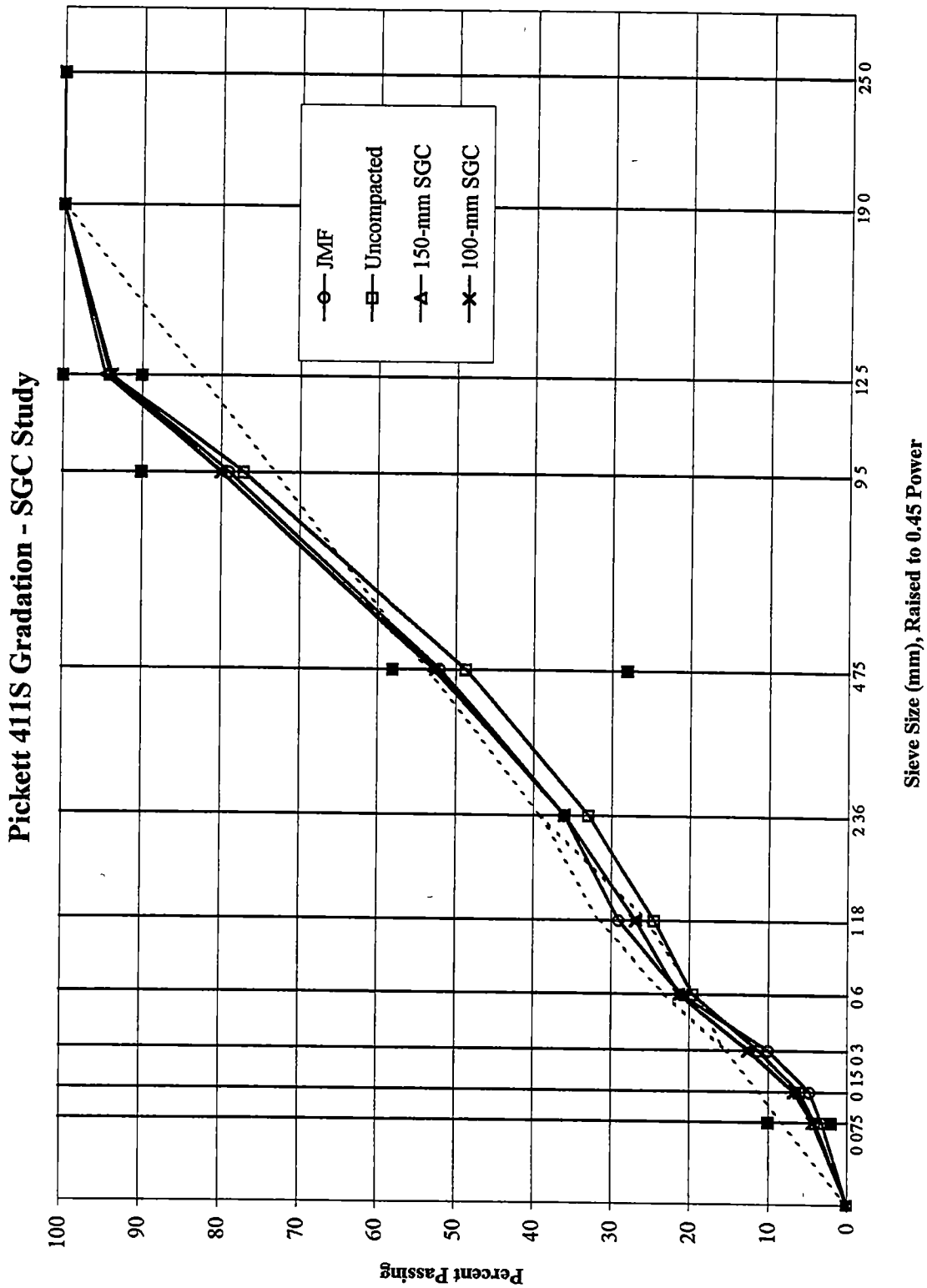
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Pickett
Mix Type: 411 S
Project Number: 67950-3503-04(5313)
Contractor: Highway Materials

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0
12 5 mm (1/2")	94	94 0	94 6	93 7
9 5 mm (3/8")	79	77 1	80 0	80 0
4 75 mm (#4)	52	48 7	52 8	52 6
2 36 mm (#8)	36	32 9	36 1	36 0
1 18 mm (#16)	29	24 5	26 9	26 9
0 6 mm (#30)	21	19 5	21 3	21 3
0 3 mm (#50)	10	11 2	12 5	12 5
0 15 mm (#100)	5	6 0	6 6	6 7
0 075 mm (#200)	3	4 1	4 2	4 4

Asphalt Content	4 90%	4 97%	4 92%	4 89%
% Dust	3 20%	4 08%	4 21%	4 36%


Pickett 411S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Polk**
Mix Type:	**411 D**
TDOT Project No.:	**70004-4575-04**
Contract No.:	**5195**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 6/3/98

Project Ref No _____ County Polk Region II
Proj No 70004-4575-04 Contract No 5195
Type _____ Sec No 411D Article _____
Contractor Hillis Group Subcontractor _____
State Rt _____ **TOTAL MIX INCLUDING BITUMEN** Date of Letting _____

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A	5/8-Pan	Caldwell Stone, Ellijay, GA	37 48
Screenings	3/8-Pan	Bradley Stone, Cleveland, TN	23 42
Sand	3/8-Pan	Bradley Stone & Sand Jasper, TN	32 80
Asphalt Cement	PG 64-22	Amoco Chattanooga, TN	6 30
Anti-Strip	TYPE Kling-Beta	DOSAGE RATE 0 03	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material	100

				AGGREGATE ANALYSIS TOTAL PERCENT PASSING					
SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	Screenings Percent	Sand Percent	Filler Percent	Calculated Mix
		Percent			40 0	25 0	35 0		
% A.C		6 30			NCAT Furnace Corr Factor				
Temp					LOI:	6 8			
	Compaction Temp				Theo:	2 474			
	Mixing Temp								
5/8"					100 0	100 0	100 0		100 0
1/2"	95-100	95 6			89 0	100 0	100 0		95 6
3/4"	80-93	83 6			59 0	100 0	100 0		83 0
#4	54-76	61 7			10 0	95 0	97 0		61 7
#8	35-57	45 3			2 0	63 0	82 0		45 3
#30	17-29	29 0			1 0	26 0	63 0		29 0
#50	10 0-18	11 6			1 0	18 0	19 0		11 6
#100	3 0-10	4 7			1 0	13 0	3 0		4 7
#200	0-6 5	3 5			1 0	11 0	1 0		3 5

Requested _____

Approved _____ Approved _____
Contractor Region Materials Engineer

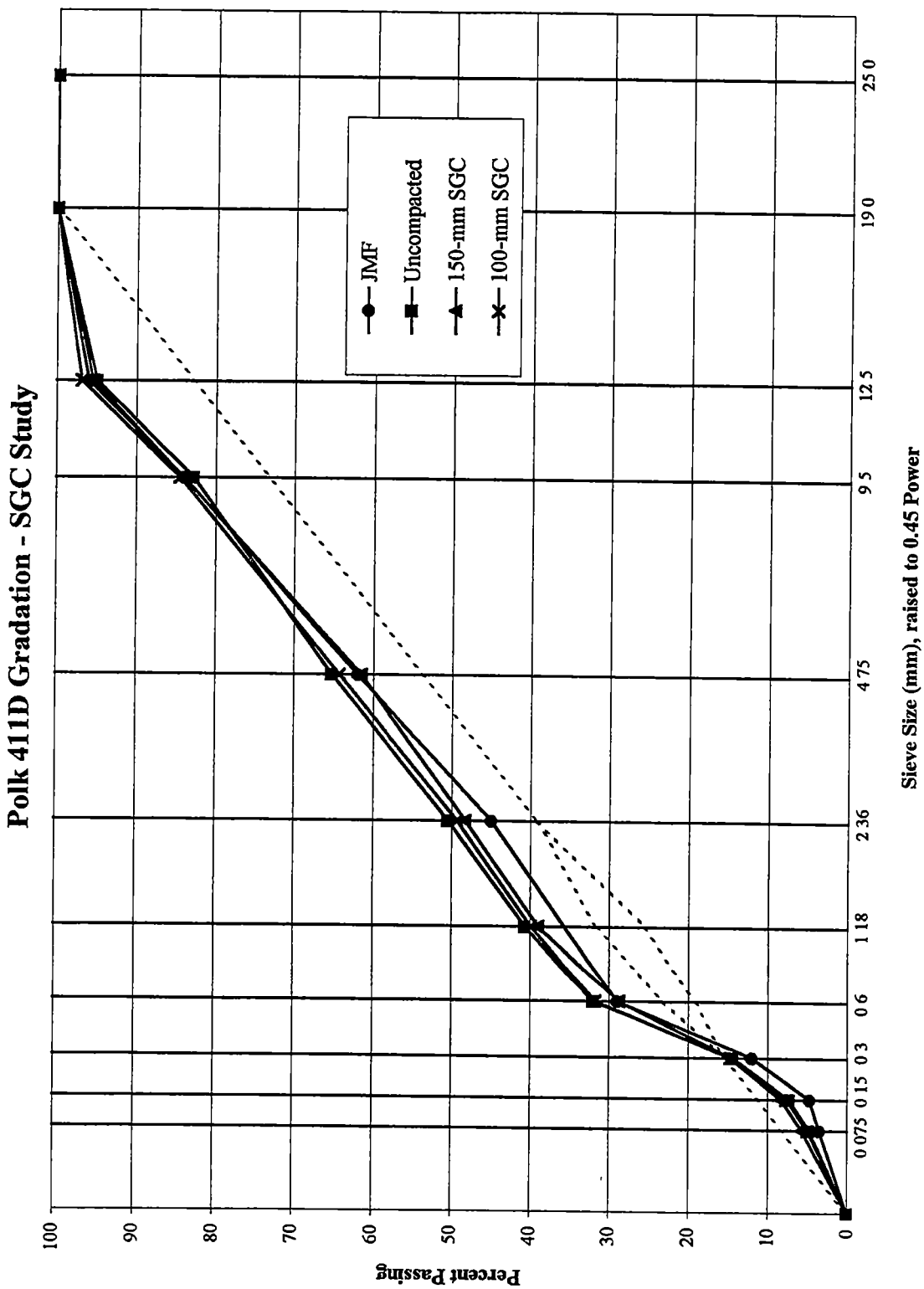
Approved _____
Region Construction Engineer

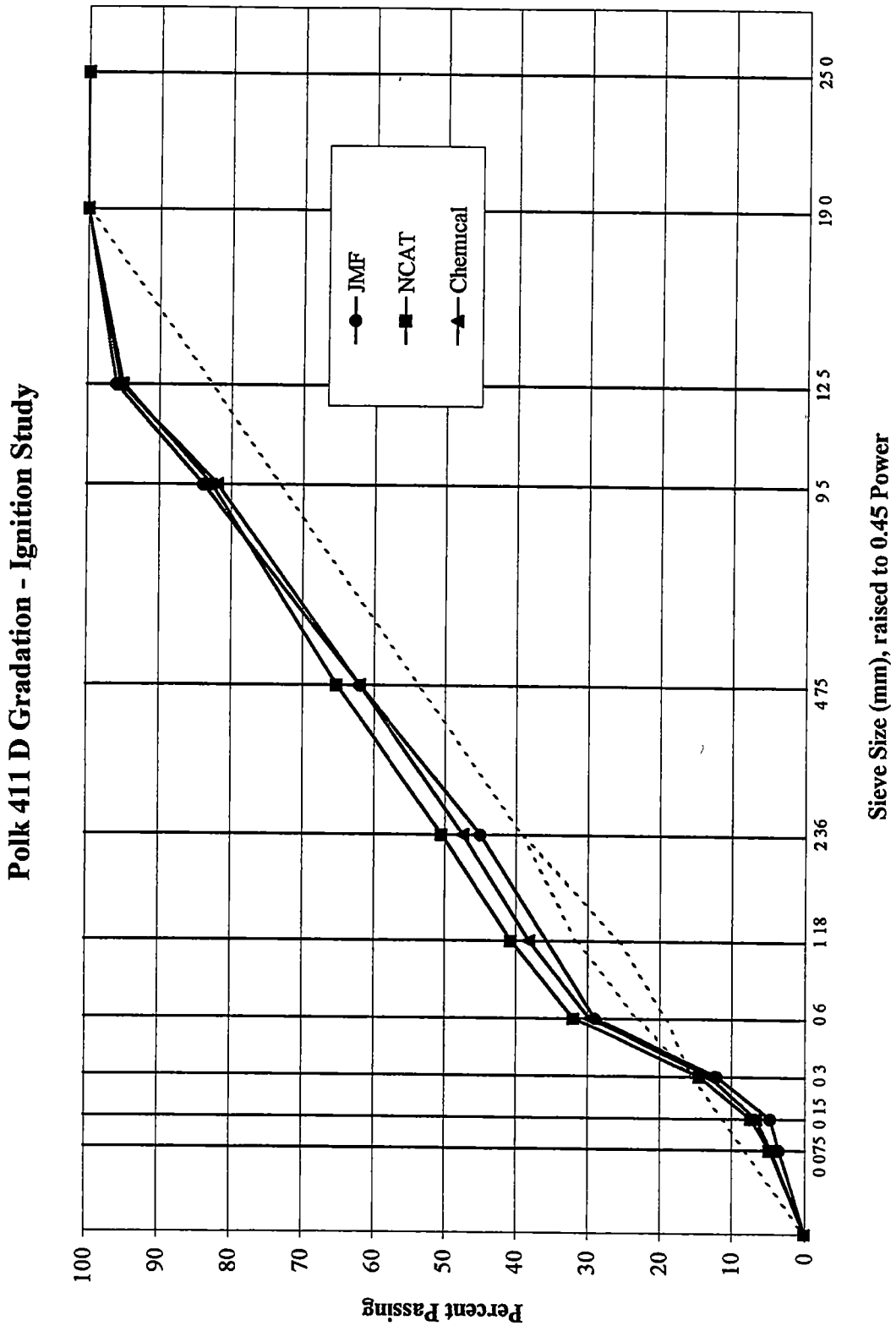
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Polk
Mix Type: 411 D
Project Number: 70004-4575-04(5195)
Contractor: Hillis Group

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0	100 0
12 5 mm (1/2")	96	95 4	95 0	95 5	96 8
9 5 mm (3/8")	84	82 0	82 8	84 1	84 5
4 75 mm (#4)	62	62 0	65 2	61 5	64 3
2 36 mm (#8)	45	47 5	50 5	48 3	49 3
1 18 mm (#16)		38 1	40 7	39 0	39 9
0 6 mm (#30)	29	29 7	32 0	28 7	31 7
0 3 mm (#50)	12	13 0	14 4	14 7	14 7
0 15 mm (#100)	5	6 7	7 3	8 3	7 7
0 075 mm (#200)	4	4 6	4 7	5 7	4 9
Asphalt Content	6.30%	6 84%	6 62%	6 40%	6 13%
% Dust	3 50%	4 63%	4 74%	5 71%	4 94%


Polk 411D Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), raised to 0.45 Power


Polk 411 D Gradation - Ignition Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
NCAT
Chemical
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), raised to 0.45 Power

Appendix A

Project Summary

County:	**Putnam**
Mix Type:	**307 S**
TDOT Project No.:	**71005-4229-04**
Contract No.:	**5386**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 10/12/98

Project Ref No SP County Putnam Region II
Proj No 71005-4229-04 Contract No 5386
Type BPMB-H M Sec No 307-S Article 01 01-01 02
Contractor Highways, Inc Subcontractor N/A
State Rt **TOTAL MIX INCLUDING BITUMEN** Date of Letting 7/24/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	#57	Rogers Group Algood, TN	28 86
Med C A	#7	Rogers Group Algood, TN	33 67
Screenings	B D	Rogers Group Algood, TN	24 05
Sand	N Sand	Highways, Inc Monterey, TN	9 62
RAP			0 00
Asphalt Cement	PG 64-22	Ergon Nashville, TN	3 80
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE 0 05	
% Fractured Faces on +4 Material		% Glassy Particles on +4 Mater 0	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A Percent	Med. C A. Percent	Screenings Percent	Sand Percent	RAP Percent	Calculated Mix
		Percent		30 0	35 0	25 0	10 0		
% A.C		3 80			NCAT Furnace Corr Factor				
Temp	275-325	300F			LOI:				
	Compaction Temp	295-305			Theo:	2 529			
	Mixing Temp	305-315							
31 5mm									
25mm		100 0	100 0	100 0	100 0	100 0	100 0		100 0
19mm		95 5	89 8-100	85 0	100 0	100 0	100 0		95 5
16mm									
12 7mm		78 8	73 1-84 5	35 0	95 0	100 0	100 0		78 8
9 5mm		64 3	58 6-70 0	24 0	63 0	100 0	100 0		64 3
4 75mm		38 7	34 7-42 7	7 0	10 0	93 0	98 0		38 7
2 36mm		27 1	23 8-30 4	5 0	5 0	58 0	93 0		27 1
1 18mm		23 7	20 4-27	4 0	5 0	47 0	90 0		23 7
600um		16 1	12 8-19 4	4 0	4 0	24 0	75 0		16 1
300um		9 6	6 3-12 9	4 0	4 0	18 0	25 0		9 6
150um		5 8	4 2-7 4	3 0	3 0	14 0	3 0		5 8
75um		3 9	2 3-5 5	2 0	2 0	10 0	1 0		3 9

Requested _____ Approved _____
Region Materials Engineer

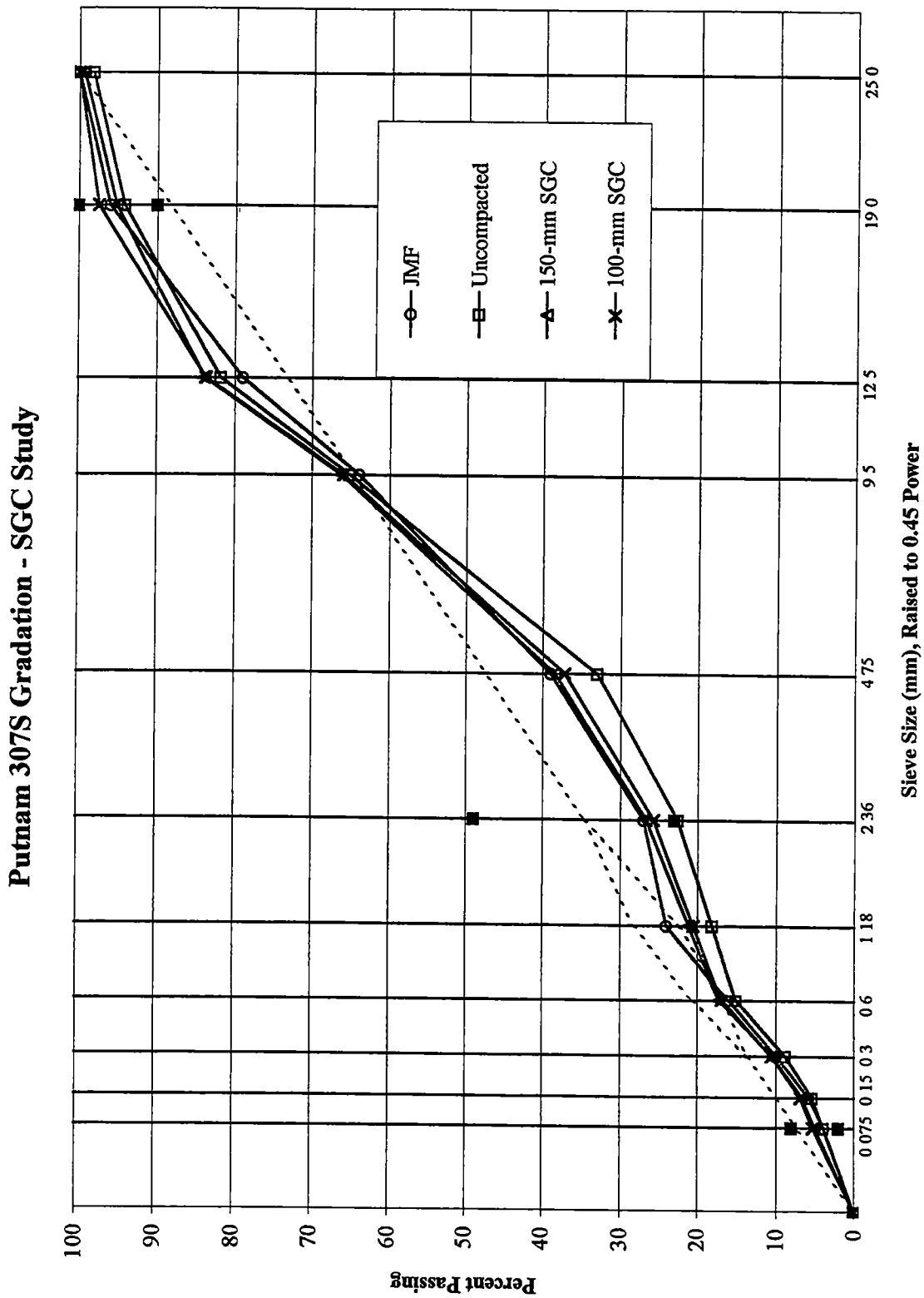
Approved _____ Approved _____
Contractor Region Construction Engineer

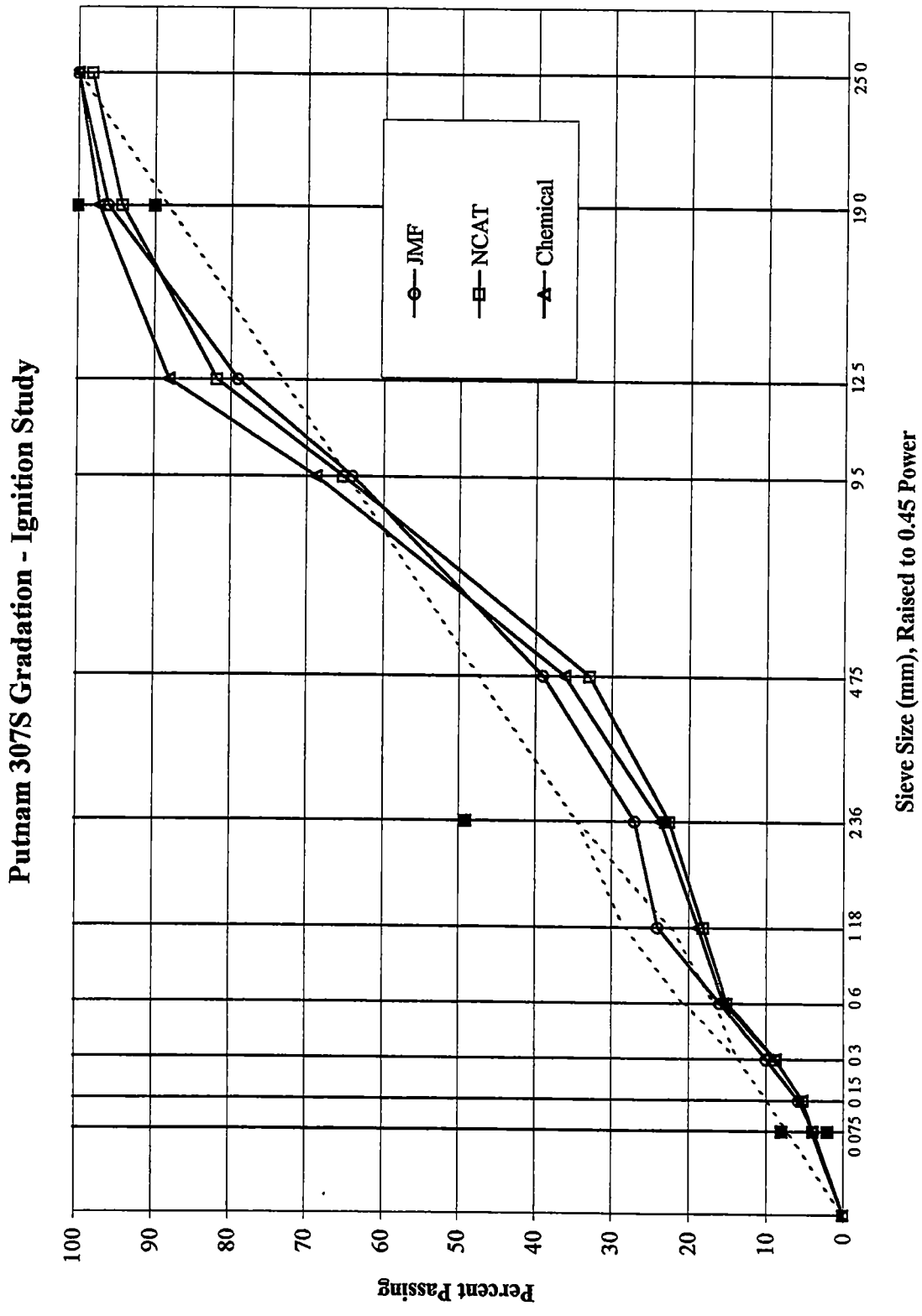
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Putnam
Mix Type: 307 S
Project Number: 71005-4229-04(5386)
Contractor: Highways, Inc

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	98 1	99 3	100 0
19 mm (3/4")	96	97 1	94 2	95 2	97 4
12 5 mm (1/2")	79	88 0	81 8	83 9	83 7
9 5 mm (3/8")	64	68 7	65 2	66 2	66 0
4 75 mm (#4)	39	36 2	32 9	38 5	37 2
2 36 mm (#8)	27	23.7	22 6	26 7	25 7
1 18 mm (#16)	24	18 8	18 1	21 1	20 5
0 6 mm (#30)	16	15 5	15 1	17 2	16 9
0 3 mm (#50)	10	8 8	8 8	10 4	10 5
0 15 mm (#100)	6	5 3	5 3	6 6	6 8
0 075 mm (#200)	4	4 2	3 9	5 0	5 3
Asphalt Content	3 80%	4 81%	3 79%	3 88%	3 60%
% Dust	3 90%	4 20%	3 95%	4 99%	5 32%


Putnam 307S Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC


Putnam 307S Gradation - Ignition Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
JMF
NCAT
Chemical
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Putnam**
Mix Type:	**411 S**
TDOT Project No.:	**71005-4229-04**
Contract No.:	**5386**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 10/27/98

Project Ref No SP County Putnam Region II
Proj No 71005-4229-04 Contract No 5386
Type A C S -H M Sec No 411M-S P Article 411M-01 01, 02
Contractor Highway Materials Subcontractor N/A
State Rt **TOTAL MIX INCLUDING BITUMEN** Date of Letting 7/24/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A	16mm-pan	Rogers Group, Gordonsville, TN	57 06
B D	4 75-pan	Rogers Group Algood, TN	23 78
Nat Sand	4 75-pan	Highways, Inc Monterey, TN	14 27
M S			
Asphalt Cement	PG 64-22	Ergon Nashville, TN	4 90
Anti-Strip	TYPE Pavebond Lite	DOSAGE RATE	0
% Fractured Faces on +4 Material		% Glassy Particles on +4 Mat 0	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	B D Percent	Nat. Sand Percent	M S Percent	Calculated Mix
		Percent			60 0	25 0	15 0		100 0
% A.C		4 90			NCAT Furnace Corr Factor				
Temp		300F			**LOI:** 32 1				
	Compaction Temp	295-305			**Theo:** 2 545				
	Mixing Temp	305-315							
25mm									
19mm									
16mm		100 0			100 0	100 0	100 0		100 0
12 7mm		98 0			97 0	100 0	100 0		97 5
9 5mm		83 0			72 0	100 0	100 0		83 2
4 75mm		50 0			20 0	93 0	98 0		50 0
2 36mm		32 0			5 0	58 0	93 0		31 5
1 18mm		25 0			5 0	34 0	90 0		25 0
600um		20 0			4 0	24 0	75 0		19 7
300um		10 0			3 0	18 0	25 0		10 1
150um		4 9			2 0	17 0	3 0		5 9
75um		4 1			2 0	11 0	1 0		4 1

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

Gradation Comparison Sheet

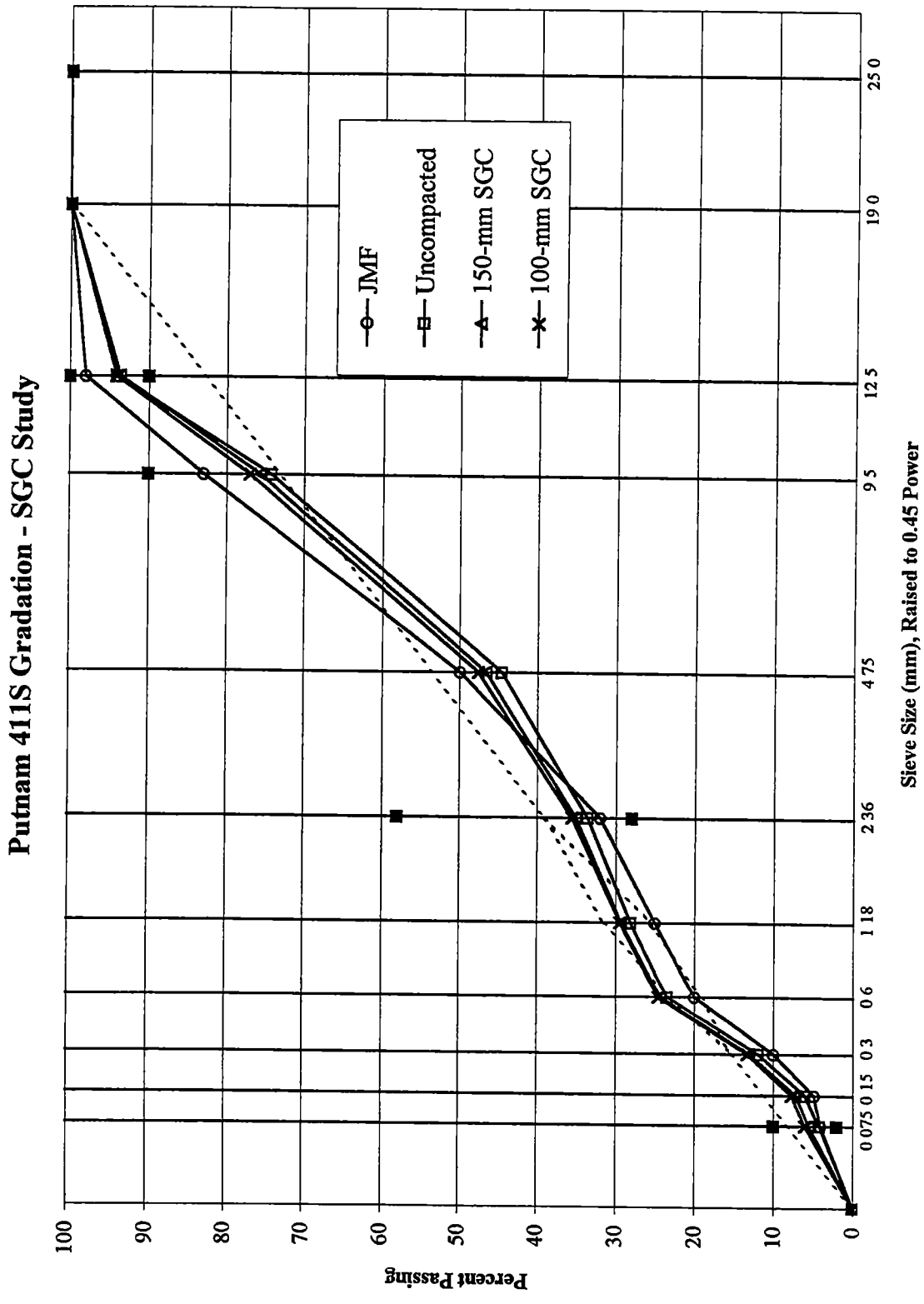
Aggregate Degradation
University of Tennessee, Knoxville

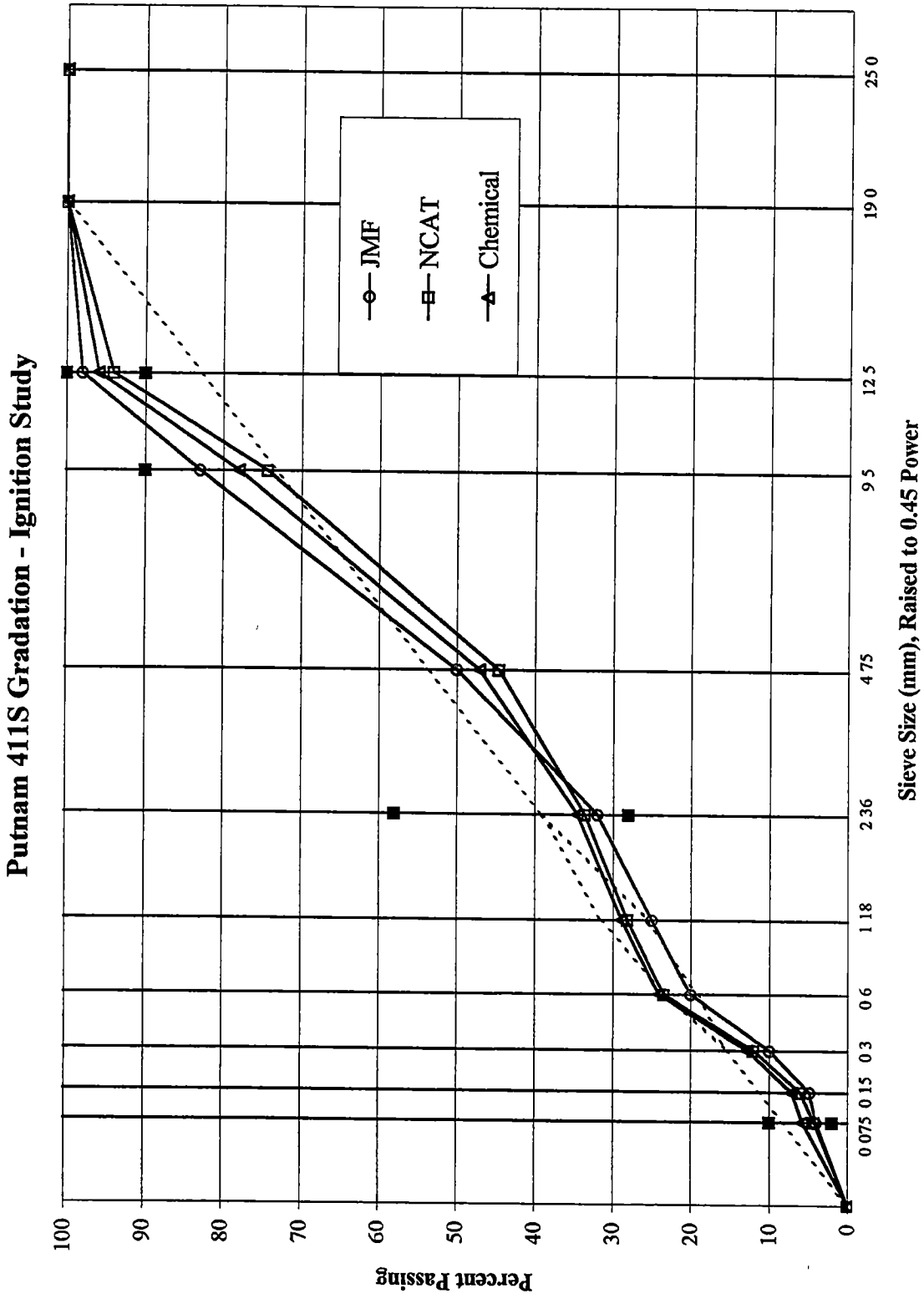
County: Putnam
Mix Type: 411 S
Project Number: 71005-4229-04(5386)
Contractor: Highway Materials

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100 0	100 0	100 0	100 0	100 0
19 mm (3/4")	100 0	100 0	100 0	100 0	100 0
12 5 mm (1/2")	98 0	95 8	94 0	93 6	94 1
9 5 mm (3/8")	83 0	78 0	74 3	75 7	77 0
4 75 mm (#4)	50 0	47 1	44 6	46 6	47 6
2 36 mm (#8)	32 0	34 5	33 6	35 1	35 6
1 18 mm (#16)	25 0	28 9	28 1	29 3	29 5
0 6 mm (#30)	20 0	24 0	23 5	24 3	24 5
0 3 mm (#50)	10 0	12 8	12 0	13 1	13 3
0 15 mm (#100)	4 9	7 1	6 0	7 2	7 7
0 075 mm (#200)	4 1	5 7	4 3	5 6	6 1

* Chemically Extracted

Asphalt Content	4 90%	4 98%	5 40%	5 40%	5 11%
% Dust	4 10%	5 74%	4 27%	5 58%	6 08%


Putnam 411S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), Raised to 0.45 Power


Putnam 411S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Rutherford**
Mix Type:	**307 BM/2**
TDOT Project No.:	**75001-3167-44**
Contract No.:	**4725**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 5/6/97

Project Ref No M-24-1(77)62 County Rutherford Region III
Proj No 75001-3167-44 Contract No 4725
Type BPMB-HM Sec No 307-BMZ R Article 307 04 36
Contractor Lojac Ent Subcontractor
State Rt I-24 TOTAL MIX INCLUDING BITUMEN Date of Letting

MATERIAL	Screen Total Percent Passing	PRODUCER AND ADDRESS	% USED
C A #56	1 1/4" Pan	Stoneman Inc Murfreesboro, TN	26 82
Med C A	3/4" Pan	Stoneman Inc Murfreesboro, TN	18 20
Washed Screenings	3/8"-Pan	Stoneman Inc Murfreesboro, TN	12 45
Sand	3/8" Pan	Hunter Marine Nashville, TN	19 16
Filler RAP	3/4"Pan	Lojac Ent Murfreesboro, TN	20 17
A C and Pen	AC-20 Polymer	Southern States Nashville, TN	3 19
Anti-Strip	ASA Pavebond Lite	Southern States Nashville, TN	0 30
% Fractured Faces on +4 Material		% Glassy Particles on +4 Material N/A	100%

Screen	Total Passing Master Range	Requested Percent	Tolerance Percent	C A Percent	Med C A Percent	Washed Scr Percent	Sand Percent	RAP Percent	Calculated Mix
				28 0	19 0	13 0	20 0	20 0	100 0
Temp	275	315 00	295-335		NCAT Furnace Corr Factor			N/A	
%AC	4 2-6 2	4 2			**LOI:**				
					Theo: 2 520				
1 1/4"	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
3/4"	81-93	91 0	85 3-96 7	70 0	100 0	100 0	100 0	99 0	91 4
1/2"									
3/8"	57-73	67 0	51.3-72 7	10 0	67 0	100 0	100 0	90 0	66 5
#4	40-56	47 0	43-51	4 0	13 0	83 0	99 0	67 0	47 4
#8	28-43	35 0	31 7-38 3	3 0	4 0	33 0	94 0	50 0	34 7
#30	13-25	21 0	17 7-24 3	2 0	3 0	10 0	63 0	30 0	21 0
#50	9-19	9 0	5 7-12 3	1 9	2 5	7	13	20	8 5
#100	6-10	5 2	3 6-6 8	1 7	2 2	5	15	17	5 2
#200	2 5-6 5	4 60	3 0-6 2	1 6	2 0	4 5	0 8	15 0	4 6

Requested _____ Approved _____
Region Materials Engineer

Approved _____
Contractor

Approved _____
Region Construction Engineer

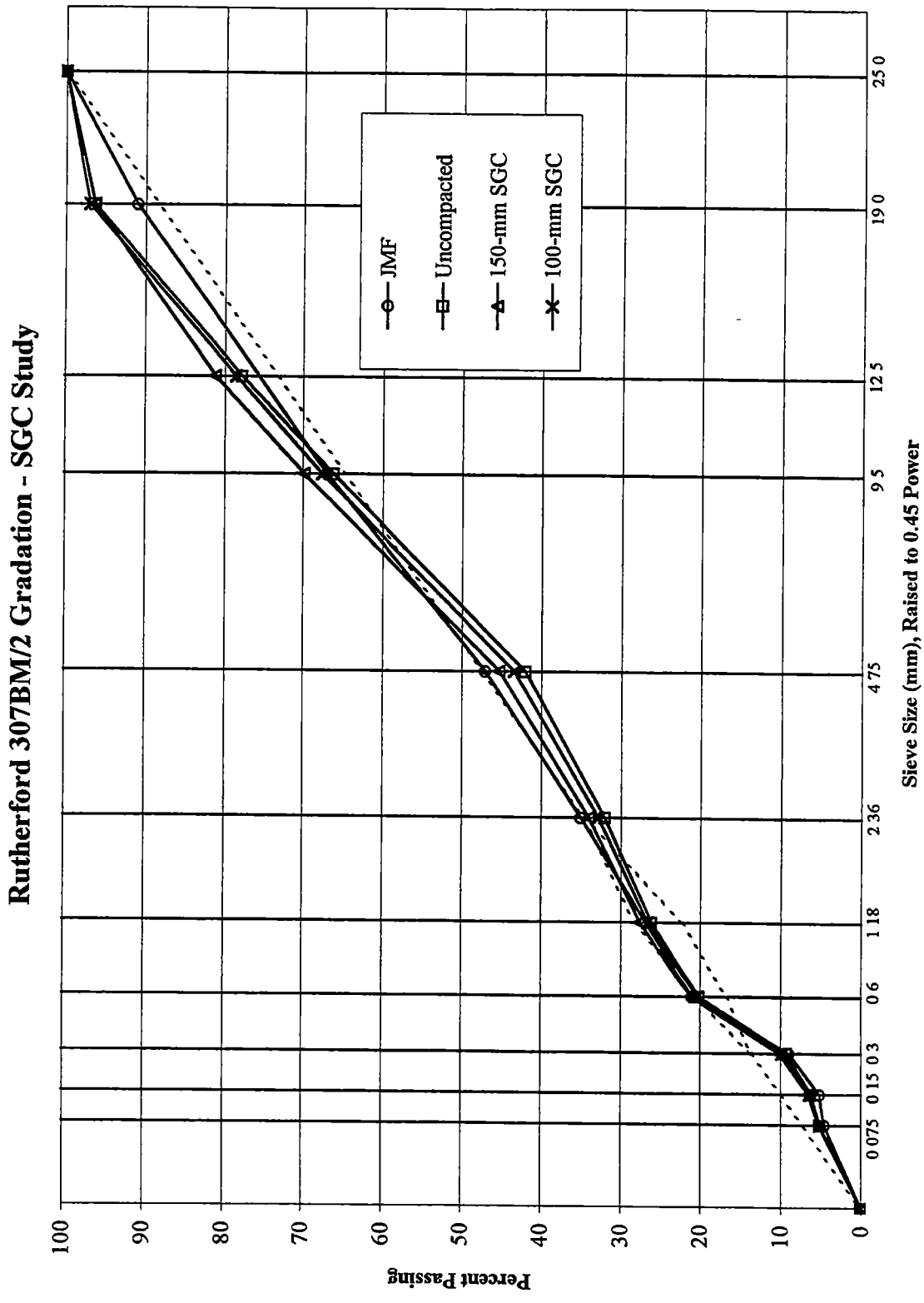
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County	Rutherford
Mix Type	307 BM/2
Project Number	75001-3167-44(4725)
Contractor	LOJAC Enterprises

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	91	96 4	96 3	96 9
12 5 mm (1/2")		77 8	81 2	78 5
9 5 mm (3/8")	67	66 2	69 8	67 6
4 75 mm (#4)	47	42 0	45 2	43 4
2 36 mm (#8)	35	32 0	34 0	32 8
1 18 mm (#16)		26 1	27 6	26 6
0 6 mm (#30)	21	20 2	21 1	20 4
0 3 mm (#50)	9	9 3	10 1	9 8
0 15 mm (#100)	5	6 2	6 6	6 4
0 075 mm (#200)	5	5 1	5 2	5 1

Asphalt Content	4 20%	4 16%	4 25%	4 02%
% Dust	4 60%	5 08%	5 21%	5 11%


Rutherford 307BM/2 Gradation - SGC Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC

Appendix A

Project Summary

County:	**Sequatchie**
Mix Type:	**411 D**
TDOT Project No.:	**77004-4207-04**
Contract No.:	**5318**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 7/6/98

Project Ref No _____ County Sequatchie Region II
Proj No 77004-4207-04 Contract No 5318
Type _____ Sec No 411M01 01 Article _____
Contractor Thomas Bros Construction Subcontractor _____
State Rt **TOTAL MIX INCLUDING BITUMEN** Date of Letting 6/12/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	5/8"-#200	Vulcan Sand & Gravel Chattanooga, TN	51 37
Med C A			
Screenings	1/4" - #200	Dunlap Stone Inc Dunlap, TN	18 68
Sand	1/4" - #200	Dunlap Stone Inc Dunlap, TN	8 68
Lime	#4 - #200	Dunlap Stone Inc Dunlap, TN	4 67
Asphalt Cement	PG 64-22	Shell Oil Co Chattanooga, TN	6 60
Anti-Strip	TYPE LP Pavebond Lite	DOSAGE RATE	0 5
% Fractured Faces on +4 Material	88	% Glassy Particles on +4 Material	100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	C A. Percent	Med. C A. Percent	Screenings Percent	Sand Percent	Lime Percent	Calculated Mix
		Percent		55 0		20 0	20 0	5 0	
% A.C	5 3-7 0	6 60			NCAT Furnace Corr Factor				
Temp		150 C			**LOI:** 10%				
	Compaction Temp				**Theo:** 2 292				
	Mixing Temp								
50mm									
37.5mm									
25mm									
19mm									
16mm	100 0	100 0		100 0		100 0	100 0	100 0	100 0
12 5mm	95-100	97 8		96 0		100 0	100 0	100 0	97 8
9 5mm	80-93	88 5		79 0		100 0	100 0	100 0	88 5
4 75mm	50-76	68 9		47 0		96 0	97 0	100 0	68 9
2 36mm	35-57	50 7		29 0		66 0	84 0	95 0	50 7
600um	17-29	28 6		11 0		29 0	68 0	62 0	28 6
300um	10-18	16 3		8 0		20 0	28 0	46 0	16 3
150um	3-10	8 4		5.2		15 5	4 1	32 8	8 42
75um	0-6 5	5 4		3 1		11 5	1 1	23 5	5 40

Requested _____ Approved _____
Region Materials Engineer

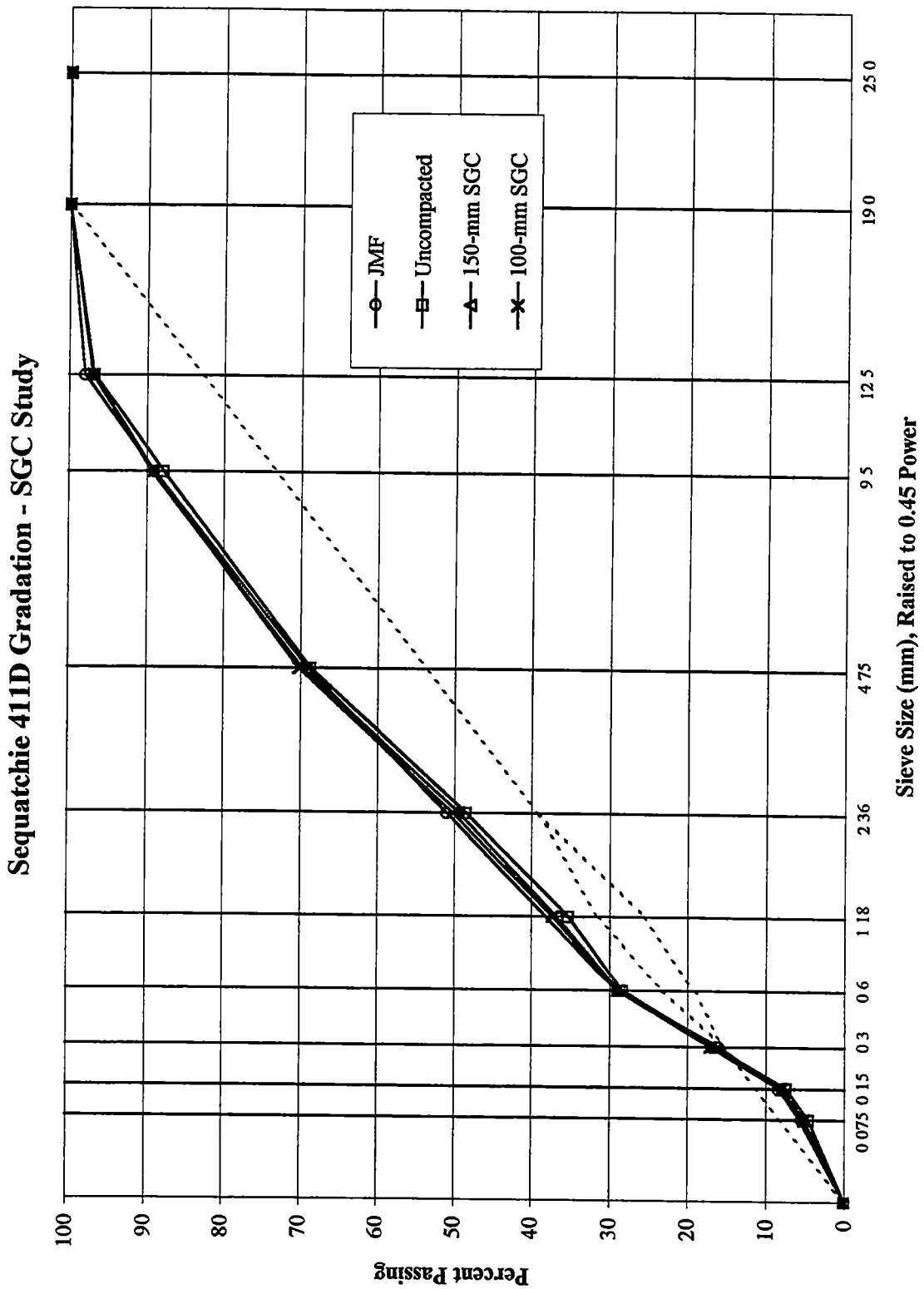
Approved _____ Approved _____
Contractor Region Construction Engineer

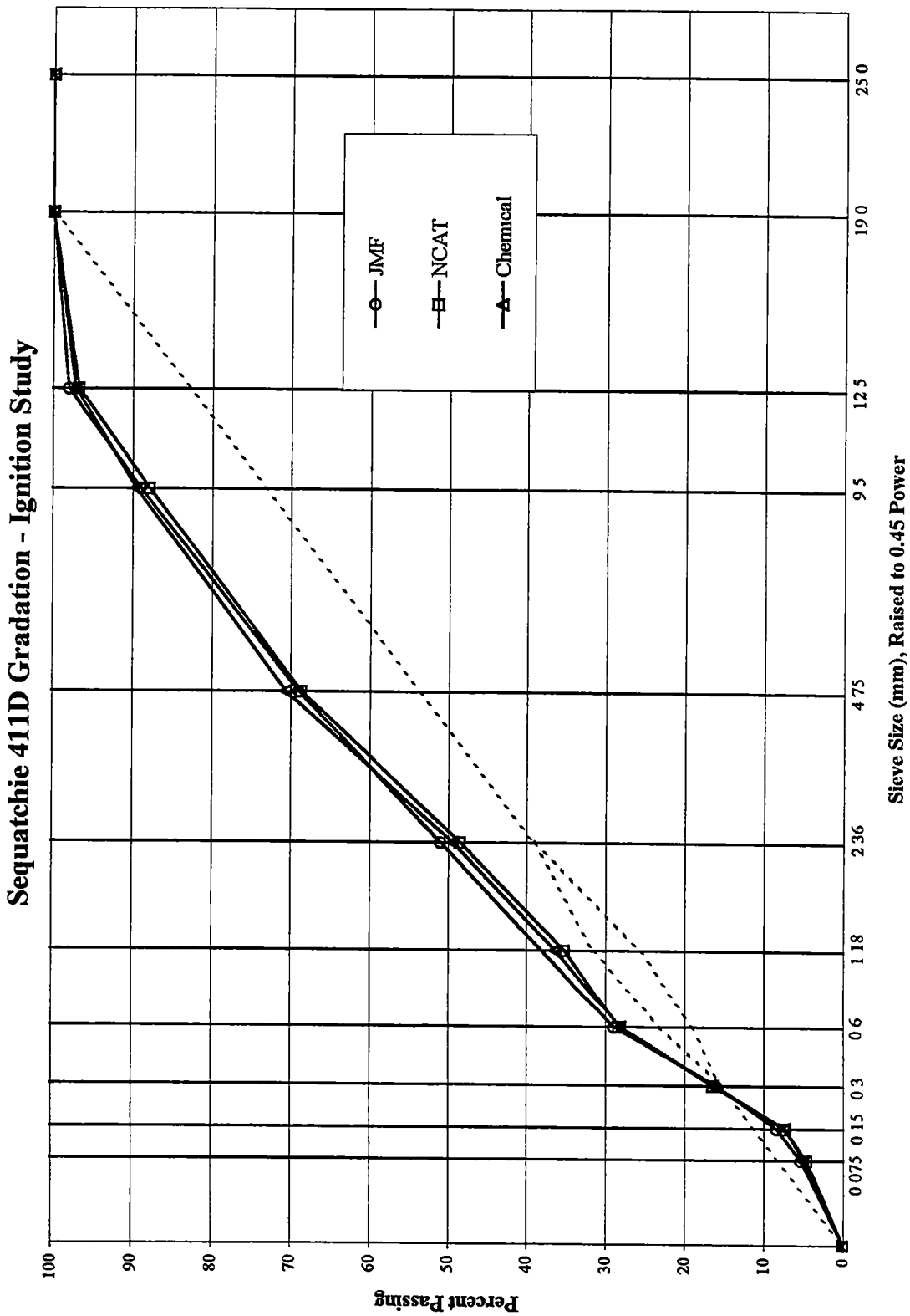
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County	Sequatchie
Mix Type	411 D
Project Number	77004-4027-04(5318)
Contractor	Thomas Bros Const

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0	100 0
12 5 mm (1/2")	98	97 1	96 7	96 9	96 9
9 5 mm (3/8")	89	89 5	87 8	89 4	89 1
4 75 mm (#4)	69	70 6	68 6	69 8	70 2
2 36 mm (#8)	51	49 4	48 5	49 4	50 2
1 18 mm (#16)		36 4	35 3	36.8	37 3
0 6 mm (#30)	29	28 1	28 4	28 7	28 9
0 3 mm (#50)	16	16 3	16 5	17 1	17 1
0 15 mm (#100)	8	7 3	7 5	8 3	8 0
0 075 mm (#200)	5	5 1	4 6	5 7	5 1
Asphalt Content	6 60%	6 23%	7 14%	6 97%	7 00%
% Dust	5 40%	5 05%	4 60%	5 69%	5 15%


Sequatchie 411D Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075 0.15 0.3 0.6 1.18 2.36 4.75 9.5 12.5 19.0 25.0
Sieve Size (mm), Raised to 0.45 Power


Sequatchie 411D Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Sevier**
Mix Type:	**307 S**
TDOT Project No.:	**78066-4207-04**
Contract No.:	**5398**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 10/11/98

Mix Design Nc DV-1(98)323
Project Ref No SP County Sevier I
Proj No 78016-4207-04 Contract No 5398
Type BPMB HM GRADING S Sec No 307S BINDER
Contractor CHARLES BLALOCK & SONS Subcontractor
State Rt S R 339 **TOTAL MIX INCLUDING BITUMEN** Date of Lettin 7/27/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A	19mm-75um	Vulcan Materials, Sevierville, TN	28 50
Med. C A	19mm-75um	Vulcan Materials, Sevierville, TN	23 75
Screenings	19mm-75um	Vulcan Materials, Sevierville, TN	42 75
Sand			
Asphalt Cement	PG 64-22	Volunteer Shell, Knoxville, TN	5 00
Anti-Strip	TYPE Kling Beta IV	DOSAGE RATE 0 3	100
% Fractured Faces on +4 Material	NA	% Glassy Particles on +4 Material	NA

SCREEN	Ttl Passing	Requested Percent		AGGREGATE ANALYSIS TOTAL PERCENT PASSING C A. Percent	Med. C A. Percent	Screenings Percent	Sand	Filler Percent	CALC MIX %
				30 0	25 0	45 0			100 0
% A.C		5 00			NCAT Furnace Corr Factor 2 5				
	Temp	135-162 8 C	148 9 C		LOI·				
					Theo	2 533			
1"	100	100 0		100 0					100 0
3/4"	90-100	98 0		94 3	100 0				98 3
3/8"	90	83 0		45 0	96 0				82 5
#4				27 4	75 0	100 0			72 0
#8				6 0	24 0	93 0			48 7
#16				3 5	10 0	66 0			33 3
#30				2 6	5 0	42 0			20 9
#50				2 0	3 0	27 0			13 5
#100				1 3	2 0	17 0			8 5
#200	2-8	4 4		0 4	0 8	9 1			4 4

Requested_____

Approved_____ Contractor

Approved_____ Region Materials Engineer

Approved_____ Region Construction Engineer

Gradation Comparison Sheet

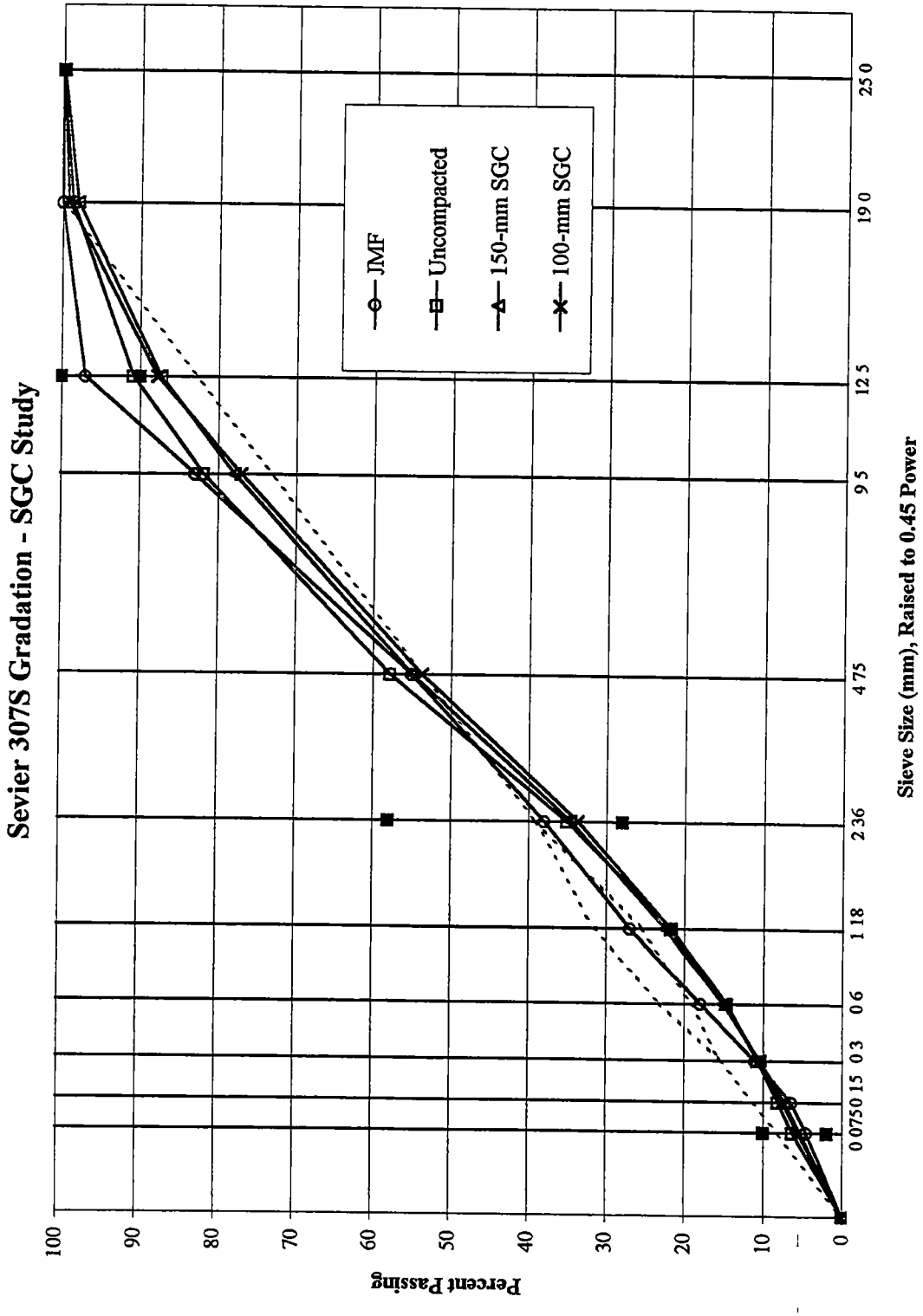
Aggregate Degradation
University of Tennessee, Knoxville

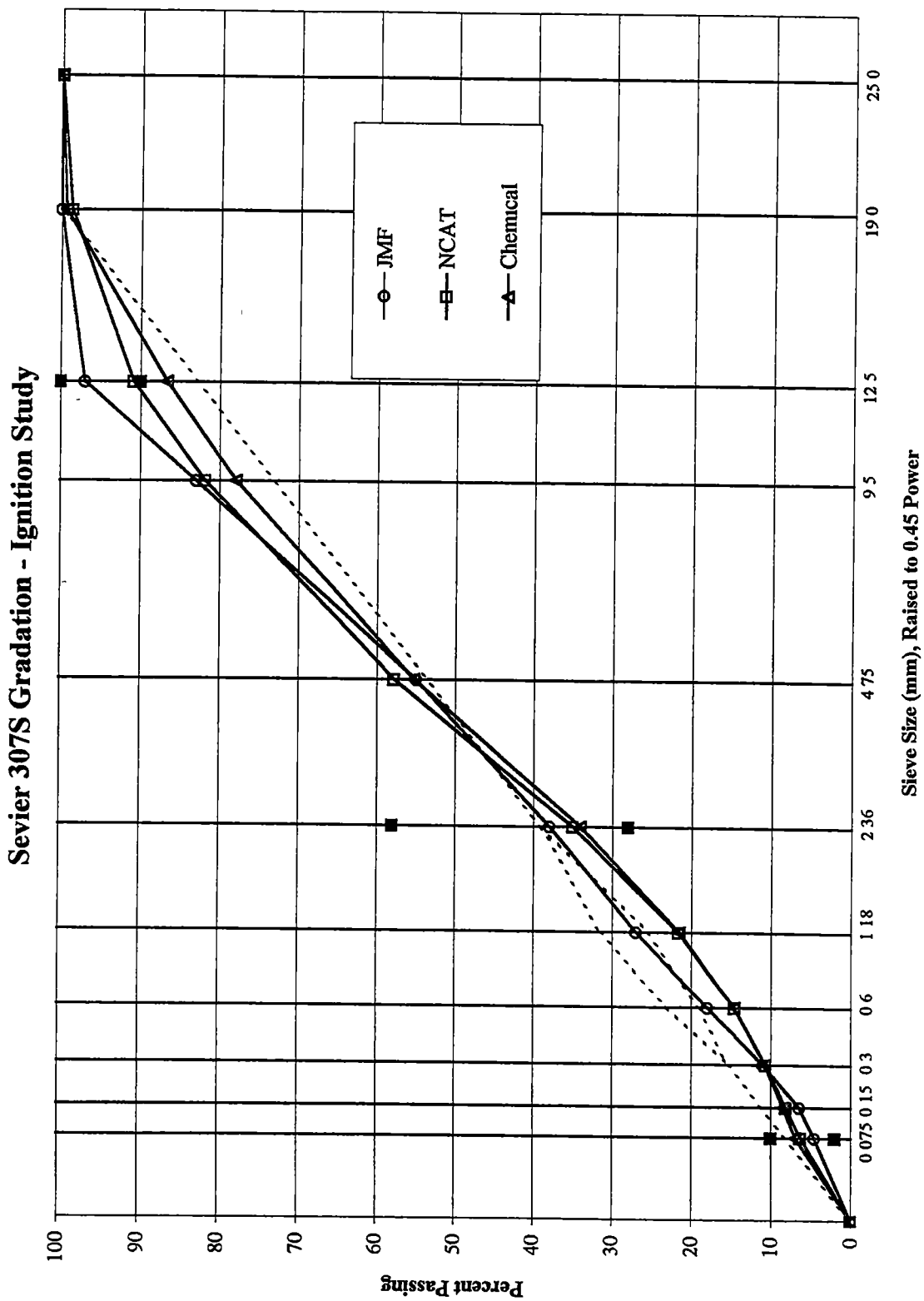
County	Sevier
Mix Type	307 S
Project Number	78066-4207-04(5398)
Contractor	Charles Blalock and Sons

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	99 9	100 0
19 mm (3/4")	100	99 4	98 7	98 0	99 2
12 5 mm (1/2")	97	86 7	90 8	87 4	87 8
9 5 mm (3/8")	83	78 0	81 9	77 9	77 0
4 75 mm (#4)	55	55 3	57 8	55 0	53 7
2 36 mm (#8)	38	34 0	35 1	34 6	33 7
1 18 mm (#16)	27	21 6	21 6	22 5	21 8
0 6 mm (#30)	18	14 6	14 6	15 0	14 8
0 3 mm (#50)	11	10 7	10 7	10 4	10 4
0 15 mm (#100)	7	8 5	8 1	7 3	7 6
0 075 mm (#200)	5	6 9	6 4	5 4	5 6

* Chemically Extracted

Asphalt Content	5 40%	4 77%	4 72%	4 99%	4 26%
% Dust	4 60%	6 94%	6 36%	5 35%	5 60%


Sevier 307S Gradation - SGC Study
Percent Passing
Sieve Size (mm), Raised to 0.45 Power
JMF
Uncompacted
150-mm SGC
100-mm SGC
0
10
20
30
40
50
60
70
80
90
100
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0


Sevier 307S Gradation - Ignition Study
JMF
NCAT
Chemical
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

Appendix A

Project Summary

County:	**Sevier**
Mix Type:	**411 S**
TDOT Project No.:	**78066-4207-04**
Contract No.:	**5398**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 10/19/98

Mix Design No DV-1(98)331
Project Ref No SP County Sevier I
Proj No 78016-4207-04 Contract No 5398
Type ACS GRADING 411-S Sec No 411-S
Contractor CHARLES BLALOCK & SONS Subcontractor
State Rt S R 339 **TOTAL MIX INCLUDING BITUMEN** Date of Letting 7/27/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
C A			
Med C A	19mm-75um	Newport Sand & Gravel, Newport, TN	56 76
Screenings	9 5mm-75um	Vulcan Materials, Sevierville, TN	23 65
Sand	9 5mm-75um	Newport Sand & Gravel, Newport, TN	14 19
Asphalt Cement	PG 64-22	Volunteer Shell, Knoxville, TN	5 40
Anti-Strip	TYPE Kling Beta IV	DOSAGE RATE 0 3	100
% Fractured Faces on +4 Material	96 4	% Glassy Particles on +4 Material	NA

SCREEN	Ttl Passing	Requested Percent		C A Percent	Med. C A Percent	Screenings Percent	Sand	CALC MIX %
					60 0	25 0	15 0	100 0
% A.C		5 40			NCAT Furnace Cor			
	Temp	135-162 8 C	148 9 C		**LOI:**	11 0		
					Theo:	2 434		
1"								
3/4"	100				100 0			100 0
1/2"	90-100	97 0			95 0			97 0
3/8"	-90	82 8			71 3	100 0	100 0	82 8
#4		55 3			29 0	93 0	97 8	55 3
#8	28-58	37 6			17 0	66 0	72 5	37 6
#16		26 5			12 4	42 0	56 9	26 5
#30		18 2			9 8	27 0	37 2	18 2
#50		11 4			7 5	17 0	17 4	11 4
#100		6 5			4 6	12 0	5 0	6 5
#200	2-10	4 6			3 3	9 1	2 4	4 6

Requested _____

Approved _____ Contractor

Approved _____ Region Materials Engineer

Approved _____ Region Construction Engineer

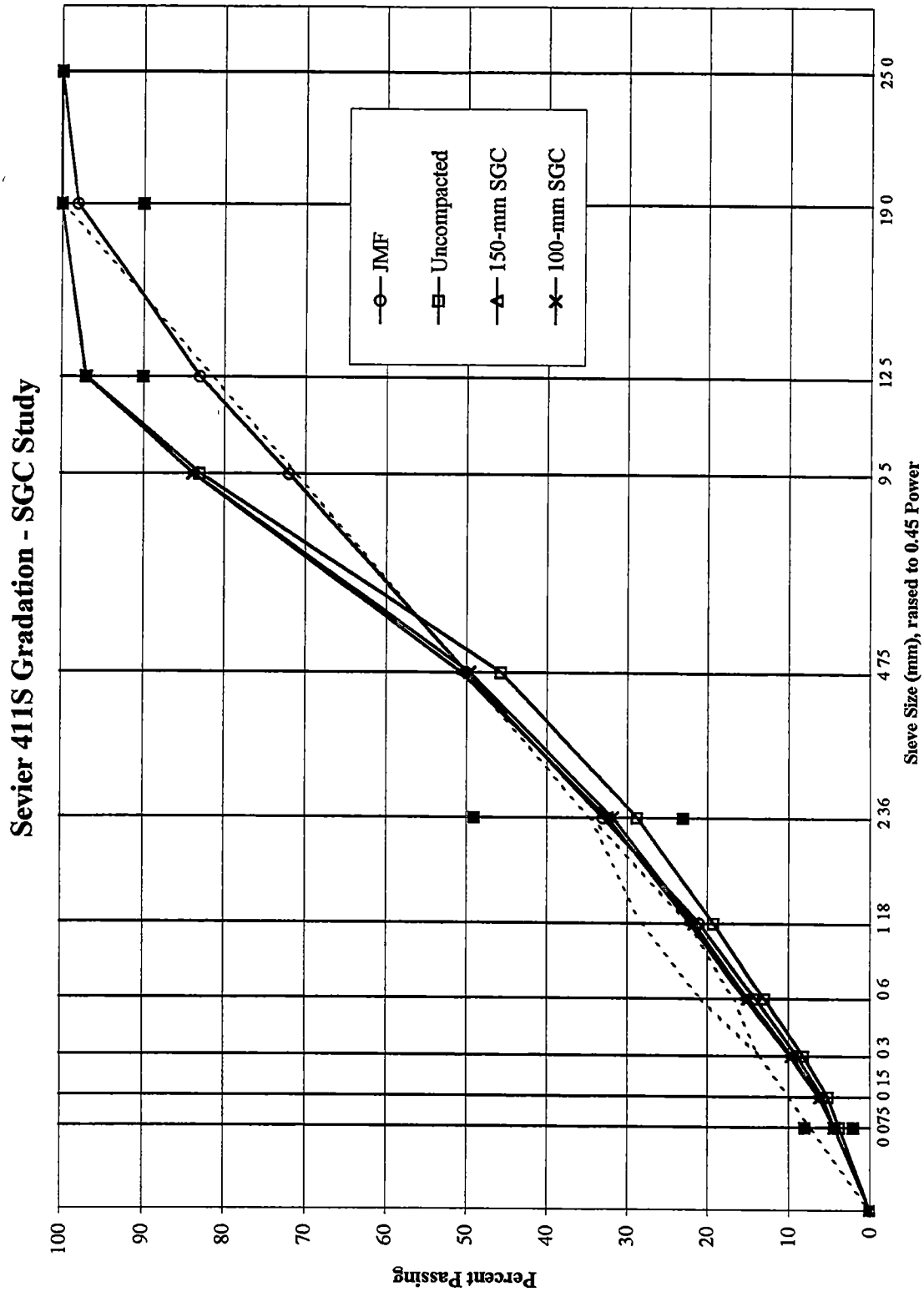
Gradation Comparison Sheet

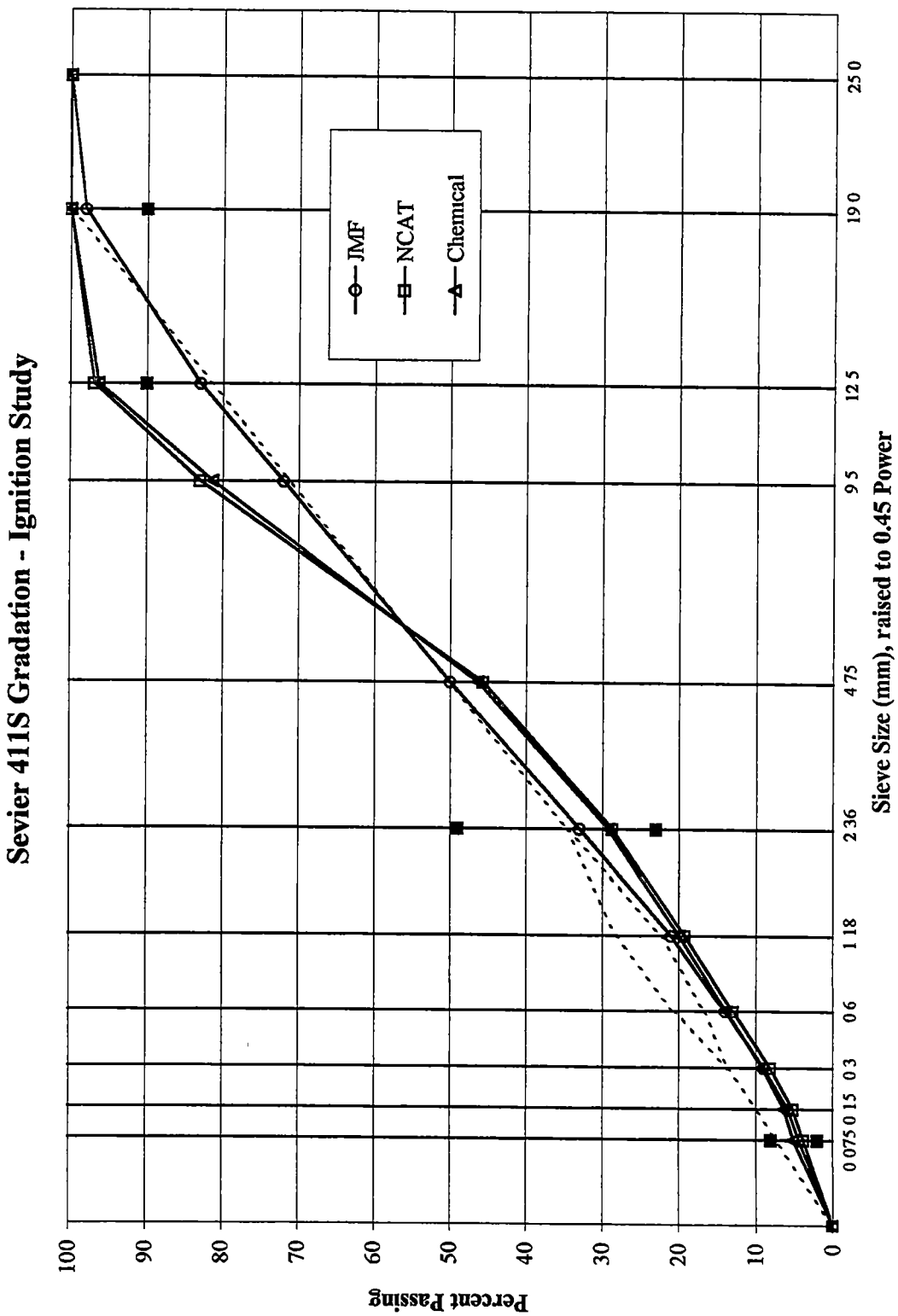
Aggregate Degradation
University of Tennessee, Knoxville

County: Sevier
Mix Type: 411 S
Project Number: 78018-4207-04(5398)
Contractor: Charles Blalock & Sons

	JMF	Chemical Extraction	Uncompacted (NCAT)	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0	100 0
19 mm (3/4")	98	100 0	100 0	100 0	100 0
12 5 mm (1/2")	83	96 3	96 9	97 0	96 9
9 5 mm (3/8")	72	81 3	83 0	83 9	83 9
4 75 mm (#4)	50	46 3	45 7	50 7	49 6
2 36 mm (#8)	33	29 2	28 8	32 5	31 9
1 18 mm (#16)	21	19 9	19 2	22 1	21 7
0 6 mm (#30)	14	13 8	13 0	15 2	14 9
0 3 mm (#50)	9	9 2	8 2	9 8	9 6
0 15 mm (#100)	6	6 3	5 2	6 3	6 2
0 075 mm (#200)	4	5 1	3 8	4 4	4 4

Asphalt Content	5 00%	5 40%	5 32%	5 54%	5 33%
% Dust	4 40%	5 13%	3 80%	4 42%	4 40%


Sevier 411S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), raised to 0.45 Power


Sevier 411S Gradation - Ignition Study
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.075
0.15
0.3
0.6
1.18
2.36
4.75
9.5
12.5
19.0
25.0
Sieve Size (mm), raised to 0.45 Power
JMF
NCAT
Chemical

Appendix A

Project Summary

County:	**Shelby**
Mix Type:	**411 S**
TDOT Project No.:	**79020-4242-04**
Contract No.:	**5149**

Appendix A **Project Summary**

STATE OF TENNESSEE ASPHALT JOB MIX FORMULA

Date 7/13/98

Project Ref No		County Shelby		Region	IV
Proj No	79020-4242-04	Layer	Surface	Contract No	5149
Type	ASCS-HM	Sec No	411-S	Article	01 01-01 02
Contractor	Lehman-Roberts Co		Subcontractor	Lehman-Roberts Co	
State Rt	Lamar	**TOTAL MIX INCLUDING BITUMEN**		Date of Letting	1/26/98

MATERIAL	Size Range or Type	PRODUCER AND ADDRESS	% USED
5/8 Cr Gravel	5/8" - #200	Memphis Stone & Gravel pit#534	56 34
#10 Limestone	3/8" - #200	Vulcan Materials pit#457	15 96
Mfg Sand	3/8" - #200	Memphis Stone & Gravel pit#534	15 96
Ag Lime	3/8" - #200	Vulcan Materials pit#457	5 63
Asphalt Cement	PG76-22	Ergon Petroleum Poly Blend	6 10
Anti-Strip	TYPE Morelife	DOSAGE RATE 0 30%	

% Fractured Faces on +4 Material 88 9 % Glassy Particles on +4 Material N/A 100

SCREEN	Ttl Passing Design Range	Requested Percent	Tolerance Percent	%	5/8" Cr Gravel %	#10 Limestone %	Mfg Sand %	Ag Lime %	Calculated Mix
		Percent		0 0	60 0	17 0	17 0	6 0	100 0
Temp	320-360				NCAT Furnace Corr Factor				
%A C		6 1			**LOI:** 9 2				
Compaction Temp		345			**Theo:** 2 341				
Mixing Temp		355							
25 0		100 0			100 0	100 0	100 0	100 0	100 0
19 0		100 0			100 0	100 0	100 0	100 0	100 0
12 5	90-100	95 0			92 0	100 0	100 0	100 0	95 2
9 5		86 0			77 0	100 0	99 0	100 0	86 0
4 8		60 0			42 0	91 0	81 0	99 0	60 4
2 36	28-58	36 0			23 0	60 0	37 0	97 0	36 1
1 18		26 0			18 0	36 0	21 0	85 0	25 6
0 600		18 0			13 0	22 0	9 5	73 0	17 5
0 300		13 0			9 0	16 0	7 4	56 0	12 7
0 425		8 9			6 0	11 5	5 8	40 0	8 9
0 075	2-10	6 3			4 0	9 7	3 1	28 0	6 3

Requested _____ Approved _____
Region Materials Engineer

Approved _____ Approved _____
Contractor Region Construction Engineer

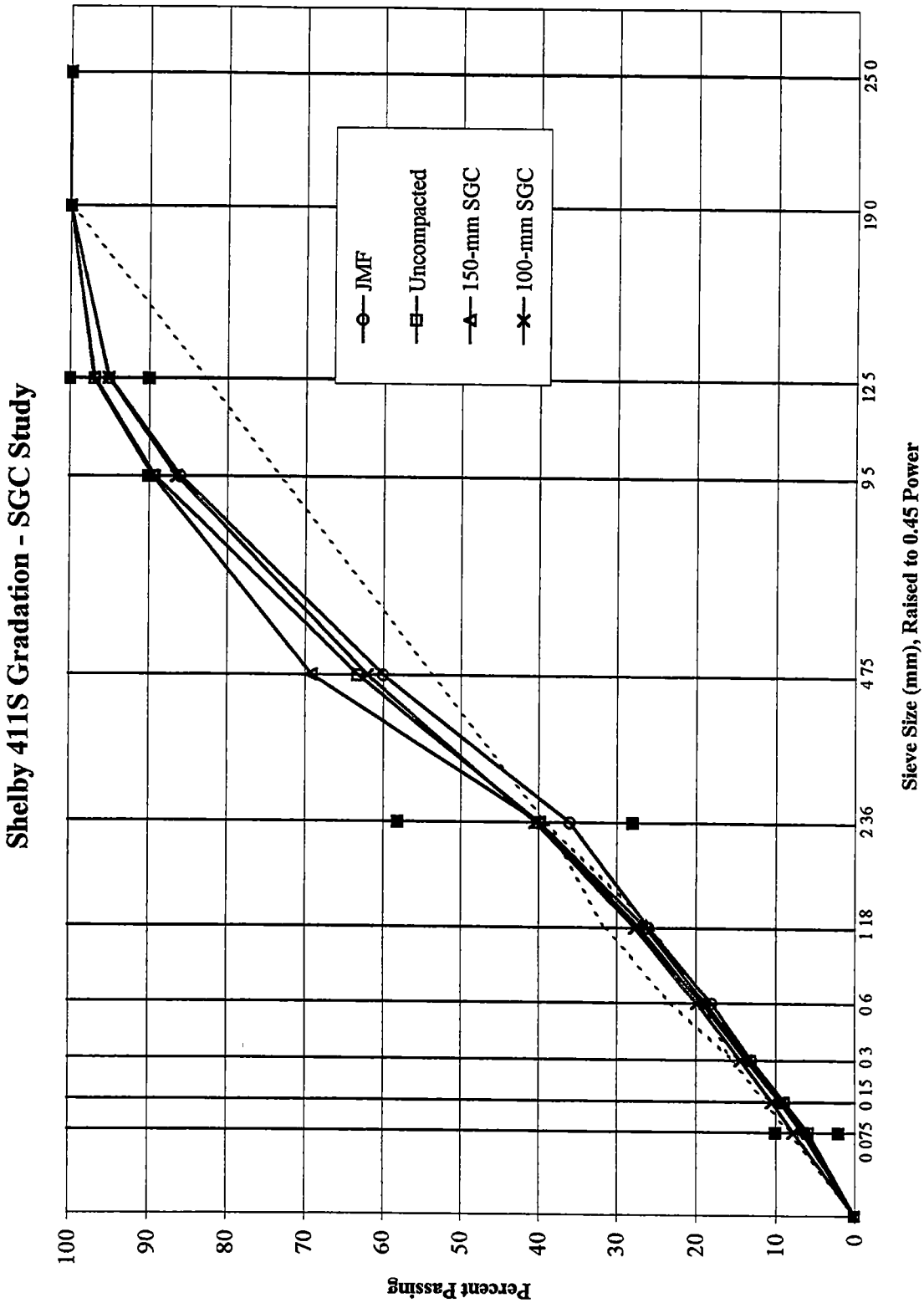
Gradation Comparison Sheet

Aggregate Degradation
University of Tennessee, Knoxville

County: Shelby
Mix Type: 411 S
Project Number: 79020-4242-04(5149)
Contractor: Lehman-Roberts Co

	JMF	Uncompacted	6" Nmax Pills	4" Nmax Pills
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
25 mm (1")	100	100 0	100 0	100 0
19 mm (3/4")	100	100 0	100 0	100 0
12 5 mm (1/2")	95	96 8	97 0	95 0
9 5 mm (3/8")	86	89 2	89 6	86 5
4 75 mm (#4)	60	63 2	69 1	62 0
2 36 mm (#8)	36	40 0	39 9	40 4
1 18 mm (#16)	26	26 3	27 2	27 7
0 6 mm (#30)	18	18 8	19 2	19 8
0 3 mm (#50)	13	13 2	13 6	14 4
0 15 mm (#100)	9	9 0	9 5	10 5
0 075 mm (#200)	6	6 0	6 7	7 8

Asphalt Content	6 10%	6 19%	6 09%	5 97%
% Dust	6 30%	5 96%	6 70%	7 81%


Shelby 411S Gradation - SGC Study
JMF
Uncompacted
150-mm SGC
100-mm SGC
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 075
0 15
0 3
0 6
1 18
2 36
4 75
9 5
12 5
19 0
25 0
Sieve Size (mm), Raised to 0.45 Power

APPENDIX B

Statistical Analysis Results

Aggregate Degradation Due to Laboratory Compaction using the Superpave Gyratory Compactor (SGC)

Aggregate Degradation
Data Analysis
All Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0500	0 6879	99 5	0 9
19 mm (3/4")	0 3694	0 0441	97 3	0 9
12 5 mm (1/2")	0 3677	0 1925	89 3	2 3
9 5 mm (3/8")	1 2935	0 0004	77 9	6 4
4 75 mm (# 4)	1 7823	<0 0001	51 7	2 4
2 36 mm (# 8)	1 6081	<0 0001	36	2 4
1 18 mm (#16)	1 4694	<0 0001	26 9	2 4
0 6 mm (# 30)	1 1887	<0 0001	20 2	2 4 or 1 5
0 30 mm (# 50)	0 9726	<0 0001	11 4	1 0
0 15 mm (# 100)	0 7339	<0 0001	6 8	1 1
0 075 mm (# 200)	0 4338	0 0001	4 8	1 1

62 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Mixes
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 3688	0 1308	99 2	0 9
19 mm (3/4")	0 7313	0 0516	97 3	0 9
12 5 mm (1/2")	0 7188	0 1430	90 3	2 3
9 5 mm (3/8")	1 4375	0 0258	80 4	3 8 or 6 4
4 75 mm (# 4)	0 9125	0 1350	59 8	2 4
2 36 mm (# 8)	0 6563	0 0896	45 0	2 4
1 18 mm (#16)	0 7188	0 0304	35 9	2 4
0 6 mm (# 30)	0 4625	0 2575	27 1	2 4
0.30 mm (# 50)	0 7750	<0 0001	13 9	1 0
0 15 mm (# 100)	0 4875	0 0084	7 4	1 1
0 075 mm (# 200)	0 1813	0 4155	5 1	1 1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Mixes
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0063	0 9750	99 6	0 9
19 mm (3/4")	0 3563	0 2340	97 7	0 9
12 5 mm (1/2")	0 2063	0 6545	90 4	2 3
9 5 mm (3/8")	1 0250	0 0764	78 9	6 4
4 75 mm (# 4)	2 3875	0 0001	49 8	2 4
2.36 mm (# 8)	2 3000	<0 0001	32 2	2 4
1 18 mm (#16)	2 1000	<0 0001	22 4	2 4
0 6 mm (# 30)	1 4875	<0 0001	17 0	1 5
0 30 mm (# 50)	0 9969	<0 0001	10 5	1 0
0 15 mm (# 100)	0 9875	<0 0001	6 8	1 1
0 075 mm (# 200)	0 6531	0 0003	5 0	1 1

32 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Mixes
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 2143	0 1658	99 4	0 9
19 mm (3/4")	-0 0129	0 9929	96 5	0 9
12 5 mm (1/2")	1 7429	0 0049	85 6	2 3 or 3 8
9.5 mm (3/8")	0 3357	0 4452	72 6	6 4
4 75 mm (# 4)	1 3929	0 0287	47 3	2 4
2 36 mm (# 8)	1 1143	0 0311	34 6	2 4
1 18 mm (#16)	0 8857	0 0298	27 0	2 4
0 6 mm (# 30)	0 8071	0 0369	19 8	1 5 or 2 4
0 30 mm (# 50)	0 0757	0 0009	10 9	1 0
0 15 mm (# 100)	0 4357	0 0003	6 0	1 1
0 075 mm (# 200)	0 2214	0 0159	4 3	1 1

14 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0775	0 6869	99 3	0 9
19 mm (3/4")	0 4000	0 1218	96 8	0 9
12 5 mm (1/2")	0 4250	0 3033	86 9	2 3
9 5 mm (3/8")	1 5150	0 0040	74 8	6 4
4 75 mm (# 4)	1 8750	0 0006	50 4	2 4
2.36 mm (# 8)	1 6050	0 0001	35 9	2 4
1.18 mm (#16)	1 4200	<0 0001	27 3	2 4
0 6 mm (# 30)	1 1225	0 0002	20 4	2 4 or 1 5
0 30 mm (# 50)	0 9675	<0 0001	11 3	1 0
0 15 mm (# 100)	0 7050	<0 0001	6 7	1 1
0 075 mm (# 200)	0 3925	0 0102	4 9	1 1

40 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
Limestone Mixes
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0417	0 4350	99 9	0 9
19 mm (3/4")	0 2167	0 5250	98 2	0 9
12 5 mm (1/2")	0 7833	0.2067	89 2	2 3
9.5 mm (3/8")	2 0583	0 0303	78 2	6 4
4 75 mm (# 4)	1 4917	0 1777	55 7	2 4
2 36 mm (# 8)	1 3167	0 1957	41 3	2 4
1 18 mm (#16)	1 0833	0 1625	33 1	2 4
0 6 mm (# 30)	0 3917	0 3399	22 4	2 4
0 30 mm (# 50)	1 0417	0 006	12 4	1 0
0 15 mm (# 100)	0 8250	0 0157	7 2	1 1
0.075 mm (# 200)	0 5333	0 1174	5 3	1 1

12 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
Limestone Mixes
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0.2667	0.5252	98.7	0.9
19 mm (3/4")	0.7833	0.1357	95.2	0.9
12.5 mm (1/2")	0.2889	0.7128	85.7	2.3 or 3.8
9.5 mm (3/8")	1.1000	0.2321	73.8	6.4
4.75 mm (# 4)	2.2111	0.0106	49.0	2.4
2.36 mm (# 8)	2.0778	0.0001	33.6	2.4
1.18 mm (#16)	1.9778	<0.0001	23.8	2.4
0.6 mm (# 30)	1.4222	0.0046	20.2	1.5 or 2.3
0.30 mm (# 50)	1.0389	<0.0001	10.6	1.0
0.15 mm (# 100)	0.8389	0.0028	6.7	1.1
0.075 mm (# 200)	0.4667	0.0751	5.0	1.1

18 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
Limestone Mixes
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 2200	0 2744	99 7	0 9
19 mm (3/4")	-0 0700	0 7344	98 1	0 9
12 5 mm (1/2")	0 2400	0 6845	86 3	2 3
9 5 mm (3/8")	1 6100	0 0467	72 7	6 4
4.75 mm (# 4)	1 6600	0 0622	46 4	2 4
2 36 mm (# 8)	1 1000	0 1124	33 9	2 4
1 18 mm (#16)	0 8200	0 1219	26 7	2 4
0 6 mm (# 30)	1 4600	0 0244	18 6	1 5
0 30 mm (# 50)	0 6900	0 0140	11 0	1 0
0 15 mm (# 100)	0 3200	0 0020	6 1	1 1
0 075 mm (# 200)	0 0900	0 0811	4 4	1 1

10 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0000	1 0000	99 7	0 9
19 mm (3/4")	0 3450	0 1681	98 0	0 9
12.5 mm (1/2")	0 4000	0 1716	93 5	2 3
9 5 mm (3/8")	0 9850	0 0182	83 7	3 8
4 75 mm (# 4)	1 7000	0 0006	54 8	2 4
2 36 mm (# 8)	1 5600	<0 0001	36 9	2 4
1 18 mm (#16)	1 5800	<0 0001	26 6	2 4
0 6 mm (# 30)	1 3150	<0 0001	20 0	2 4 or 1 5
0 30 mm (# 50)	0 9800	<0 0001	11 9	1 0
0 15 mm (# 100)	0 7900	0 0002	7 0	1 1
0 075 mm (# 200)	0 5200	0 0019	4 7	1 1

20 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
River Gravel Mixes
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")			100 0	0 9
12 5 mm (1/2")	0 1750	0 0689	96 9	0 9
9 5 mm (3/8")	0 6000	0 4437	87 9	2 3
4.75 mm (# 4)	1 1500	0 0957	66 9	1 6
2.36 mm (# 8)	1 3500	0 0265	46.6	2 4
1.18 mm (#16)	1 5750	0 0080	34 5	2 4
0 6 mm (# 30)	0 7750	0 0600	27 1	2 4
0 30 mm (# 50)	0 8250	0 0082	15 9	1 0
0 15 mm (# 100)	0 2250	0 4594	7 6	1 1
0 075 mm (# 200)	-0 1000	0 8668	5 0	1 1

4 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
River Gravel Mixes
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0.0667	0.1661	100.0	0.9
19 mm (3/4")	0.5333	0.2064	99.2	0.9
12.5 mm (1/2")	0.4167	0.3715	95.6	0.9 or 2.3
9.5 mm (3/8")	0.7500	0.1993	86.1	2.3
4.75 mm (# 4)	2.2083	0.0051	52.5	2.4
2.36 mm (# 8)	1.7667	0.0006	33.7	2.4
1.18 mm (#16)	1.7583	<0.0001	23.6	2.4
0.6 mm (# 30)	1.5167	<0.0001	17.8	1.5
0.30 mm (# 50)	1.0500	<0.0001	11.1	1.0
0.15 mm (# 100)	1.0000	0.0018	7.2	1.1
0.075 mm (# 200)	0.7167	<0.0001	4.8	1.1

12 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
River Gravel Mixes
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 2000	0 4564	98 8	0 9
19 mm (3/4")	0 1250	0 2783	92 7	2 3
12.5 mm (1/2")	0 5750	0 3559	83 8	3 8
9 5 mm (3/8")	2 0750	0 0351	72 7	6 4
4 75 mm (# 4)	0 7250	0 0952	49 4	2 4
2 36 mm (# 8)	1 1500	0 1241	36 5	2 4
1 18 mm (#16)	1 0500	0 1303	27 8	2 4
0.6 mm (# 30)	1 2500	0 1474	19 4	1 5 or 2 4
0 30 mm (# 50)	0 9250	0 0460	10 7	1 0
0 15 mm (# 100)	0 7250	0 0330	6 0	1 1
0 075 mm (# 200)	0 5500	0 0520	4 2	1 1

4 Sample Pairs

* Falls out of Precision Range

Aggregate Degradation
Data Analysis
All 411 Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0000		100 0	0 9
19 mm (3/4")	-0 0063	0 3251	100 0	0 9
12 5 mm (1/2")	0 0938	0 5551	96 5	0 9
9 5 mm (3/8")	1 3375	0 0001	84 9	3 8 or 6 4
4 75 mm (# 4)	1 8000	<0 0001	56 6	2 4
2 36 mm (# 8)	1 5125	<0 0001	39 0	2 4
1 18 mm (#16)	1 4351	<0 0001	28 9	2 4
0 6 mm (# 30)	1 0844	<0 0001	21 6	2 4
0 30 mm (# 50)	1 0031	<0 0001	11 9	1 0
0 15 mm (# 100)	0 8656	<0 0001	6 9	1 1
0.075 mm (# 200)	0 5969	0 0018	4 8	1 1

32 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
411 Mixes
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")			100 0	0 9
12 5 mm (1/2")	0 4700	0 0292	96 8	0 9
9 5 mm (3/8")	1 4100	0 0305	86 8	2 3
4 75 mm (# 4)	0 9200	0 2366	65 0	1 6
2 36 mm (# 8)	0 6200	0 1720	47 5	2 4
1 18 mm (#16)	0 7600	0 0706	36 8	2 4
0 6 mm (# 30)	0 0600	0 8892	28 3	2 4
0 30 mm (# 50)	0 7500	0 0001	14 0	1 0
0 15 mm (# 100)	0 4600	0 0896	7 3	1 1
0 075 mm (# 200)	0 0200	0 9517	5 0	1 1

10 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
411 Mixes
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")	-0 0125	0 3332	100 0	0 9
12 5 mm (1/2")	-0 1063	0 6174	96 9	0 9
9 5 mm (3/8")	0 9375	0 0652	85 3	2 3 or 3 8
4 75 mm (# 4)	2.3188	0 0003	52 5	2 4
2 36 mm (# 8)	1 9313	<0 0001	33 9	2 4
1 18 mm (#16)	1 8688	<0 0001	23 9	2 4
0 6 mm (# 30)	1 4625	<0 0001	18 1	1 5
0 30 mm (# 50)	1 0000	<0 0001	11 0	1 0
0 15 mm (# 100)	1 2000	0 0001	7 0	1 1
0 075 mm (# 200)	1 0375	0 0006	5 0	1 1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
411 Mixes
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100.0	0.9
19 mm (3/4")			100.0	0.9
12.5 mm (1/2")	0.0000	1.0000	94.5	0.9 or 2.3
9.5 mm (3/8")	2.2833	0.0018	80.1	3.8 or 6.4
4.75 mm (# 4)	1.8800	0.0415	53.6	2.4
2.36 mm (# 8)	1.8833	0.0128	28.4	2.4
1.18 mm (#16)	1.5000	0.0163	29.2	2.4
0.6 mm (# 30)	1.4667	0.0368	19.6	1.5 or 2.4
0.30 mm (# 50)	1.1167	0.0008	10.9	1.0
0.15 mm (# 100)	0.6500	0.0099	5.8	1.1
0.075 mm (# 200)	0.3833	0.0620	4.0	1.1

6 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
411 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")			100 0	0 9
12 5 mm (1/2")	0 2571	0 3527	95 4	0 9 or 2 3
9 5 mm (3/8")	2 3643	<0 0001	82 0	3 8
4 75 mm (# 4)	2 0429	0 0088	55 6	2 4
2 36 mm (# 8)	1 2286	0 0124	40 6	2 4
1 18 mm (#16)	1 0143	0 0106	31 8	2 4
0 6 mm (# 30)	0 7357	0 1365	23 9	2 4
0 30 mm (# 50)	0 9071	<0 0001	12 1	1 0
0 15 mm (# 100)	0 9643	0 0023	6 6	1 1
0 075 mm (# 200)	0 5714	0 0529	4 8	1 1

14 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
411 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100.0	0.9
19 mm (3/4")	-0.0125	0.3332	100.0	0.9
12.5 mm (1/2")	0.1000	0.5759	97.7	0.9
9.5 mm (3/8")	0.6125	0.1377	88.0	2.3
4.75 mm (# 4)	1.6750	0.0026	58.0	2.4
2.36 mm (# 8)	1.6063	<0.0001	38.6	2.4
1.18 mm (#16)	1.7000	<0.0001	27.3	2.4
0.6 mm (# 30)	1.3688	<0.0001	20.2	2.4
0.30 mm (# 50)	0.9688	<0.0001	12.2	1.0
0.15 mm (# 100)	0.7938	0.0017	7.1	1.1
0.075 mm (# 200)	0.6438	0.0290	4.8	1.1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All 307 Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 1033	0 6917	98 9	0 9
19 mm (3/4")	0 7700	0 0410	94 4	0 9 or 2 3
12 5 mm (1/2")	0 6667	0 2360	81 7	3 8
9 5 mm (3/8")	1 2567	0 5710	70 5	3 7
4 75 mm (# 4)	1 5267	0 0083	46 9	2 4
2 36 mm (# 8)	1 4700	0 0004	33 2	2 4
1 18 mm (#16)	1 3167	<0 0001	24 9	2 4
0 6 mm (# 30)	1 2033	0 0001	18 8	1 5
0 30 mm (# 50)	0 8433	<0 0001	11 0	1 0
0 15 mm (# 100)	0 5933	0 0003	6 7	1 1
0 075 mm (# 200)	0 3300	0 0368	4 9	1 1

30 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
307 Mixes
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 9833	0 1351	97 9	0 9
19 mm (3/4")	1 9500	0 0375	92 8	2 3
12.5 mm (1/2")	1 1333	0 4081	78 3	6 4
9.5 mm (3/8")	1 4833	0 3185	69 8	6 4
4 75 mm (# 4)	0 9000	0 4281	51 3	2 4
2 36 mm (# 8)	0 7167	0 3663	40 8	2 4
1 18 mm (#16)	0 6500	0 2956	34 5	2 4
0 6 mm (# 30)	1 1333	0 1920	25 0	2 4
0 30 mm (# 50)	0 8167	0 0160	13 7	1 0
0 15 mm (# 100)	0 5333	0 0282	7 6	1 1
0 075 mm (# 200)	0 4500	0 0791	5 5	1 1

6 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
307 Mixes
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0.0125	0.9756	99.1	0.9
19 mm (3/4")	0.7250	0.2314	95.4	0.9 or 2.3
12.5 mm (1/2")	0.5313	0.5616	83.8	2.3
9.5 mm (3/8")	1.3125	0.2891	72.6	6.4
4.75 mm (# 4)	2.0125	0.0305	47.4	2.4
2.36 mm (# 8)	2.2188	0.0004	30.8	2.4
1.18 mm (#16)	2.0125	<0.0001	21.0	2.4
0.6 mm (# 30)	1.4222	0.0046	15.8	1.5
0.30 mm (# 50)	1.0313	0.0020	10.0	1.0
0.15 mm (# 100)	0.7750	0.0093	6.6	1.1
0.075 mm (# 200)	0.4000	0.1628	4.9	1.1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
307 Mixes
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 3750	0 1716	99 0	0 9
19 mm (3/4")	-0 0250	0 9264	93 9	2 3
12 5 mm (1/2")	0 5875	0 3887	78 9	6 4
9.5 mm (3/8")	1 3375	0 1623	66 5	1 6
4 75 mm (# 4)	1 0250	0 2726	42 5	2 4
2 36 mm (# 8)	0 5375	0 4483	31 8	2 4
1 18 mm (#16)	0 4250	0 4341	25 4	2 4
0 6 mm (# 30)	0 3125	0 4680	20 1	1 5 or 2 4
0 30 mm (# 50)	0 4875	0 0985	10 9	1 0
0 15 mm (# 100)	0 2750	0 0012	6 3	1 1
0 075 mm (# 200)	0 1000	0 0676	4 6	1 1

8 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
307 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 1192	0 6899	98 9	0 9
19 mm (3/4")	0 6154	0 1225	95 1	0 9 or 2 3
12 5 mm (1/2")	0 5154	0 4095	82 4	3 8
9 5 mm (3/8")	1 0577	0 1547	71 0	6 4
4 75 mm (# 4)	1 7577	0 0161	47 5	2 4
2.36 mm (# 8)	1 8077	0 0022	33 4	2 4
1 18 mm (#16)	1 5923	0 0003	24 9	2 4
0.6 mm (# 30)	1 3308	0 0005	18 7	1 5
0.30 mm (# 50)	1 0038	<0 0001	10 8	1 0
0 15 mm (# 100)	0 5654	0 0022	6 7	1 1
0 075 mm (# 200)	0 2962	0 0971	5 0	1 1

26 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
307 River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0000	1 0000	98 7	0 9
19 mm (3/4")	1 7750	0 1710	90 1	2 3
12 5 mm (1/2")	1 6500	0 2272	77 2	6 4
9 5 mm (3/8")	2 5500	0 0251	67 0	6 4
4 75 mm (# 4)	2 0250	0 0945	41 9	2 4
2 36 mm (# 8)	1 7250	0 1396	30 0	2 4
1 18 mm (#16)	1 5250	0 1438	23 8	2 4
0 6 mm (# 30)	1 5750	0.1516	19 3	1 5 or 2 4
0 30 mm (# 50)	1 0250	0 0560	11 3	1 0
0 15 mm (# 100)	0 7750	0 0394	6 9	1 1
0 075 mm (# 200)	0 5500	0 0520	4 5	1 1

4 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 1065	0 3783	99 6	0 9
19 mm (3/4")	0 2484	0 2347	97 6	0 9
12 5 mm (1/2")	0 6161	0 0657	90 0	2 3
9 5 mm (3/8")	1 3903	0 0027	78 4	6 4
4 75 mm (# 4)	1 6290	0 0008	52 0	2 4
2 36 mm (# 8)	1 4194	<0 0000	36 2	2 4
1 18 mm (#16)	1 3645	<0 0001	27 0	2 4
0 6 mm (# 30)	1 1226	0 0001	20 1	2 4 or 1 5
0 30 mm (# 50)	0 8839	<0 0001	11 5	1 0
0 15 mm (# 100)	0 6903	<0 0001	6 8	1 1
0 075 mm (# 200)	0 4129	0 0102	4 8	1 1

31 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 3250	0 3703	99 2	0 9
19 mm (3/4")	0 6125	0.2104	97 2	0 9
12 5 mm (1/2")	0 7250	0 0797	90 3	2 3
9 5 mm (3/8")	1 6750	0 0224	80.5	3 8 or 6 4
4 75 mm (# 4)	0 9000	0 3183	59 8	1 6 or 2 4
2 36 mm (# 8)	0 6500	0 2339	44 9	2 4
1 18 mm (#16)	0 7250	0 1392	35 9	2 4
0 6 mm (# 30)	0 5500	0 4858	26 1	2 4
0 30 mm (# 50)	0 6750	0 0044	13 9	1 0
0 15 mm (# 100)	0 4000	0 2029	7 3	1 1
0 075 mm (# 200)	0 1250	0 7584	5 1	1 1

8 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 1563	0 1250	99 7	0 9
19 mm (3/4")	0 2688	0 3955	97 7	0 9
12 5 mm (1/2")	0 5375	0 3429	90 6	2 3
9 5 mm (3/8")	1 1188	0 1426	79 0	3 8 or 6 4
4 75 mm (# 4)	2 1625	0 0042	50 2	2 4
2 36 mm (# 8)	1 9250	<0 0001	32 5	2 4
1 18 mm (#16)	1 8625	<0 0001	22 6	2 4
0 6 mm (# 30)	1 5000	<0 0001	17 6	1 5
0 30 mm (# 50)	1 0313	<0 0001	10 5	1 0 or 1 1
0 15 mm (# 100)	0 9250	0 0005	6 8	1 1
0 075 mm (# 200)	0 6735	0 0073	4 9	1 1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 2571	0 3845	99 3	0 9
19 mm (3/4")	-0 2143	0 4343	96 4	0 9
12 5 mm (1/2")	0 6714	0 3081	85 8	2 3 or 3 8
9 5 mm (3/8")	1 6857	0 0558	72 7	6 4
4 75 mm (# 4)	1 2429	0 1744	47 2	2 4
2 36 mm (# 8)	1 1429	0 1433	34 6	2 4
1 18 mm (#16)	0 9571	0 1238	27 0	2 4
0 6 mm (# 30)	1 0143	0 1244	18 7	15 0
0 30 mm (# 50)	0 7857	0 0284	10 9	1 0
0 15 mm (# 100)	0 4857	0 0085	6 1	1 1
0 075 mm (# 200)	0 2286	0 1168	4 3	1 1

7 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 1400	0 4578	99 3	0 9
19 mm (3/4")	0 2650	0 3900	96 8	0 9
12 5 mm (1/2")	0 6850	0 1542	87 1	2 3
9 5 mm (3/8")	1 6650	0 0139	74 8	6 4
4 75 mm (# 4)	1 8250	0 0188	80 3	2 4
2 36 mm (# 8)	1 6650	0 0067	36 0	2 4
1 18 mm (#16)	1 4650	0 0019	27 4	2 4
0 6 mm (# 30)	1 2850	0 0098	20 2	1 5 or 2 4
0 30 mm (# 50)	0 9950	<0 0001	11 3	1 0
0 15 mm (# 100)	0 7050	0 0026	6 7	1 1
0 075 mm (# 200)	0 3850	0 0842	4 9	1 1

20 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0500	0 2443	99 8	0 9
19 mm (3/4")	0.2400	0 3092	97 9	0 9
12 5 mm (1/2")	0 5800	0 1845	93 6	2 3
9 5 mm (3/8")	0 9800	0 0614	83 7	3 8
4 75 mm (# 4)	2 0300	0 0138	54 9	2 4
2 36 mm (# 8)	1 5700	0 0033	36 9	2 4
1 18 mm (#16)	1 6000	0 0001	26 6	2 4
0 6 mm (# 30)	1 3500	0 0010	20 1	1 5 or 2 4
0 30 mm (# 50)	0 9400	0 0002	11 9	1 0
0 15 mm (# 100)	0 6400	0 0019	6 9	1 1
0 075 mm (# 200)	0 4600	0 0586	4 7	1 1

10 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
411 Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0000		100 0	0 9
19 mm (3/4")	-0 0125	0 3332	100 0	0 9
12 5 mm (1/2")	0 2063	0 1973	96 5	0 9
9 5 mm (3/8")	1 2688	0 0098	85 0	2 3 or 3 8
4 75 mm (# 4)	1 8438	0 0086	56 6	2 4
2 36 mm (# 8)	1 3625	0 0018	38 9	2 4
1.18 mm (#16)	1 3438	0 0002	28 9	2 4
0 6 mm (# 30)	1 0688	0 0137	21 4	2 4
0 30 mm (# 50)	0 9188	<0 0001	11 9	1 0
0 15 mm (# 100)	1 0250	<0 0001	6 8	1 1
0 075 mm (# 200)	0 7625	0 0009	4 8	1 1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
411 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")			100 0	0 9
12 5 mm (1/2")	0 3714	0 2536	95 4	0 9 or 2 3
9 5 mm (3/8")	2 3000	0 0164	82 0	3 8
4 75 mm (# 4)	1 6714	0 1822	55 5	2 4
2 36 mm (# 8)	1.0571	0 1648	40 6	2 4
1 18 mm (#16)	0 9286	0 1435	31 8	2 4
0 6 mm (# 30)	0 6857	0 4304	23 2	2 4
0 30 mm (# 50)	0 9000	0 0017	12 1	1 0
0 15 mm (# 100)	0 9286	0 0490	6 6	1 1
0 075 mm (# 200)	0 6000	0 2102	4 8	1 1

7 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
411 River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")	-0 0250	0 3506	100 0	0 9
12 5 mm (1/2")	0 1375	0 4099	97 7	0 9
9 5 mm (3/8")	0 5250	0 2612	87 9	2 3
4 75 mm (# 4)	2 0250	0 0419	58 2	2 4
2 36 mm (# 8)	1 4875	0 0107	38 6	2 4
1 18 mm (#16)	1 5875	0 0003	27 3	2 4
0 6 mm (# 30)	1 3500	0 0039	20 4	1 5 or 2 4
0 30 mm (# 50)	0 9000	0 0009	12 1	1 0
0 15 mm (# 100)	0 6000	0 0111	7 0	1 1
0 075 mm (# 200)	0 4375	0 1421	4 7	1 1

8 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
307 Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0.2200	0.3880	98.9	0.9
19 mm (3/4")	0.5267	0.2285	74.3	0.9
12.5 mm (1/2")	1.0533	0.1212	81.9	3.8
9.5 mm (3/8")	1.5200	0.0669	70.6	6.4
4.75 mm (# 4)	1.9266	0.0348	46.8	2.4
2.36 mm (# 8)	1.9800	0.0106	33.0	2.4
1.18 mm (#16)	1.7400	0.0031	24.8	2.4
0.6 mm (# 30)	1.2533	0.0035	19.7	1.5
0.30 mm (# 50)	1.0533	0.0012	11.0	1.0
0.15 mm (# 100)	0.6133	0.0119	6.7	1.1
0.075 mm (# 200)	0.3067	0.1617	4.9	1.1

15 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
307 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0.2417	0.4515	98.9	0.9
19 mm (3/4")	0.5000	0.3346	94.8	0.9 or 2.3
12.5 mm (1/2")	1.2083	0.0922	82.0	3.8
9.5 mm (3/8")	1.7667	0.0535	70.3	6.4
4.75 mm (# 4)	2.3000	0.0320	16.9	2.4
2.36 mm (# 8)	2.2000	0.0189	33.4	2.4
1.18 mm (#16)	1.8250	0.0105	25.2	2.4
0.6 mm (# 30)	1.3083	0.0114	20.1	1.5 or 2.4
0.30 mm (# 50)	1.1583	0.0025	10.9	1.0
0.15 mm (# 100)	0.7000	0.0118	6.7	1.1
0.075 mm (# 200)	0.3750	0.1328	4.8	1.1

12 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
150-mm (6-in) Diam. SGC Compacted Specimens
307 River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 1333	0 4557	99 2	0 9
19 mm (3/4")	0 6333	0 5318	92 6	2 3
12 5 mm (1/2")	0 4333	0 8583	81 3	3 8
9 5 mm (3/8")	0 5333	0 8367	71 4	6 4
4 75 mm (# 4)	0 4333	0 8273	46 7	2 4
2 36 mm (# 8)	1 1000	0 4216	31 7	2 4
1 18 mm (#16)	1 4000	0 1872	23 2	2 4
0 6 mm (# 30)	1 0333	0 2189	17 7	1 5
0 30 mm (# 50)	0 6333	0 3677	11 1	1 0
0 15 mm (# 100)	0 2667	0 6813	7 2	1 1
0 075 mm (# 200)	0 0333	0 9561	5 0	1 1

3 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 0065	0 9767	99 4	0 9
19 mm (3/4")	0 4903	0 1095	97 4	0 9
12 5 mm (1/2")	0 1196	0 7956	89 2	2 3
9 5 mm (3/8")	1 1967	0 0362	77 9	6 4
4 75 mm (# 4)	1 4645	0 0018	51 9	2 4
2 36 mm (# 8)	1 3161	<0 0001	36 1	2 4
1 18 mm (#16)	1 2548	<0 0001	27 0	2 4
0 6 mm (# 30)	0 9387	<0 0001	20 4	1 5 or 2 4
0 30 mm (# 50)	0 8742	<0 0001	11 5	1 0
0 15 mm (# 100)	0 7129	<0 0001	6 8	1 1
0 075 mm (# 200)	0 4548	0 0042	4 9	1 1

31 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 4125	0 2581	99 2	0 9
19 mm (3/4")	0 8500	0 1713	97 4	0 9
12 5 mm (1/2")	0 7125	0 4523	90 3	2 3
9 5 mm (3/8")	1 2000	0 2906	80 3	3 8 or 6 4
4 75 mm (# 4)	0 9250	0 3143	59 8	1 6 or 2 4
2 36 mm (# 8)	0 5375	0 4199	44 9	2 4
1.18 mm (#16)	0 7125	0 1540	35 9	2 4
0 6 mm (# 30)	0 3750	0 2757	28 0	2 4
0 30 mm (# 50)	0 8750	0 0005	14 0	1 0
0 15 mm (# 100)	0 5750	0 0104	7 4	1 1
0 075 mm (# 200)	0 2375	0 3101	5 2	1 1

8 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 1438	0 7150	99 5	0 9
19 mm (3/4")	0 4438	0 3985	97 7	0 9
12 5 mm (1/2")	-0 0171	0 8078	89 0	2 3
9 5 mm (3/8")	0 9313	0 3048	78 9	6 4
4 75 mm (# 4)	1 6250	0 0187	49 9	2 4
2 36 mm (# 8)	1 7750	<0 0001	32 4	2 4
1 18 mm (#16)	1 6750	<0 0001	22 4	2 4
0 6 mm (# 30)	1 3750	0 0002	16 3	1 5
0 30 mm (# 50)	0 9125	0 0001	10 5	1 0
0 15 mm (# 100)	0 9250	0 0015	6 8	1 1
0 075 mm (# 200)	0 6688	0 0184	4 9	1 1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 1714	0 2308	99 5	0 9
19 mm (3/4")	0 1857	0 1424	96 6	0 9
12 5 mm (1/2")	0 0000	1 0000	85 4	2 3 or 3 8
9 5 mm (3/8")	1 8000	0 0662	72 7	6 4
4 75 mm (# 4)	1 5429	0 1212	47 4	2 4
2 36 mm (# 8)	1 0857	0 1608	34 6	2 4
1 18 mm (#16)	0 9000	0 1309	27 0	2 4
0 6 mm (# 30)	0 6000	0 2127	20 9	1 5 or 2 4
0 30 mm (# 50)	0 7286	0 0259	10 9	1 0
0 15 mm (# 100)	0 3857	0 0250	6 0	1 1
0 075 mm (# 200)	0 2143	0 0994	4 3	1 1

7 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0150	0 9652	99 2	0 9
19 mm (3/4")	0 5350	0 2099	96 9	0 9
12 5 mm (1/2")	0 1650	0 8106	86 8	2 3
9 5 mm (3/8")	1 3650	0 1007	74 7	6 4
4 75 mm (# 4)	1 8900	0 0152	59 4	2 4
2 36 mm (# 8)	1 4950	0 0120	35 9	2 4
1 18 mm (#16)	1 3150	0 0029	27 3	2 4
0 6 mm (# 30)	0 9600	0 0060	20 8	1 5 or 2 4
0 30 mm (# 50)	0 9400	<0 0001	11 3	1 0
0 15 mm (# 100)	0 7050	0 0024	6 7	1 1
0 075 mm (# 200)	0 4000	0 0663	4 9	1 1

20 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0.0500	0.6373	99.7	0.9
19 mm (3/4")	0.4500	0.3321	98.1	0.9
12.5 mm (1/2")	0.2200	0.6008	93.4	2.3
9.5 mm (3/8")	0.9900	0.1535	83.7	3.8
4.75 mm (# 4)	1.3700	0.0237	54.6	2.4
2.36 mm (# 8)	1.5500	0.0014	36.9	2.4
1.18 mm (#16)	1.6200	<0.0001	26.6	2.4
0.6 mm (# 30)	1.2800	0.0026	19.9	1.5 or 2.4
0.30 mm (# 50)	1.0200	<0.0001	11.9	1.0
0.15 mm (# 100)	0.7400	0.0008	7.0	1.1
0.075 mm (# 200)	0.5800	0.0194	4.7	1.1

10 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
411 Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0.0000		100.0	0.9
19 mm (3/4")	0.0000		100.0	0.9
12.5 mm (1/2")	-0.0188	0.9470	96.3	0.9
9.5 mm (3/8")	1.4063	0.0069	85.0	2.3 or 3.8
4.75 mm (# 4)	1.7563	0.0010	56.6	2.4
2.36 mm (# 8)	1.5250	0.0020	39.0	2.4
1.18 mm (#16)	1.4875	<0.0001	29.0	2.4
0.6 mm (# 30)	1.1000	0.0009	21.8	2.4
0.30 mm (# 50)	1.0875	<0.0001	12.1	1.0
0.15 mm (# 100)	0.9688	0.0012	6.9	1.1
0.075 mm (# 200)	0.6813	0.0264	4.9	1.1

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
411 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100 0	0 9
19 mm (3/4")			100 0	0 9
12 5 mm (1/2")	0 1429	0 7697	95 3	0 9 or 2 3
9.5 mm (3/8")	2 4286	0 0018	82 0	3 8
4 75 mm (# 4)	2 4143	0.0231	55 8	2 4
2 36 mm (# 8)	1 2571	0 1147	40 7	2 4
1 18 mm (#16)	1 1000	0 0470	31 9	2 4
0 6 mm (# 30)	0 7857	0 1827	24 5	2 4
0 30 mm (# 50)	0 9143	0 0008	12 1	1 0
0 15 mm (# 100)	1 0000	0 3600	6 6	1 1
0.075 mm (# 200)	0 5429	0 1814	4 8	1 1

7 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
411 River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")			100.0	0.9
19 mm (3/4")			100.0	0.9
12.5 mm (1/2")	0.0625	0.8533	97.6	0.9
9.5 mm (3/8")	0.7000	0.3398	85.0	2.3 or 3.8
4.75 mm (# 4)	1.3250	0.0262	57.9	2.4
2.36 mm (# 8)	1.7250	0.0002	38.7	2.4
1.18 mm (#16)	1.8125	0.0002	26.4	2.4
0.6 mm (# 30)	1.3875	0.0014	20.1	1.5 or 2.4
0.30 mm (# 50)	1.2750	0.0031	12.3	1.0
0.15 mm (# 100)	0.9875	0.0360	7.2	1.1
0.075 mm (# 200)	0.8500	0.1145	5.0	1.1

8 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
307 Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0 0133	0 9773	98 8	0 9
19 mm (3/4")	1 0133	0 1104	94 4	0 9
12 5 mm (1/2")	0 2800	0 7629	81 4	2 3
9 5 mm (3/8")	0 9933	0 3533	70 3	3 8
4 75 mm (# 4)	1 6600	0 0837	46 7	2 4
2 36 mm (# 8)	1 6600	0 0837	32 8	2 4
1 18 mm (#16)	1 4267	0 0124	24 6	2 4
0 6 mm (# 30)	1 1533	0 0108	18 9	1 5
0.30 mm (# 50)	0 9533	0 0020	10 9	1 0
0 15 mm (# 100)	0 5733	0 0158	6 7	1 1
0 075 mm (# 200)	0 3533	0 1401	4 9	1 1

15 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
307 Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	0 0231	0 9659	98 8	0 9
19 mm (3/4")	0 8231	0 2144	95 1	0 9 or 2 3
12 5 mm (1/2")	0 1769	0 8667	82 2	3 8
9 5 mm (3/8")	0 7923	0 5144	70 8	6 4
4 75 mm (# 4)	1 6077	0 1393	47 4	2 4
2 36 mm (# 8)	1 6230	0 0540	33 3	2 4
1 18 mm (#16)	1 4308	0 0234	24 7	2 4
0 6 mm (# 30)	1 0538	0 0216	18 8	1 5
0 30 mm (# 50)	0 9538	0 0054	10 8	1 0
0 15 mm (# 100)	0 5462	0 0392	6 7	1 1
0 075 mm (# 200)	0 3231	0 2343	5 0	1 1

13 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
100-mm (4-in) Diam. SGC Compacted Specimens
307 River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	ASTM C 136-95a Precision (d2s)
25 mm (1")	-0.0250	0.7662	98.6	0.9
19 mm (3/4")	2.2500	0.4855	90.4	2.3 or 3.8
12.5 mm (1/2")	0.9500	0.6980	76.8	6.4
9.5 mm (3/8")	2.3000	0.3481	66.9	6.4
4.75 mm (# 4)	2.0000	0.4485	41.9	2.4
2.36 mm (# 8)	1.5500	0.5199	30.0	2.4
1.18 mm (#16)	1.4000	0.5219	23.7	2.4
0.6 mm (# 30)	1.8000	0.5000	19.4	1.5 or 2.4
0.30 mm (# 50)	0.9500	0.3820	11.3	1.0
0.15 mm (# 100)	0.7500	0.3440	6.9	1.1
0.075 mm (# 200)	0.5500	0.3608	4.5	1.1

2 Sample Pairs

Falls out of Precision Range

APPENDIX C

Statistical Analysis Results

Aggregate Degradation Due to Ignition Oven Testing using the NCAT Asphalt Content Tester

Aggregate Degradation
Data Analysis
All Mixes

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	-0 1563	0 3275	99 3	0 9	1 4
19 mm (3/4")	-0 4563	0 1564	97 3	0 9	1 4
12 5 mm (1/2")	-0 6313	0 3055	90 1	2 3	3 0
9 5 mm (3/8")	-0 6313	0 3012	78 2	6 4	3 0
4 75 mm (# 4)	0 0188	0 9700	51 5	2 4	3 0
2 36 mm (# 8)	0 2688	0 4441	34 9	2 4	1 8
1 18 mm (#16)	0 2313	0 4337	25 4	2 4	1 3
0 6 mm (# 30)	0 3188	0 1917	19 1	1 5	1 3
0 30 mm (# 50)	0 2750	0 1703	11 2	1 0	1 3
0 15 mm (# 100)	-0 2188	0 3455	6 7	1 1	0 8
0 075 mm (# 200)	-0 4688	0 0407	4 9	1 1	0 8

16 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Mixes
Above Restricted Zone (ARZ)

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	-0 0667	0 4226	97 7	0 9	1 4
19 mm (3/4")	-0 5000	0 4226	95 8	0 9 or 2 3	1 4 or 3 0
12 5 mm (1/2")	-0 5000	0 0377	90 7	2 3	3 0
9 5 mm (3/8")	0 2333	0 8362	80 4	3 8 or 6 4	3 0
4 75 mm (# 4)	1 4667	0 4866	61 6	1 6	3 0
2 36 mm (# 8)	1 5333	0 3373	46 5	2 4	3 0
1 18 mm (#16)	1 0333	0 4394	36 9	2 4	1 8
0 6 mm (# 30)	1 2667	0 1599	28 7	2 4	1 8
0 30 mm (# 50)	0 7667	0 1585	14 5	1 0 or 1 5	1 3
0 15 mm (# 100)	0 2333	0 3688	7 2	1 1	0 8
0 075 mm (# 200)	-0 4333	0 2744	4 9	1 1	0 6 or 0 8

3 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Mixes
Below Restricted Zone (BRZ)

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	-0 1800	0 4849	99 8	0 9	1 4
19 mm (3/4")	-0 6000	0 2337	98 3	0 9	1 4
12 5 mm (1/2")	-0 4600	0 6275	91 9	2 3	3 0
9 5 mm (3/8")	-0 4900	0 5835	79 7	3 8 or 6 4	3 0
4 75 mm (# 4)	-0 0300	0 9584	49 3	2 4	3 0
2 36 mm (# 8)	0 3300	0 2708	31 3	2 4	1 8
1 18 mm (#16)	0 3000	0 2939	21 5	2 4	1 3
0 6 mm (# 30)	0 2600	0 3594	15 7	1 0 or 1 5	1 3
0 30 mm (# 50)	0 2600	0 3646	10 2	1 0 or 1 1	0 8 or 1 3
0 15 mm (# 100)	-0 3700	0 3171	6 7	1 1	0 8
0 075 mm (# 200)	-0 5700	0 1113	5 0	1 1	0 6 or 0 8

10 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
All Mixes
Through Restricted Zone (TRZ)

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	-0 1667	0 4226	99 4	0 9	1 4
19 mm (3/4")	0 0667	0 4226	95 0	2 3 or 0 9	1 4 or 3 0
12 5 mm (1/2")	-1 3333	0 3580	83 8	3 8	3 0
9 5 mm (3/8")	-1 9667	0 1039	71 4	6 4	3 0
4 75 mm (# 4)	-1 2667	0 0208	48 7	2 4	3 0
2 36 mm (# 8)	-1 2000	0 0649	35 2	2 4	1 8
1 18 mm (#16)	-0 8333	0 0702	26 6	2 4	1 8
0 6 mm (# 30)	-0 4333	0 0691	20 4	1 5 or 2 4	1 3
0 30 mm (# 50)	-0 1667	0 1994	11 0	1 0	0 8 or 1 3
0 15 mm (# 100)	-0 1667	0 1296	6 2	1 1	0 8
0 075 mm (# 200)	-0 1667	0 4975	4 4	1 1	0 6

3 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
Limestone Mixes

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	-0.4429	0.1640	98.8	0.9	1.4
19 mm (3/4")	-1.2571	0.0706	96.8	0.9	1.4
12.5 mm (1/2")	-1.2000	0.3645	89.1	2.3	3.0
9.5 mm (3/8")	-0.7714	0.5215	76.9	6.4	3.0
4.75 mm (# 4)	0.5000	0.6395	51.4	2.4	3.0
2.36 mm (# 8)	0.8143	0.2144	36.1	2.4	1.8
1.18 mm (#16)	0.7000	0.1536	26.7	2.4	1.8
0.6 mm (# 30)	0.3571	0.4361	19.9	1.5 or 2.4	1.3
0.30 mm (# 50)	0.3571	0.2297	11.3	1.0	1.3
0.15 mm (# 100)	-0.5429	0.1876	6.9	1.1	0.8
0.075 mm (# 200)	-0.7286	0.0192	5.2	1.1	0.6

7 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
River Gravel Mixes

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	0 0750	0 6514	99 7	0 9	1 4
19 mm (3/4")	0 1875	0 1250	97 2	0 9	1 4
12 5 mm (1/2")	-0 1500	0 7988	90 4	2 3	3 0
9 5 mm (3/8")	-0 7375	0 3137	79 9	3 8 or 6 4	3 0
4 75 mm (# 4)	-0 5625	0 1920	51 6	2 4	3 0
2 36 mm (# 8)	-0 2250	0 6029	34 6	2 4	1 8
1 18 mm (#16)	-0 1375	0 7467	25 0	2 4	1 3 or 1 8
0 6 mm (# 30)	0 1750	0 6247	18 7	1 5	1 3
0 30 mm (# 50)	0 1375	0 6678	11 4	1 0	1 3
0 15 mm (# 100)	-0 0875	0 7572	6 7	1 1	0 8
0 075 mm (# 200)	-0 4750	0 1315	4 7	1 1	0 6

8 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
411 Mixes

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")			100 0	0 9	1 4
19 mm (3/4")	0 0556	0 3466	100 0	0 9	1 4
12 5 mm (1/2")	-0 3111	0 3189	96 5	0 9	1 4
9 5 mm (3/8")	0 5111	0 7419	85 5	2 3 or 3 8	3 0
4 75 mm (# 4)	-0 1555	0 8006	55 3	2 4	3 0
2 36 mm (# 8)	0 3111	0 5423	36 8	2 4	1 8
1 18 mm (#16)	0 2667	0 5834	26 4	2 4	1 8
0 6 mm (# 30)	0 3667	0 3881	19 6	1 5 or 2 4	1 3
0 30 mm (# 50)	0 4111	0 2439	11 4	1 0	1 3
0 15 mm (# 100)	-0 1222	0 7635	6 6	1 1	0 8
0 075 mm (# 200)	-0 3444	0 3219	4 7	1 1	0 6

9 Sample Pairs

Falls out of Precision Range

Aggregate Degradation
Data Analysis
307 Mixes

Sieve	Difference	p-Value	Percent Passing	Precision	
				ASTM C136-95a Precision (d2s)	ASHTO T30-93 Precision (d2s)
25 mm (1")	-0.3571	0.3500	98.4	0.9	1.4
19 mm (3/4")	-1.1143	0.1288	93.7	2.3	3.0
12.5 mm (1/2")	-1.0429	0.4695	82.4	3.8	3.0
9.5 mm (3/8")	-0.6714	0.5838	70.4	6.4	3.0
4.75 mm (# 4)	0.2429	0.7885	46.5	2.4	3.0
2.36 mm (# 8)	0.2143	0.6874	32.4	2.4	1.8
1.18 mm (#16)	0.1857	0.5753	24.1	2.4	1.3
0.6 mm (# 30)	0.1286	0.6194	18.2	1.5	1.3
0.30 mm (# 50)	0.1000	0.4618	10.9	1.0	0.8 or 1.3
0.15 mm (# 100)	-0.3429	0.0493	6.9	1.1	0.8
0.075 mm (# 200)	-0.6286	0.0430	5.0	1.1	0.6 or 0.8

7 Sample Pairs

Falls out of Precision Range

APPENDIX D

Bulk Specific Gravity Data

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Benton	307 BM/2	2 487	2.467	2 486	0 00	0 76
Campbell	411D	2 506	2 473	2 504	0 00	1 24
Coffee	307 BM	2 497	2 462	2 493	0 00	1 24
Coffee	411D	2.521	2 490	2.516	0 00	1 03
Coffee	411D	2.520	2 497	2 516	0 00	0 76
Coffee	411D	2.516	2.486	2.516	0.00	1.19
Davidson / Wilson	307 BM	2.519	2.504	2.518	0 00	0 56
Giles	307 BM/2	2.486	2.444	2 486	0.00	1.69
Polk	411D	2.441	2.400	2.439	0 00	1.60
Putnam	411S	2.523	2.502	2.523	0.00	0 83
Putnam	411S	2.530	2 505	2 523	0.00	0 71
Putnam	411S	2.523	2 482	2.523	0 00	1 63
Coffee	411D	2 515	2 489	2 516	0.03	1 07
Putnam	411S	2.522	2.497	2 523	0 04	1 03
Benton	307 BM/2	2.485	2 473	2 486	0 04	0.52
Polk	411D	2 438	2 402	2 439	0.04	1 52
Campbell	411D	2.502	2 473	2 504	0 08	1 24
Davidson / Wilson	307 BM	2 515	2 428	2 518	0 12	3 57
Coffee	411D	2 513	2.466	2 516	0 12	1 99
Davidson	411D	2.436	2 327	2 439	0.12	4 59
Campbell	411D	2 500	2 472	2 504	0 16	1 28
Davidson	411D w/ Latex	2.428	2 401	2 432	0 16	1 27
Giles	307 BM/2	2.481	2.451	2 486	0.20	1 41
Giles	307 BM/2	2 480	2.454	2 486	0.24	1 29
Polk	411D	2 433	2 402	2 439	0.25	1 52
Davidson	411D w/ Latex	2.426	2 402	2 432	0.25	1 23
Hamilton	411D	2.317	2 290	2 323	0.26	1.42
Marion	411D	2.299	2.285	2 305	0.26	0.87
Giles	307 BM/2	2 479	2 456	2.486	0.28	1 21
Davidson / Wilson	307 BM	2.510	2 495	2 518	0 32	0 91
Davidson	411D w/ Latex	2 424	2 398	2 432	0 33	1 40
Davidson / Wilson	307 BM	2 509	2 493	2 518	0 36	0.99
Benton	307 BM/2	2 477	2 456	2 486	0 36	1 21
Davidson	411D w/ Latex	2.423	2 387	2 432	0.37	1 85
Hamilton	411D	2.314	2.309	2.323	0 39	0 60
Coffee	411D	2 506	2 467	2 516	0 40	1 95
Campbell	411D	2 494	2 468	2 504	0 40	1 44
Benton	307 BM/2	2 476	2 463	2 486	0 40	0 93
Polk	411D	2.429	2.405	2 439	0.41	1 39
Hamilton	411D	2.312	2.276	2.323	0.47	2 02
Coffee	307 BM	2 481	2.447	2 493	0.48	1 85
Rutherford	307 BM/2	2.515	2.497	2 528	0.51	1.23

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Rutherford	307 BM/2	2.514	2 491	2.528	0 55	1 46
Marion	411D	2 292	2 282	2.305	0 56	1 00
Davidson	411D	2 425	2 415	2 439	0.57	0 98
Davidson	411D	2 425	2 414	2 439	0 57	1 03
Davidson	411D	2 424	2 412	2 439	0 62	1 11
Madison	307 BM/2	2.486	2 479	2.502	0 64	0 92
Davidson	411D	2.423	2 418	2 439	0 66	0 86
Madison	307 BM/2	2 485	2 476	2 502	0 68	1.04
Coffee	307 BM	2.476	2 405	2 493	0 68	3 53
Hamilton	411D	2 307	2 291	2 323	0 69	1 38
Marion	411D	2 289	2 277	2 305	0 69	1 21
Rutherford	307 BM/2	2.510	2 456	2 528	0 71	2 85
Rutherford	307 BM/2	2 509	2 476	2.528	0 75	2 06
Madison	307 BM/2	2.482	2 470	2.502	0.80	1 28
Coffee	307 BM	2.473	2 433	2 493	0 80	2 41
Marion	411D	2 286	2.268	2.305	0.82	1 61
Grundy	307 BM	2.496	2 447	2.518	0 87	2.82
Madison	307 BM/2	2 479	2 468	2 502	0.92	1 36
Coffee	411D	2.491	2 445	2 516	0 99	2 82
Campbell	411D	2.479	2 444	2 504	1 00	2 40
Coffee	307 BM	2.468	2 421	2 493	1 00	2 89
Dyer	307S	2 361	2.326	2 385	1.01	2 47
Campbell	411D	2.476	2 436	2 504	1.12	2.72
Coffee	307 BM	2 465	2 415	2 493	1 12	3 13
Campbell	411D	2 475	2 430	2 504	1 16	2 96
Coffee	411D	2 485	2 429	2 516	1 23	3 46
Knox (Clinton Hwy)	411S	2 483	2.433	2 514	1 23	3 22
Campbell	411D	2 473	2 408	2 504	1 24	3 83
Knox (Clinton Hwy)	411S	2 479	2 398	2 514	1 39	4 61
Blount	411S	2 476	2 436	2 512	1 43	3 03
Grundy	307 BM	2.476	2 438	2 518	1 67	3 18
Sevier	307S	2.510	2 475	2 553	1 68	3 06
Coffee	307 BM	2.451	2 375	2 493	1 68	4 73
Jackson	411D	2.447	2.429	2 489	1.69	2 41
Jackson	411D	2 447	2 431	2.489	1 69	2 33
Jackson	411D	2.447	2 424	2.489	1 69	2 61
Blount	411S	2 469	2.432	2 512	1 71	3 18
Maury	411S	2 395	2 357	2 437	1 72	3 28
Jackson	411D	2.445	2 416	2.489	1 77	2 93
Rutherford	307 BM/2	2 483	2 435	2 528	1 78	3 68
Knox (Clinton Hwy)	411S	2 469	2 422	2 514	1 79	3 66
Davidson / Wilson	307 BM	2 472	2 435	2 518	1 83	3 30

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Dyer	307S	2 341	2 314	2 385	1 84	2 98
Davidson / Wilson	307 BM	2 470	2 426	2 518	1 91	3 65
Dyer	307S	2 339	2 299	2 385	1 93	3 61
Davidson / Wilson	307 BM	2 469	2 440	2 518	1 95	3 10
Sequatchie	411D	2 267	2.245	2 312	1 95	2 90
Knox (Clinton Hwy)	411S	2 463	2 390	2 514	2 03	4 93
Blount	411S	2 461	2 410	2 512	2.03	4 06
Blount	411S	2 461	2.406	2.512	2 03	4 22
Sevier	307S	2.501	2 460	2.553	2 04	3 64
Pickett	411S	2 441	2.413	2 492	2 05	3.17
Davidson / Wilson	307 BM	2.466	2 432	2.518	2 07	3 42
Pickett	411S	2.440	2 407	2 492	2 09	3 41
Maury	411S	2 386	2 346	2 437	2 09	3 73
Campbell	307 BM/2	2 560	2 520	2 615	2 10	3 63
Coffee	307 BM	2 440	2 351	2 493	2 13	5 70
Grundy	411D	2 248	2 226	2 297	2 13	3 09
Rutherford	307 BM/2	2 474	2 425	2 528	2 14	4.07
Maury	411S	2 384	2 346	2 437	2 17	3 73
Maury	411S	2 384	2 333	2 437	2 17	4 27
Grundy	411D	2 247	2 217	2 297	2 18	3 48
Grundy	307 BM	2 463	2 427	2 518	2 18	3 61
Jackson	307 BM	2 441	2 417	2 496	2 20	3 17
Sequatchie	411D	2 261	2 243	2 312	2 21	2 98
Jackson	307 BM	2 440	2.420	2 496	2 24	3 04
Jackson	307 BM	2.440	2 413	2 496	2.24	3 33
Pickett	411S	2 436	2.405	2 492	2 25	3.49
Sequatchie	411D	2 260	2.230	2 312	2.25	3 55
Campbell	307 BM/2	2 556	2.514	2.615	2.26	3.86
Maury	411S	2 382	2.344	2 437	2.26	3 82
Pickett	411S	2 435	2 403	2 492	2.29	3 57
Shelby	411S	2.306	2.280	2 360	2 29	3 39
Sequatchie	411D	2 259	2 246	2 312	2.29	2 85
Rutherford	307 BM/2	2 470	2 423	2 528	2 29	4 15
Dickson	411D	2 374	2 342	2 430	2 30	3 62
Dyer	307S	2 329	2 264	2 385	2 35	5 07
Rutherford	307 BM/2	2 468	2 422	2 528	2 37	4 19
Maury	411S	2 379	2 334	2 437	2 38	4 23
Grundy	307 BM	2 458	2 447	2 518	2 38	2 82
Dyer	307S	2.328	2 265	2 385	2 39	5 03
Shelby	411S	2 303	2 268	2 360	2 42	3 90
Maury	411S	2 378	2.316	2.437	2.42	4.97
Grundy	411D	2.241	2.216	2 297	2.44	3 53

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Jackson	307 BM	2 435	2.406	2 496	2 44	3 61
Blount / Loudon	307 BM/2	2.553	2 498	2 617	2.45	4 55
Sevier	307S	2 490	2 426	2 553	2 47	4 97
Dickson	411D	2.370	2.352	2 430	2 47	3 21
Blount / Loudon	307 BM/2	2.552	2 506	2.617	2.48	4.24
Blount / Loudon	307 BM/2	2.552	2.501	2.617	2 48	4 43
Dickson	411D	2.369	2.338	2 430	2.51	3.79
Blount / Loudon	307 BM/2	2.551	2 501	2 617	2.52	4 43
Blount / Loudon	307 BM/2	2.551	2.470	2 617	2.52	5 62
Grundy	411D	2.239	2.193	2 297	2.53	4 53
Maury	411S	2.375	2.323	2 437	2.54	4 68
Dyer	307S	2 324	2 277	2 385	2 56	4 53
Blount / Loudon	307 BM/2	2 550	2 503	2 617	2 56	4 36
McMinn	411S	2 238	2 211	2 297	2 57	3 74
Blount	411S w/ Fibers	2.447	2 409	2 512	2 59	4 10
Dickson	307 BM	2 368	2 306	2 431	2 59	5 14
Blount / Loudon	307 BM/2	2 549	2 470	2 617	2 60	5 62
Shelby	411S	2.298	2 268	2 360	2 63	3 90
Davidson	411D w/ Latex	2.368	2.329	2 432	2.63	4 24
Dickson	411D	2.365	2.285	2 430	2 67	5 97
Campbell	307 BM/2	2.545	2.500	2 615	2 68	4.40
Campbell	307 BM/2	2.544	2.500	2 615	2.72	4 40
Dickson	411D	2.364	2.343	2 430	2 72	3 58
McMinn	411S	2 234	2 206	2 297	2 74	3 96
Shelby	411S	2.295	2.269	2 360	2.75	3 86
Davidson	411D w/ Latex	2.365	2.325	2 432	2 75	4 40
Putnam	307S	2 459	2 411	2 530	2 81	4 70
Madison	411S w/ Fibers	2.249	2 221	2 314	2 81	4 02
Dickson	307 BM	2 362	2.298	2.431	2 84	5 47
Blount	411S w/ Fibers	2 440	2 408	2 512	2 87	4 14
Davidson	411D w/ Latex	2 362	2 320	2 432	2 88	4 61
Madison	411S w/ Fibers	2.247	2 212	2 314	2 90	4 41
McMinn	411S	2 230	2 195	2 297	2 92	4 44
Davidson	411D w/ Latex	2.361	2.319	2 432	2 92	4 65
Dickson	307 BM	2.360	2 319	2 431	2 92	4 61
Grundy	307 BM	2 444	2 395	2 518	2 94	4 88
Polk	411D	2 367	2.323	2.439	2 95	4 76
McMinn	411S	2.229	2.197	2.297	2.96	4.35
Putnam	307S	2.455	2.356	2.530	2 96	6 88
Blount	411S w/ Fibers	2 437	2 385	2 512	2.99	5 06
Sevier	307S	2 476	2.400	2.553	3.02	5.99
Blount / Loudon	307 BM/2	2 538	2.456	2 617	3 02	6 15

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Campbell	307 BM/2	2.536	2 474	2 615	3 02	5 39
Campbell	307 BM/2	2.536	2 460	2 615	3 02	5 93
Madison	411S w/ Fibers	2 243	2 192	2 314	3 07	5 27
Grundy	411D	2 226	2 195	2 297	3 09	4 44
Blount	307S w/ Fibers	2 502	2 461	2 582	3 10	4 69
Blount	307S	2 529	2 482	2 610	3 10	4 90
Blount	411S w/ Fibers	2 434	2 374	2 512	3.11	5 49
Dickson	307 BM	2 354	2.309	2 431	3 17	5 02
Campbell	307 BM/2	2 532	2 460	2 615	3.17	5 93
Dickson	307 BM	2.352	2 303	2 431	3.25	5 27
Grundy	411D	2 222	2 164	2 297	3.27	5 79
Polk	411D	2 359	2.325	2 439	3 28	4 67
Marion	411D	2 229	2.193	2.305	3.30	4.86
Madison	307S w/ Fibers	2 420	2.376	2.503	3 32	5 07
Putnam	307S	2 446	2.372	2.530	3.32	6.25
Davidson	411D	2 358	2.339	2 439	3 32	4 10
Davidson	411D	2.357	2.336	2.439	3.36	4.22
Benton	307 BM/2	2 402	2 356	2 486	3.38	5.23
Knox (Clinton Hwy)	411S	2 429	2.322	2 514	3 38	7 64
Grundy	307 BM	2 432	2 379	2 518	3 42	5 52
Madison	307S w/ Fibers	2 417	2 379	2 503	3 44	4 95
Dyer	307S	2 303	2.252	2 385	3 44	5 58
Putnam	411S	2 436	2 362	2 523	3 45	6 38
Jackson	411D	2 403	2 375	2 489	3 46	4 58
Jackson	411D	2 403	2 375	2 489	3 46	4 58
Benton	411D	2 247	2 224	2 328	3 48	4 47
Dyer	307S	2 302	2 253	2 385	3 48	5 53
Grundy	307 BM	2 430	2 393	2 518	3 49	4 96
Madison	411S w/ Fibers	2.233	2.181	2 314	3 50	5 75
Shelby	411S	2.277	2 228	2 360	3.52	5 59
Dickson	307 BM	2 345	2.296	2 431	3.54	5.55
Sequatchie	411D	2 230	2 202	2 312	3.55	4.76
Shelby	411S	2 276	2 224	2.360	3 56	5 76
Blount	307S w/ Fibers	2.490	2 439	2 582	3.56	5 54
Blount	307S	2 517	2.483	2 610	3 56	4.87
Dickson	307 BM	2.344	2 293	2.431	3 58	5.68
Madison	307S w/ Fibers	2 413	2 352	2 503	3 60	6.03
Blount	307S	2 516	2 448	2 610	3 60	6.21
Blount	307S	2.516	2.443	2 610	3 60	6 40
Polk	411D	2 351	2 321	2 439	3 61	4 84
Giles	307 BM/2	2 396	2 330	2 486	3 62	6 28
Polk	411D	2 350	2 322	2 439	3 65	4 80

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Benton	411D	2.243	2.217	2 328	3 65	4 77
Hamilton	411D	2.238	2.213	2 323	3 66	4 74
Benton	307 BM/2	2.395	2.358	2.486	3 66	5.15
Dickson	307 BM	2.342	2.296	2.431	3.66	5 55
Madison	411S w/ Fibers	2.229	2.190	2 314	3.67	5 36
Madison	307S w/ Fibers	2.411	2.360	2.503	3 68	5 71
Blount	307S w/ Fibers	2.487	2.414	2.582	3.68	6 51
Grundy	411D	2.212	2.183	2.297	3 70	4 96
Giles	307 BM/2	2 394	2.305	2 486	3 70	7.28
Madison	307S w/ Fibers	2.410	2.341	2 503	3.72	6 47
Benton	411D	2 241	2 233	2 328	3.74	4 08
Blount	411S	2.418	2 345	2 512	3.74	6 65
Blount	411S w/ Fibers	2 418	2 353	2 512	3 74	6 33
Hamilton	411D	2 236	2 211	2 323	3 75	4 82
Hamilton	411D	2 236	2 196	2 323	3 75	5 47
Putnam	307S	2 435	2.358	2 530	3 75	6 80
Madison	307S w/ Fibers	2 409	2 349	2 503	3.76	6 15
Sequatchie	411D	2.225	2.201	2 312	3 76	4 80
Putnam	411S	2 428	2 361	2 523	3.77	6 42
Giles	307 BM/2	2 392	2 332	2 486	3 78	6 19
Grundy	411D	2 210	2 184	2 297	3.79	4 92
Madison	307S w/ Fibers	2.408	2 347	2.503	3.80	6 23
Madison	411S w/ Fibers	2.226	2 181	2.314	3 80	5.75
Jackson	307 BM	2 401	2.356	2 496	3 81	5 61
Sequatchie	411D	2 223	2 203	2 312	3.85	4 71
Grundy	307 BM	2 421	2.383	2 518	3 85	5 36
Benton	307 BM/2	2 390	2 357	2 486	3 86	5 19
Benton	307 BM/2	2 390	2.357	2 486	3 86	5 19
Pickett	411S	2.395	2 342	2 492	3 89	6 02
Jackson	307 BM	2 398	2 357	2 496	3 93	5 57
Jackson	307 BM	2 398	2.321	2 496	3 93	7 01
Sequatchie	411D	2 221	2.204	2 312	3 94	4 67
Dickson	411D	2 334	2 310	2 430	3.95	4 94
Benton	411D	2 236	2.226	2 328	3.95	4 38
McMinn	307S	2 472	2 394	2 575	4 00	7 03
Blount	307S w/ Fibers	2 478	2 400	2 582	4 03	7 05
Putnam	307S	2.428	2 356	2 530	4 03	6 88
Putnam	307S	2.428	2.366	2 530	4 03	6 48
Marion	411D	2.212	2 194	2 305	4.03	4 82
Marion	411D	2.212	2.194	2.305	4.03	4 82
Sevier	411S	2.358	2.317	2 458	4.07	5 74
Sevier	411S	2.358	2 317	2 458	4 07	5 74

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Hamilton	411D	2 228	2.180	2 323	4 09	6 16
Jackson	411D	2 387	2 365	2 489	4.10	4 98
Blount	307S	2 503	2 447	2 610	4 10	6 25
Blount	411S	2 409	2.356	2 512	4 10	6 21
Blount	411S	2 408	2 356	2.512	4 14	6 21
Benton	411D	2 231	2.223	2 328	4 17	4 51
Blount	307S w/ Fibers	2.474	2 404	2 582	4 18	6 89
Putnam	307S	2.424	2 351	2 530	4 19	7 08
Shelby	411S	2.261	2 225	2 360	4 19	5 72
Dickson	411D	2 328	2 310	2 430	4 20	4 94
Putnam	411S	2 417	2.362	2 523	4 20	6 38
Dickson	411D	2.327	2 298	2.430	4 24	5 43
Jackson	411D	2.383	2.365	2 489	4.26	4 98
Putnam	307S	2.422	2 359	2.530	4 27	6 76
Sevier	307S	2.444	2.350	2 553	4.27	7.95
Blount	307S	2.498	2.440	2.610	4 29	6 51
Benton	411D	2 228	2.220	2 328	4.30	4 64
Blount	411S w/ Fibers	2 404	2 360	2.512	4 30	6 05
Davidson	411D	2 334	2.316	2 439	4.31	5 04
McMinn	411S	2 198	2 155	2 297	4 31	6 18
Madison	411S w/ Fibers	2.214	2 177	2.314	4 32	5 92
Shelby	411S	2 258	2 225	2 360	4 32	5 72
Marion	411D	2.205	2 172	2 305	4 34	5 77
Sevier	307S	2 442	2.354	2 553	4 35	7 79
Madison	307 BM/2	2 393	2 352	2 502	4 36	6 00
Putnam	411S	2.412	2 353	2 523	4 40	6 74
Blount	307S	2 495	2 436	2 610	4 41	6 67
Benton	411D	2 225	2 201	2 328	4 42	5 46
Montgomery	307S	2 376	2.274	2 486	4 42	8 53
Sevier	307S	2 440	2 388	2 553	4 43	6 46
McMinn	411S	2 195	2 164	2 297	4 44	5 79
Montgomery	307S	2.375	2.331	2.486	4 47	6 23
Benton	411D	2.224	2 198	2 328	4.47	5.58
McMinn	411S	2 194	2 164	2 297	4 48	5 79
Madison	411S	2.241	2.183	2 347	4 52	6 99
Pickett	411S	2 377	2 334	2 492	4 61	6 34
Blount	307S w/ Fibers	2 462	2 399	2 582	4.65	7 09
Blount	307S	2 488	2.442	2.610	4.67	6 44
McMinn	307S	2 454	2.410	2 575	4 70	6 41
Giles	307 BM/2	2 369	2 293	2 486	4 71	7 76
Montgomery	307S	2 369	2 315	2 486	4 71	6 88
Madison	307 BM/2	2 384	2 354	2 502	4 72	5 92

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Blount	307S w/ Fibers	2 460	2 366	2 582	4 73	8 37
Jackson	307 BM	2 378	2.336	2.496	4 73	6 41
Montgomery	307S	2.368	2 323	2 486	4 75	6 56
Montgomery	307S	2 368	2 294	2.486	4 75	7 72
Knox (Clinton Hwy)	411S	2.393	2.325	2 514	4 81	7 52
Knox (Clinton Hwy)	411S	2 393	2 325	2 514	4 81	7 52
Madison	411S	2.234	2.174	2 347	4 81	7 37
Madison	411S w/ Fibers	2.202	2 154	2 314	4 84	6 91
Madison	307 BM/2	2.380	2 358	2 502	4.88	5.76
McMinn	307S	2 449	2 402	2 575	4 89	6.72
Pickett	411S	2 370	2 326	2 492	4 90	6 66
Montgomery	307S	2.364	2 289	2 486	4 91	7 92
McMinn	411S	2 184	2 134	2 297	4 92	7 10
Sevier	307S	2.427	2 377	2 553	4 94	6 89
Blount	307S w/ Fibers	2 454	2 386	2.582	4 96	7 59
Dyer	411S	2.204	2.110	2 319	4 96	9 01
Dyer	411S	2.203	2 164	2 319	5 00	6 68
Sevier	411S	2 335	2 280	2 458	5 00	7 24
Sevier	411S	2.335	2 269	2 458	5 00	7 69
Sevier	411S	2.334	2 279	2 458	5 04	7 28
McMinn	307S	2.445	2.385	2 575	5 05	7 38
McMinn	307S	2.445	2 386	2 575	5.05	7 34
Madison	411S	2.228	2 189	2 347	5 07	6 73
Madison	307S w/ Fibers	2 376	2 319	2 503	5.07	7 35
Dyer	411S	2.201	2 160	2 319	5 09	6 86
Pickett	411S	2 365	2 323	2 492	5 10	6 78
McMinn	307S	2 442	2 414	2 575	5 17	6 25
Sevier	411S	2 330	2 254	2 458	5 21	8 30
Madison	411S	2 223	2.187	2 347	5 28	6 82
Dyer	411S	2 196	2 140	2 319	5 30	7 72
Knox (Clinton Hwy)	411S	2 379	2 281	2 514	5 37	9 27
Dyer	411S	2.194	2 148	2 319	5 39	7 37
McMinn	307S	2.436	2 405	2.575	5 40	6.60
Sevier	411S	2.324	2 255	2 458	5 45	8 26
Sevier	411S	2 323	2 267	2 458	5 49	7 77
Madison	411S	2.218	2.182	2.347	5.50	7 03
Dyer	411S	2.190	2 142	2.319	5.56	7 63
Dyer	411S	2 190	2 136	2 319	5 56	7 89
Madison	411S	2 216	2.177	2.347	5 58	7 24
Montgomery	307S	2.347	2 263	2.486	5 59	8 97
McMinn	307S	2 429	2 380	2 575	5 67	7 57
Dyer	411S	2.184	2.115	2 319	5 81	8 80

Bulk Specific Gravity Data

Mix Identification		Bulk Specific Gravity			VTM	
County	Type	SSD	Parafilm	Gmm	SSD	Parafilm
Madison	411S	2.210	2 170	2 347	5.84	7 54
Madison	411S	2 207	2 152	2 347	5 97	8 31
Montgomery	307S	2 337	2 293	2 486	5 99	7 76

VITA

Patrick Vaughan Kiser, the middle of three sons, was born in Abingdon, Virginia on June 2, 1976 He attended schools in the Sullivan County, Tennessee Public School System, where he graduated from Sullivan East High School in June, 1994

Patrick began his college career at Alice Lloyd College in Pippa Passes, Kentucky, enrolling in a pre-engineering program After his sophomore year, he transferred to the University of Tennessee, Knoxville to major in Civil Engineering Upon graduation with a Bachelor of Science in Civil and Environmental Engineering from the University of Tennessee, he was awarded a graduate research assistantship to pursue a Master of Science in Civil Engineering, also at the University of Tennessee, Knoxville

After graduating in May, 2000, Patrick has taken employment with Fuller, Mossbarger, Scott, & May Engineers of Lexington, Kentucky as a staff engineer Patrick has been married to Becky Snodgrass since 1999