GDOT

Georgia Department of Transportation

Hot Mix Asphalt Quality Control Technician – Level 2

Study Aid & Reference Materials

November 2019

Contents

Introduction

In order to become certified as a Quality Control Technician (QCT) Level 2, the QCT must be Level 1 certified and obtain a passing grade on a written exam. A Level 2 QCT, in addition to Level 1 requirements, must be capable of making process control adjustments to asphaltic concrete mixture during asphalt plant operations. The Bituminous Construction Branch of the Office of Materials and Testing provides several two day workshops annually for remedial training assistance to Level 1 QCTs in attaining their certification or as continuing training hours for Level 2 QCT as a means to maintain his or her certification. The first day of the QCT Level 2 workshop consists of reviewing current specifications and testing procedures, various mathematical calculations related to material management and introducing basic concept of asphaltic concrete mixture adjustment. The actual QCT Level 2 written test is scheduled for day two.

Office of Materials and Testing Contacts:

Vacant
State Bituminous Construction Engineer
(404) 608-4856

Jason Oglesby
Bituminous Technical Services Manager
(404) 694-6745

This manual contains the necessary sampling and testing procedures required to fulfill the requirements of the Level 2 certifications. It is intended as a basic reference for the QCT. It is also provided as a study aid to help prepare the QCT for the certification process.

Level 2 Quality Control Workshop

Purpose
To provide training to the Quality Control Technician in process control adjustments to asphaltic concrete mixture during asphalt plant operations and improve overall quality in bituminous materials.

Who Should Attend
All Asphalt Producers' Quality Control Technicians (QCT) Level 1, Level 1 Georgia Department of Transportation employees, and Engineering Consultant Level 1 Quality Control Technicians who wish to obtain a QCT Level 2 certification or QCT Level 2 Technicians who wish to retain their certification.

Instructors
Training will be provided by the Bituminous Branch of the Office of Materials and Testing, various asphalt contractor's quality control personnel, and other asphalt industry personnel recruited by the Department.

Agenda
Day 1 – Presentations and in-class exercises
Day 2 – 6 hour written exam (Only for new certification and re-certifications who did not attend required training.)

Guideline for GDOT Hot Mix Asphalt Quality Control Technician Level 2 Training and Qualification Program

1. Introduction

1.1 This document communicates the evaluation and qualification procedures for personnel engaged in process control adjustments to asphalt plant operations.

1.2 The term QCT Level 2 identifies a Quality Control Technician (QCT) at Level 2.

1.3 An individual must be QCT Level 1 certified before obtaining the QCT Level 2 certification.

1.4 Superpave Mix Design Technician is not currently covered by this guideline but is considered to address the function of mix design and is available through the National Center for Asphalt Technology (NCAT), Auburn, Alabama.

2. Background

2.1 Historic roles and responsibilities of industry and agencies have changed for sampling and testing activities under QA specifications. GDOT QA specifications allow the use of contractor test results in making acceptance decisions for materials and construction quality control in hot mix asphalt construction.

2.2 Qualification programs and associated training have been shown to be an effective tool for improving the quality of construction by verifying that essential knowledge and skills are possessed by agency or industry personnel who monitor, inspect, and control construction operations. Qualification programs for personnel have proven to be useful, common "yardsticks" for measuring expertise and performance among public transportation agencies, private construction contractors, and independent materials laboratories.

2.3 Provisions requiring the use of qualified technicians involved in construction project testing and inspection activities are included in GDOT's QC/QA specifications for hot mix asphalt.

3. Training

3.1 A well-planned and supportive training program is needed for a successful qualification program. A good training program will ensure qualified technicians will be performing inspection on construction projects.

3.2 A training/review class is currently provided by the GDOT for Level 2 certification.

3.3 Qualified technicians will need to be kept aware of specification, equipment, or administration changes in the training program. This need will be satisfied by re-qualification training, update courses, or special training efforts conducted by GDOT in conjunction with industry partners. Future training programs will be offered to individuals who are responsibly involved in QC/QA testing as well as those involved in the acceptance decision process including those from GDOT, local agencies, contractors, producers, or consultants. The program will be administered the same for all individuals.

4. Examination and Methods

4.1 A successful qualification program must have documented policies and procedures for examination methods to ensure consistent and fair administration by all examiners and proctors.

The Bituminous Technical Services Manager or their designee shall direct and coordinate all qualification examination activities. This includes scheduling of examinations; registration of applicants; maintaining and ensuring of security of examination materials; notifying participants of their success or failure in their examination; and maintaining all completed examination materials.

A written examination will be given to determine if the applicants possess the knowledge and skills necessary to satisfy the established qualification requirements.

4.2 *Examination Controls and Integrity* – To avoid conflicts of interest, the examiner should not be the immediate supervisor of those being qualified. Examination procedures are as follows:

(a) GDOT will be responsible for the development of and revision of qualification exams including updating or changing exams when there is a change in a test method or specification. GDOT currently administers the Level 2 QCT exam. Available dates and times for exams can be requested through the Bituminous Technical Services Manager.
(b) Applicants will be allowed no more than 6 hours for the Level 2 written examination.
(c) Cheating on an exam will result in permanent revocation of any QCT Certification and the inability to apply for any QCT certification in the future.
(d) Examinations for Level 2 will be proctored at the Central Lab or a location specified by the Bituminous Technical Services Manager. A proctor will be present in the room at all times while administering the test.
(e) Examinations may consist of various types of questions, including true/false, multiple choice, essay, fill-in-the-blank, word problems, and calculations.
(f) To protect examination integrity, course participants cannot retain a copy of their completed written examinations.
(g) The Bituminous Technical Services Manager will maintain several equivalent versions of the test and alternately present different versions to examinees.

(h) Applicants will be allowed to bring one 8.5”x11” sheet of notes that must be turned in with their exam.
(i) Applicable sections, standard operating procedures, sampling procedures, and testing procedures will be provided with the exam.
(j) Examinations will be given on an as-needed basis.
(k) Passing the written exam is considered to be a grade of 75 or higher. The applicant must show capability on the written exam of making process control adjustments to the plant operations. If the applicant scores a 75 on the written exam, but in the opinion of the Bituminous Technical Services Manager does not show capability of making process control adjustments, the applicant will be considered to have failed the examination.

4.3 *Re-Examination Policy-Written/Performance* – Whenever a participant fails a written qualification examination, an allowance will be provided for retesting. The policy is as follows:

- After first failed exam - QCT must wait 30 days before retaking Level 2 exam.
- After second failed exam - QCT must wait 90 days before retaking Level 2 exam.
- After third failed exam - QCT must wait 12 months before retaking Level 2 exam.

The number of retests allowed and the time limits are needed to avoid frivolous, trial-and-error attempts and encourage the participants to properly prepare for testing.

4.4 *Notification of Results* – Notification of an applicant’s successful or unsuccessful completion of the qualification requirements will be emailed to the applicant promptly after completion of the examination. If the applicant is unsuccessful, the procedure for re-examination will be explained in the letter.

4.5 *Confidentiality of Records* – Personal information and records of the examination are generally considered to be confidential and not to be released publicly. Confidential information includes:

(a) Personal and professional information provided by the participants applying for testing and qualification; and
(b) Specific test results and scores for participants.

4.6 *Examiner and Proctor Qualifications* –Examiners for the performance examination must be qualified in that examination area. Examiners will be the Bituminous Technical Services Manager, Assistant Bituminous Technical Services manager, Bituminous Technical Services Specialists, or others deemed appropriate by the Bituminous Technical Services Manager.

4.7 *Examination Appeals* – An applicant wishing to register a complaint or protest regarding an examination or examiner must do so in writing to the Bituminous Technical

Services Manager within 14 days of the incident. The written complaint must specify the examination date, the examiner, and the nature of the complaint or protest. Complaints and protests should be reviewed and a recommendation made to the Chairman of the Appeal Board. All complaints and protests will be promptly answered in writing.

5. Qualification

5.1 GDOT will maintain a registry of technicians who have successfully completed the requirements of QCT Level 2 certification. The registry will include:

(a) Name, qualification identification number, and address;
(b) Courses, and dates completed;
(c) Course content:
Test methods included;
Lecture or laboratory;
Written examination

5.2 GDOT shall provide the qualified technician with documentation of the certification in the form of a registration card and certificate. The document will include an expiration date.

The registered certified technician should maintain a current address on file. Send change of address notice to: Bituminous Technical Services Manager, Georgia Department of Transportation, 15 Kennedy Drive, Forest Park, GA 30297.

5.3 *Recertification Requirements* - The QCT Level 2 certification is valid for 3 years. Recertification for QCT Level 2 will be required 3 years after initial certification. The re-qualification process may include refresher courses and/or re-testing. Written testing requirements for recertification will be waived if a QCT Level 2 attends at least 18 hours of training per 3 years, prior to certification expiration.

Please see Table 1 below for information concerning training hours for recertification.

Table 1 – Training Hour Requirements for Recertification

Credit Hours Required for Recertification	QCT Level 2 Required Classes
18 hours required over the 3 year period	Option 1: Two QCT Level 2 Training Work Shops (12 Hours) and 3 annual IA Evaluations (2 hours each for a total of 6 hours). Option 2: One QCT Level 2 Training Work Shop (6 hours) plus 6 hours of other eligible supplemental training, and 3 annual IA Evaluations (2 hours each for a total of 6 hours). Option 3: One QCT Level 2 Work Shop (6 Hours) plus 12 hours of other eligible supplemental training.
Note: Regardless of other eligible training hours, IA evaluations are required yearly for active Acceptance Sample Testing certified QCT Level 2 technicians in accordance with SOP 30.	

Additional supplemental training that has been approved for use as the additional miscellaneous bituminous material related training is detailed in Table 2.

Table 2 – Approved Supplemental Training

Training Eligible for Additional Hours Credit	Offered	Credit Hours
Bituminous Construction Work Shop	Annually	6
OMAT Approved Industry Sponsored Training	As Available	4-6
Georgia Quality Initiative (GQI) Conference	As Available	6
Asphalt Quality Paving Conference	As Available	6
QCT Level 1 training	As Available	6
GDOT Current IT or Computer Acceptance Sample Data System	As Available	6
Southeastern Asphalt User/Producer Group (SEAUPG)	Annually	6

As detailed in Table 2, the Office of Materials and Testing may consider other bituminous materials or construction related training. Technicians should send copies of training workshop agenda(s) and proof of attendance (e.g. certificates) to submit for consideration to either the Bituminous Technical Services Manager or the Assistant Bituminous Technical Services Manager.

If the QCT has not fulfilled the continual training hours requirements within the established time period, he or she must retake the certification written test to continue performing QCT Level 2 duties.

6. Conflict Resolution (QCT Level 2)

6.1 *Incorrect Procedures* - QCTs will be made aware of incorrect sampling and testing methods or failure to comply with QCT responsibilities at the time the incorrect procedure is identified. The QCT Level 2 Manager will be made aware of these discrepancies at the same time. The QCT will be instructed on how to correct discrepancies. (See Diagram 1 for description of process)

6.2 *Discussion Meeting* - If the QCT continues to fail in performing the duties as required, a meeting will be held at the District Lab in the District where the discrepancies occurred or the Central Lab. The QCT, the QCT Manager and Bituminous Technical Services personnel will be present to discuss the discrepancies to address the problem and/or communicate the correct procedure. The meeting will be formally documented and possible future disciplinary action will be noted in the follow-up letter.

6.3 *Progressive Actions* - If further problems are encountered:

(a) The QCT will be required to re-take the performance and/or written certification exam (at their existing Level) for failing to demonstrate the abilities of a Level 1 or Level 2 QCT.

(b) Certification may be suspended for a period of time.

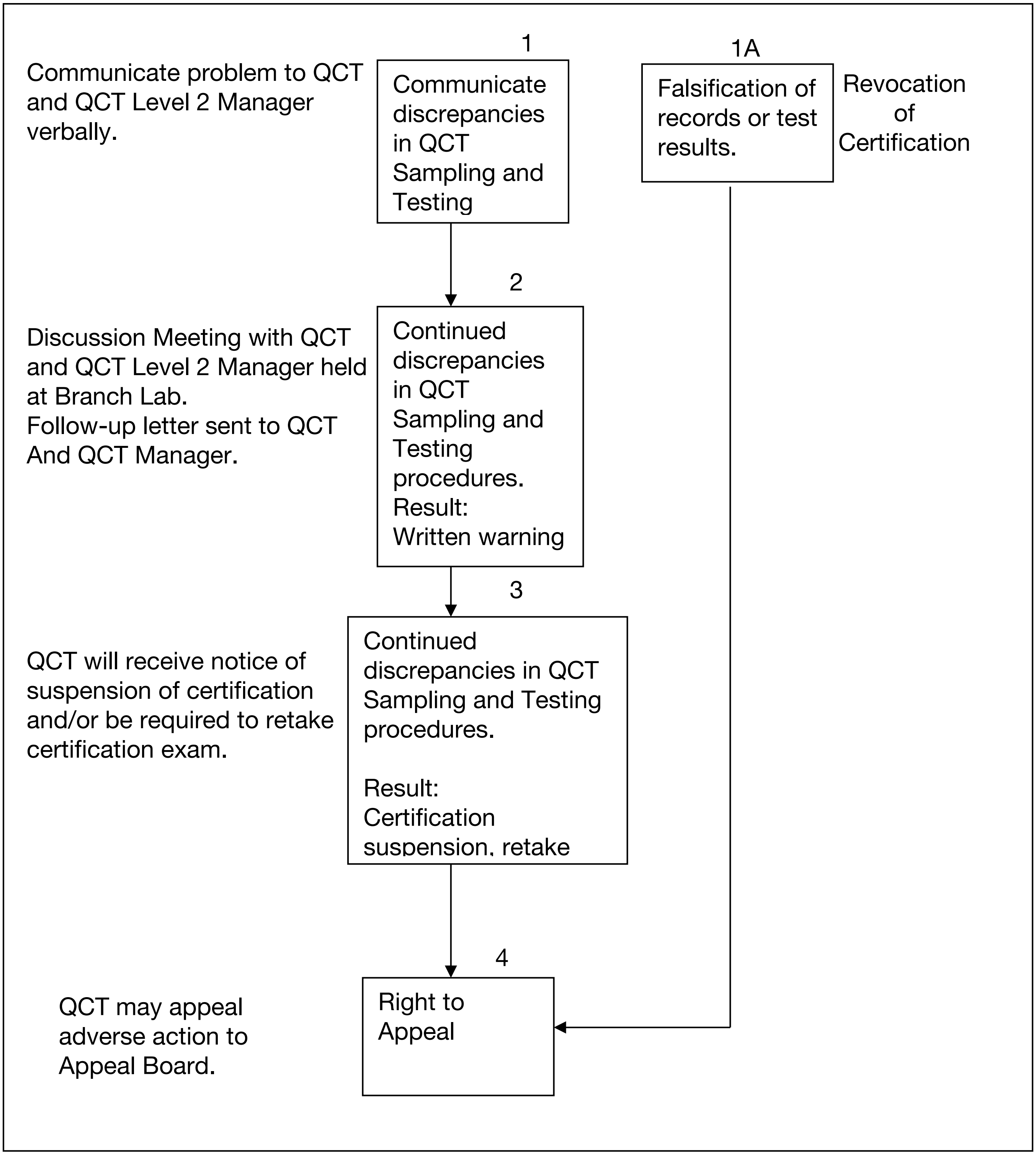
6.4 *Intentional Falsification of Records* - Falsification of records or acceptance test results will result in permanent revocation of QCT Certification. A certified letter will be sent to the QCT, the QCT Manager, and the Corporate Head of the company that employs the QCT providing notification of permanent revocation and the appeal process.

6.5 *Appeal Process* - The QCT will have the right to appeal any adverse action which results in suspension or permanent revocation of certification by responding to an Appeal Board within 10 calendar days after receiving notice of the proposed adverse action. Failure to appeal within 10 calendar days will result in the proposed adverse action becoming effective on the date specified in the notice. Failure to appeal within the time specified will result in a waiver of all future appeal rights regarding the adverse action taken. The QCT may appeal in writing or in person to the Chairman of the Appeal Board at: Director of Construction, Georgia Department of Transportation, One Georgia Center, 600 West Peachtree Street, Atlanta, GA 30308. The Director of Construction may be reached by phone at 404-631-1970 between the hours of 8 a.m. and 4 p.m. (Monday through Friday) in order to schedule an appointment. The QCT may continue working during the appeal process. An Appeal Board meeting will be scheduled as needed by the Chairman of the Appeal Board within 10 days of receiving the appeal notice. There will be five members on the Appeal Board, called by the Chairman:

GDOT Division Director of Construction - (Chairman of the Appeal Board)
GDOT Construction Liaison (not from affected District)
Consultant (nominated by the Consultant community)
Contractor (other than the QCT's company- nominated by the Contracting Industry)
FHWA Resource Center Material Engineer or designee

The Appeal Board will hear the appeal and make a decision within 5 days of hearing the appeal. Decisions of the Appeal Board shall be final and shall be made in writing to the QCT.

Diagram 1 – Conflict Resolution Diagram



Exercises

COAC- Corrected Optimum AC – OLD (75:25)

SOP 2 – Appendix D

Method of calculating Credited Asphalt Cement content for asphaltic concrete mixtures incorporating reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS)

Example: 12.5 mm SMA Mix with 6.1 % original optimum AC (OOAC) with 15 % RAP with 5.75 % AC in RAP

Using standard mix design procedure, RAP binder contribution constitutes

5.75 x 0.15 = 0.86 % AC for 100 % binder credit

Using factor to calculate Credited AC (CAC)

0.86 x 0.75 = 0.65 % CAC

Using factor to calculate Non-Credited AC (NCAC)

0.86 - 0.65 = 0.21 % NCAC

Add 0.21 % + 6.1 % = 6.31 % COAC

The COAC is 6.31 % On JMF COAC = 6.30

This will be noted on the bottom of the design and submitted for job mix formulas

COAC- Corrected Optimum AC – January 2019 60:40

SOP 2 – Appendix D

Method of calculating Credited Asphalt Cement content for asphaltic concrete mixtures incorporating reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS)

Example: 12.5 mm SMA Mix with 6.1 % original optimum AC (OOAC) with 15 % RAP with 5.75 % AC in RAP

Using standard mix design procedure, RAP constitutes

5.75 x 0.15 = 0.86 % AC for 100 % binder credit

Using factor to calculate Credited AC (CAC)

0.86 x 0.60 = 0.52 % CAC

Using factor to calculate Non-Credited AC (NCAC)

0.86 - 0.52 = 0.34% NCAC

Add 0.34 % + 6.1 % = 6.44 % COAC

The COAC is 6.44 % On JMF COAC = 6.40

This will be noted on the bottom of the design and submitted for job mix formulas

COAC- Corrected Optimum AC – January 2019 (60:40)

Short Cut

Example: 12.5 mm SMA Mix with 6.1 % original optimum AC (OOAC) with 15 % RAP and RAP AC is 5.75 %

Using short cut method

5.75 x 0.15 x 0.40 = 0.34 % Non-credited Binder AC

Add 0.34 % + 6.1 % = 6.44 % COAC

The COAC is 6.44 % On JMF COAC = 6.40

This will be noted on the bottom of the design and submitted for job mix formulas

What is the Maximum % RAP Allowed in SMA

What GDT governs testing protocol for determining AC content using the Ignition Oven?

What are the minimum and maximum sample weights for 12.5 mm SMA mix?

What PG binder grade is required for 12.5 mm SMA

Where do you find the PG binder grade requirements for various mix types?

What is the frequency for AC samples on a state project?

What is the frequency for AC samples on an interstate project?

Blending Problem 1- 12.5 mm SMA

Plant Type Drum

Mix Type 12.5 mm SMA

15 % RAP **RAP AC 5.75 %**

12.5 mm SMA **15 % RAP**

Plant Speed 300 TPH **COAC 6.40 %**

Percent Lime 1.0 %

Sieve Size	7	89	W10	RAP	Fly Ash	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100	100.0	100
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	92.9	93
9.5 mm	45	99.1	100	98.4	100	100	70.1	70
4.75 mm	4.0	16.7	92.3	83	100	100	28.1	28
2.36 mm	1.4	8.1	84.1	75.2	100	100	23.7	24
300 um	1	3.1	6.2	47.4	99	100	18.2	18
75 um	0.8	0.5	4.4	9.5	84.3	100	10.5	11

Blending Problem – 1 – 12.5 mm SMA
What are the Bin Pulls for Each Material?

Sieve Size	7	89	W10	RAP	Fly Ash	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100	100.0	100
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	92.9	93
9.5 mm	45	99	100	98	100	100	70.1	70
4.75 mm	4.0	17	92	83	100	100	28.1	28
2.36 mm	1.4	8.1	84	75	100	100	23.7	24
300 um	1	3.1	6.2	47	99	100	18.2	18
75 um	0.8	0.5	4.4	9.5	84.3	100	10.5	11
							100	

Blending Problem 2 - 12.5 mm SP

Plant Type Drum

Mix Type 12.5 mm SP

Optimum AC 5.35 %

Drum

25 % RAP RAP AC 4.75 % Plant Speed 250 TPH

Percent Lime .9%

SIZE	007	089	w10		Rap	Lime		COMB.	JMF
SOURCE								GRAD.	
1 1/2"	100.0	100.0	100.0		100.0	100.0			100
1"	100.0	100.0	100.0		100.0	100.0			100
3/4"	100.0	100.0	100.0		100.0	100.0			100
1/2"	86.9	100.0	100.0		100.0	100.0			98
3/8"	43.9	99.1	100.0		98.4	100.0			86
#4	3.0	35.7	99.5		87.0	100.0			56
#8	1.4	7.1	84.1		71.8	100.0			43
#16	1.1	3.8	63.9		60.8	100.0			33
#30	1.0	2.0	46.2		48.2	100.0			26
#50	0.8	1.6	27.8		35.2	100.0			18
#100	0.7	1.0	12.6		21.9	100.0			11
#200	0.5	0.5	4.4		11.9	100.0			5.5
Pull									

COAC- Corrected Optimum AC

12.5 mm Superpave Mix with 5.35 % original optimum AC (OOAC) with 25 % and AC in 4.75 % RAP (25% RAP with RAP AC of 4.75%)

Using short cut method

Blending Problem – 2 – 12.5 mm SP
What are the Bin Pulls for Each Material?

Sieve Size	7	89	W10	RAP	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100.0	100
25 mm	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	97.0	98
9.5 mm	44	99	100	98	100	86.5	86
4.75 mm	4.0	36	100	87	100	59.1	59
2.36 mm	1.4	7.1	84	72	100	43.7	43
75 um	0.8	0.5	4.4	12	100	5.4	5.5
						100	

Aggregate Moisture Sample Testing Calculate Combined Moisture Base on Bin Pulls

Aggregate Bin	007	089	W10	RAP	
Aggregate Bin Pull %					
Initial Weight	500	500	500	500	
Final Dry Weight	484	472	463	459	

Calculate the extraction below:

Type of Mix: 12.5 mm Superpave		Temperature:	305
Total Weight	2257.4	Final Weight of Silica	258.8
Dry Weight		Beginning Weigh Silica	125.0
Difference Weight		Difference	
Percent AC		+ Dry Sample Weight	2014.0
Job Mix Formula AC	5.5	Total Dry Weight	

You are producing the12.5 mm Superpave mix through a drum plant using 007, 089, 810, W10 and RAP

Calculate the extraction below:

Type of Mix	12.5 mm SP	Mix Temperature	300	
Total Weigth	1665.6	Final Wt. Silica	199.5	
Total Dry Weight	0	Beginning Wt. Silica	125	
Difference in Wt.	1665.6	Difference in Wt.		
Percent AC		+ Dry Weight	1502.8	
JMF AC %	5.50	Total Dry Weight		
0	Total Dry Weight of Sample			
SIEVES	WEIGHT	% RET.	% PASSING	JMF
19 mm	0	#DIV/0!	#DIV/0!	100
12.5 mm	22.18	#DIV/0!	#DIV/0!	98
9.5 mm	215.8	#DIV/0!	#DIV/0!	86
2.36 mm	986.5	#DIV/0!	#DIV/0!	43
75 um	1502.41	#DIV/0!	#DIV/0!	5.5

Does this Sample Meet Mixture Control Tolerances in Section 828?

A second QA sample was obtained on the 12.5 mm Superpave mix and the following sample information was obtained

Calculate the extraction below:

Type of Mix	12.5 mm SP	Mix Temperature	300
Total Weigth	1660.3	Final Wt. Silica	192.7
Total Dry Weight	0	Beginning Wt. Silica	125
Difference in Wt.	1660.3	Difference in Wt.	
Percent AC		+ Dry Weight	1500.5
JMF AC %	5.50	Total Dry Weight	

0	Total Dry Weight of Sample

SIEVES	WEIGHT	% RET.	% PASSING	JMF
19 mm	0	#DIV/0!	#DIV/0!	100
12.5 mm	21.8	#DIV/0!	#DIV/0!	98
9.5 mm	213.6	#DIV/0!	#DIV/0!	86
2.36 mm	981.5	#DIV/0!	#DIV/0!	43
75 um	1501.1	#DIV/0!	#DIV/0!	5.5

For the 12.5 mm Superpave mix in the Previous Problem

Does this sample meet GDOT specified requirements?

What must the contractor do at this point

What about the mix in the silo?

How long are extracted aggregate from QA samples required to be stored at the asphalt plant?

Blending Problem 3 – 9.5 mm SP Type 2

Mix Type :	9.5 mm	Type 2				Percent of RAP 30% AC in RAP 4.89 %					
Plant Type	Drum					Percent of AC = 5.50% Lime %				0.9%	
Plant Speed	300 TPH					COAC = ____________					
SIZE	7	89	W10	M10	RAP	Lime		COMB.		JMF	LIMITS
SOURCE								GRAD.			
1 1/2"	100	100	100	100	100	100				100	100
1"	100	100	100	100	100	100				100	100
3/4"	100	100	100	100	100	100				100	100
1/2"	71.0	100.0	100	100	99	100				100	98-100
3/8"	18	99	100	100	96	100				98	90-100
#4	2	39	99	99	76	100				70	55-75
#8	1.5	6	79	87	59	100				47	42-47
#16	1	4	56	67	48	100					
#30	1	3	41	52	40	100					
#50		2	24	35	30	100					
#100		1	10	20	20	100					
#200		1	3.1	11	11	100				6.0	5.0-7.0
					30%	0.9%					

COAC- Corrected Optimum AC

9.5 mm Superpave Mix with 5.50 % original optimum AC (OOAC) with 30 % and AC in 4.89 % RAP

Using short cut method

Calculate the Percent of Lime in pounds/minute

Mix Type :	9.5 mm	Type 2				Percent of RAP 30% - AC in RAP 4.89 %
Plant Type	Drum					Percent of AC = 5.50%
Mix Type	GDOT					COAC = ________
Plant Speed	300 TPH					Lime % 0.9%

What about Anti-strip

What if Anti-strip additive was also required at a rate of 0.5 percent of neat AC. How many pounds per minute of additive will be required?

On what QPL are approved anti-stripping additives listed?

Blending Problem - 3 - 9.5 mm SP Type II
What are the Bin Pulls for each Material?

Sieve Size	7	89	W10	M10	RAP	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100	100	100
25 mm	100	100	100	100	100	100	100	100
19 mm	100	100	100	100	100	100	100	100
12.5 mm	71	100	100	100	99	100	99.7	100
9.5 mm	18	99	100	100	96	100	98.4	98
4.75 mm	2	39	99	99	76	100	69.9	70
2.36 mm	1.5	6	79	87	59	100	46.8	47
75 um	0	1	3.1	11	11	100	6.2	6
							100	
							100	

Aggregate Bin Pull Calculations
In Pounds per Minute

Total Aggregate TPH	0					
Aggregate Type (size)	0	89	W10	810	RAP	Lime
Total Plant Production TPH (A)	0	0	0	0	0	0
Aggregate Bin Pull % (B)	0	37	24	8.1	30	0.9
Each Agg. % TPH (C = A x (B/100)	0.00	0.00	0.00	0.00	0.00	0.00
Convert Tons to Pounds (D = C x 20	0	0	0	0	0	0
Calculate PPM (E = D/60)	0.0	0.0	0.0	0.0	0.0	0.0

Total Calculated Aggregate TPH	0.00		Check	0	**Agg. TPH**
Total Calculated Aggregate PPM	0.0			0	**Agg PPM**

Using the information below, calculate the maximum and effective specific gravities

Flask Number	1	2	3	4
Percent of AC	5	5	5.5	5.5
Sample Wt in Air	1695.3	1693.4	1699.8	1700.9
Flask Wt in Air	454.1	454.2	453.9	455.1
Net Wt				
Sample Wt in Water	820.9	819.3	821.2	820.8
Flask Wt in Water	75.3	75.1	75.9	75.2
Net Wt in Water				
Difference				
Maximum SPG				
SPG of AC	1.033	1.033	1.033	1.033
Effective SPG				

Maximum SPG =

(Air Weight)

$$\frac{\text{(Air Weight)}}{\text{(Air Weight-Water Weight)}}$$

Effective SPG

$$\frac{\text{(\% Aggregate)}}{\text{(100/Maximum SPG) - (\% AC / AC SPG)}}$$

Tonnage Reduction

Combined Specific Gravity of Aggregate	2.779
Percent of Asphalt Cement	5.20 %
Percent of Hydrated Lime	0.90 %
Lot Tonnage	1250 tons

Determine T1

$$T1 = T \times \left\{ \frac{\% AC + \left(\dfrac{\% \text{ Aggregate} \times 2.75}{\text{combined bulk Specific Gravity}} \right) + \% Y}{100} \right\}$$

T1	Pay weight, tonnage (Mg)
T=	Actual weight
% AC=	Percent asphalt cement by weight of total mixture
% Aggregate =	Percent aggregate by weight of total mixture minus the hydrated lime
Combined Bulk Sp. Gr.=	Calculated combined bulk specific gravity of various mineral aggregates used in the mixture
% Y=	Percent hydrated lime by weight of mineral aggregate

Job Mix Formula (JMF) SOP 40

Original Job Mix Formula Approval

After the Contract has been awarded, Job mix Formulas must be submitted at least two weeks prior to the beginning of mixing operations in accordance with Section 400.1.03.C.

No asphaltic concrete work will be started until the Bituminous Technical Services Engineer has approved a Job Mix Formula for the mixture to be used. No mixture will be accepted until the Job Mix Formula is approved.

Revised Job Mix Formula Approval

The Contractor may request a revision to the original Job Mix Formula during the adjustment period in accordance with Section 400.3.06.B if improvement in density is required. The Bituminous Construction Technical Services Engineer may make revisions to the Job Mix Formula to address any mixture quality control issues.

Job Mix Formula revisions must be submitted in writing meeting the requirements of Section II

Job Mix Formulas will not be revised after the beginning of a lot of asphaltic concrete. If a revision is required during production, the lot will be closed and new one established prior to any revisions being used on the 159.

Who is responsible for submitting JMF?

What determines the JMF mix temperature?

What is the temperature tolerance from the temperature specified on the JMF?

Request for Approval of Asphaltic Concrete Job Mix Formula

Company Name: __________

Project No.: __________ County: __________

Contr. ID No.: __________ PI No.: __________

Bituminous TSE: __________ Date: __________

Area Engineer: __________ District: __________

Plant Location: __________ Plant No.: __________

Person Responsible for Quality Control: __________

Type of Mix	Original Mix Design ID	Agg. Size	Percentage	Source No.	Source/Location
SiteManager Mix ID #					
Material Code					
Type of Mix	Original Mix Design ID				
SiteManager Mix ID #					
Material Code					
Type of Mix	Original Mix Design ID				
SiteManager Mix ID #					
Material Code					

Grade of AC:	PG:		JMF Temp°F
Maximum Three (3) Sources per AC Grade	PG:		JMF Temp°F
	PG:		JMF Temp°F
	PG:		JMF Temp°F
	PG:		JMF Temp°F
	PG:		JMF Temp°F
Type of Anti-strip Additive	HydratedLime	☐	
	Liquid A.S.	☐	
Fiber	Mineral	☐	
	Cellulose	☐	

MIXTURE DATA

	Mix Type	Mix Type	Mix Type
1-1/2" / 37.5 mm			
1" / 25 mm			
3/4" / 19mm			
1/2" / 12.5 mm			
3/8" / 9.5 mm			
No. 4 /4.75 mm			
No.8 /2.36 um			
No.50 /300 um			
No. 200 /0.75 um			
Percent A.C.			
Theo. Spec. Gravity (Gmm)			
Calibration Factor			

Approved ☐

Disapproved ☐ BY: __________ Date: __________

Remarks / Locations: __________

COPIES TO: __________

Only a _________ approved Mix Design can be used?

Who is responsible for approving the JMF?

What is the frequency for checking mixture temperature at the asphalt plant

QA Samples and Plant Adjustments

Plant Adjustments – JMF 9.5 mm Superpave

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.9	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	73.3	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	45.9	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	6.3	6.0
AC								5.80
	0.0	31.0	32.1	11.0	25.0	0.9	100.0	

Is this a Type I or Type II 9.5 mm SP mix?

QA Sample - 1

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	98.0	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	78.7	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	53.4	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	7.3	6.0
AC							6.15	5.80

What Changes would you make?

QA Sample - 2

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.8	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	64.6	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	35.0	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	5.4	6.0
AC							5.60	5.80

What Changes would you make?

QA Sample - 3

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.9	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	68.9	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	41.8	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	6.7	6.0
AC							5.77	5.80

What Changes would you make?

QA Sample - 4

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.9	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	73.1	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	48.9	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	8.1	6.0
AC							5.95	5.80

What Changes would you make?

QA Sample - 5

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	98.0	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	78.8	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	52.8	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	7.0	6.0
AC							6.10	5.80

What changes would you make?

Plant Adjustments – JMF 12.5 mm Superpave

Sieve	7	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	96.7	97
9.5 mm	44	99	100	100	98	100	85.3	85
4.75 mm	4	35	100	78	86	100	57.9	
2.36 mm	1.6	7.7	82	61	72	100	43.3	43
75 um	0.5	0.5	4.4	12	13	100	6.1	6
AC								5.6
	25	20	22	7.1	25	0.9	100.0	

QA Sample - # 1

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	95.2	97
9.5 mm	44	99	100	100	98	100	78.7	85
4.75 mm	4	35	100	78	86	100	54.2	
2.36 mm	1.6	7.7	82	61	72	100	42.6	43
75 um	0.5	0.5	4.4	12	13	100	6.1	6
AC							5.35	5.60

What Changes would you make?

QA Sample - # 2

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	86.9	100	100	100	100	100	98.0	97
9.5 mm	43.9	99.1	100	100	98.1	100	91.0	85
4.75 mm	4	35.1	99.5	78.3	86.3	100	75.2	
2.36 mm	1.6	7.7	82.3	61.1	72.1	100	60.3	43
75 um	0.5	0.5	4.4	11.7	12.6	100	6.9	6
AC							5.75	5.60

What Changes would you make?

QA Sample - # 3

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	97.4	97
9.5 mm	44	99	100	100	98	100	88.0	85
4.75 mm	4	35	100	78	86	100	55.9	
2.36 mm	1.6	7.7	82	61	72	100	39.5	43
75 um	0.5	0.5	4.4	12	13	100	6.0	6
AC							5.55	5.60

What Changes would you make?

QA Sample - # 4

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	96.7	97
9.5 mm	44	99	100	100	98	100	85.4	85
4.75 mm	4	35	100	78	86	100	61.8	
2.36 mm	1.6	7.7	82	61	72	100	48.2	43
75 um	0.5	0.5	4.4	12	13	100	7.3	6
AC							5.88	5.60

What Changes would you make?

QA Sample - # 5

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	95.4	97
9.5 mm	44	99	100	100	98	100	79.8	85
4.75 mm	4	35	100	78	86	100	52.3	
2.36 mm	1.6	7.7	82	61	72	100	40.2	43
75 um	0.5	0.5	4.4	12	13	100	6.9	6
AC							6.16	5.60

What Changes would you make?

Plant Adjustments – JMF 19 mm Superpave

Sieve	6	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	95.0	95
12.5 mm	22	100	100	100	99	100	81.0	81
9.5 mm	8	99	100	100	90	100	75.2	75
4.75 mm	2	35	99	84	72	100	49.9	50
2.36 mm	1	6	81	65	55	100	33.2	33
75 um	0	1	3	10	11	100	5.2	5
AC								4.7
	24	28	14	8.1	25	0.9	100.0	

QA Sample - # 1

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	92.7	95
12.5 mm	22	100	100	100	99	100	72.5	81
9.5 mm	8	99	100	100	90	100	65.1	75
4.75 mm	2	35	99	84	72	100	46.2	50
2.36 mm	1	6	81	65	55	100	32.6	33
75 um	0	1	3	10	11	100	5.1	5
AC							4.35	4.7

What Changes would you make?

QA Sample - # 2

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	95.8	95
12.5 mm	22	100	100	100	99	100	84.2	81
9.5 mm	8	99	100	100	90	100	78.9	75
4.75 mm	2	35	99	84	72	100	59.9	50
2.36 mm	1	6	81	65	55	100	43.7	33
75 um	0	1	3	10	11	100	5.9	5
AC							4.81	4.7

What Changes would you make?

QA Sample - # 3

Sieve	6	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	96.9	95
12.5 mm	22	100	100	100	99	100	88.1	81
9.5 mm	8	99	100	100	90	100	83.4	75
4.75 mm	2	35	99	84	72	100	53.2	50
2.36 mm	1	6	81	65	55	100	34.2	33
75 um	0	1	3	10	11	100	5.7	5
AC							4.90	4.7

What Changes would you make?

QA Sample - # 4

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	93.7	95
12.5 mm	22	100	100	100	99	100	76.4	81
9.5 mm	8	99	100	100	90	100	69.8	75
4.75 mm	2	35	99	84	72	100	53.2	50
2.36 mm	1	6	81	65	55	100	39.3	33
75 um	0	1	3	10	11	100	6.5	5
AC							5.11	4.7

What Changes would you make?

QA Sample - # 5

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	95.0	95
12.5 mm	22	100	100	100	99	100	81.0	81
9.5 mm	8	99	100	100	90	100	75.3	75
4.75 mm	2	35	99	84	72	100	59.0	50
2.36 mm	1	6	81	65	55	100	44.1	33
75 um	0	1	3	10	11	100	6.6	5
AC							4.88	4.7

What Changes would you make?

Plant Adjustments – JMF 25 mm Superpave

Sieve	5	6	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.3	97
19 mm	27	79	100	100	100	100	100	85.1	85
12.5 mm	2	22	100	100	100	99	100	70.2	70
9.5 mm	2	8	99	100	100	93	100	65.9	
4.75 mm	1	2	35	99	84	72	100	46.7	
2.36 mm	1	1	6	81	65	55	100	33.0	33
75 um	0	0	1	3	10	11	100	4.9	5
AC									4.40
	15	19	18	16	6.1	25	0.9	100.0	

QA Sample - # 1

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	95.7	97
19 mm	27	79	100	100	100	100	100	78.5	85
12.5 mm	2	22	100	100	100	99	100	61.4	70
9.5 mm	2	8	99	100	100	93	100	57.2	
4.75 mm	1	2	35	99	84	72	100	43.6	
2.36 mm	1	1	6	81	65	55	100	32.5	33
75 um	0	0	1	3	10	11	100	4.8	5
AC								4.35	4.40

What Changes would you make?

QA Sample - # 2

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	96.6	97
19 mm	27	79	100	100	100	100	100	84.0	85
12.5 mm	2	22	100	100	100	99	100	73.3	70
9.5 mm	2	8	99	100	100	93	100	70.3	
4.75 mm	1	2	35	99	84	72	100	55.3	
2.36 mm	1	1	6	81	65	55	100	41.7	33
75 um	0	0	1	3	10	11	100	6.2	5
AC								4.64	4.40

What Changes would you make?

QA Sample - # 3

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.3	97
19 mm	27	79	100	100	100	100	100	83.4	85
12.5 mm	2	22	100	100	100	99	100	64.0	70
9.5 mm	2	8	99	100	100	93	100	58.6	
4.75 mm	1	2	35	99	84	72	100	41.2	
2.36 mm	1	1	6	81	65	55	100	29.3	33
75 um	0	0	1	3	10	11	100	4.9	5
AC								4.19	4.40

What Changes would you make?

QA Sample - # 4

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.7	97
19 mm	27	79	100	100	100	100	100	87.4	85
12.5 mm	2	22	100	100	100	99	100	75.3	70
9.5 mm	2	8	99	100	100	93	100	71.6	
4.75 mm	1	2	35	99	84	72	100	52.7	
2.36 mm	1	1	6	81	65	55	100	38.3	33
75 um	0	0	1	3	10	11	100	6.3	5
AC								4.29	4.40

What Changes would you make?

QA Sample - # 5

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.3	97
19 mm	27	79	100	100	100	100	100	85.1	85
12.5 mm	2	22	100	100	100	99	100	70.2	70
9.5 mm	2	8	99	100	100	93	100	65.9	
4.75 mm	1	2	35	99	84	72	100	46.7	
2.36 mm	1	1	6	81	65	55	100	33.0	33
75 um	0	0	1	3	10	11	100	4.9	5
AC								3.99	4.40

What Changes would you make?

Answers to Exercises

COAC- Corrected Optimum AC – OLD (75:25)

SOP 2 – Appendix D

Method of calculating Credited Asphalt Cement content for asphaltic concrete mixtures incorporating reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS)

Example: 12.5 mm SMA Mix with 6.1 % original optimum AC (OOAC) with 15 % RAP with 5.75 % AC in RAP

Using standard mix design procedure, RAP binder contribution constitutes

5.75 x 0.15 = 0.86 % AC for 100 % binder credit

Using factor to calculate Credited AC (CAC)

0.86 x 0.75 = 0.65 % CAC

Using factor to calculate Non-Credited AC (NCAC)

0.86 - 0.65 = 0.21 % NCAC

Add 0.21 % + 6.1 % = 6.31 % COAC

The COAC is 6.31 % On JMF COAC = 6.30

This will be noted on the bottom of the design and submitted for job mix formulas

COAC- Corrected Optimum AC – January 2019 60:40

SOP 2 – Appendix D

Method of calculating Credited Asphalt Cement content for asphaltic concrete mixtures incorporating reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS)

Example: 12.5 mm SMA Mix with 6.1 % original optimum AC (OOAC) with 15 % RAP with 5.75 % AC in RAP

Using standard mix design procedure, RAP constitutes

5.75 x 0.15 = 0.86 % AC for 100 % binder credit

Using factor to calculate Credited AC (CAC)

0.86 x 0.60 = 0.52 % CAC

Using factor to calculate Non-Credited AC (NCAC)

0.86 - 0.52 = 0.34% NCAC

Add 0.34 % + 6.1 % = 6.44 % COAC

The COAC is 6.44 % On JMF COAC = 6.40

This will be noted on the bottom of the design and submitted for job mix formulas

COAC- Corrected Optimum AC – January 2019 (60:40)

Short Cut

Example: 12.5 mm SMA Mix with 6.1 % original optimum AC (OOAC) with 15 % RAP and RAP AC is 5.75 %

Using short cut method

5.75 x 0.15 x 0.40 = 0.34 % Non-credited Binder AC

Add 0.34 % + 6.1 % = 6.44 % COAC

The COAC is 6.44 % On JMF COAC = 6.40

This will be noted on the bottom of the design and submitted for job mix formulas

What is the Maximum % RAP Allowed in SMA

15 %

What GDT governs testing protocol for determining AC content using the Ignition Oven?

GDT 125

What are the minimum and maximum sample weights for 12.5 mm SMA mix?

Minimum 1500 grams and maximum 2500 grams

What PG binder grade is required for 12.5 mm SMA

PG76-22

Where do you find the PG binder grade requirements for various mix types?

Sub-section 828.2.A.9.b

What is the frequency for AC samples on a state project?

1 sample per week (7 calendar days)

GSP 21 Section A.9.c

What is the frequency for AC samples on an interstate project?

2 sample per week (7 calendar days)

GSP 21 Section A.9.c

What PG binder grade is required for 12.5 mm SMA

PG76-22

Where do you find the PG binder grade requirements for various mix types?

Sub-section 828.2.A.9.b

What is the frequency for AC samples on a state project?

1 sample per week (7 calendar days)

GSP 21 Section A.9.c

What is the frequency for AC samples on an interstate project?

2 sample per week (7 calendar days)

GSP 21 Section A.9.c

Blending Problem 1- 12.5 mm SMA

Plant Type Drum **Mix Type 12.5 mm SMA**

15 % RAP **RAP AC 5.75 %** **12.5 mm SMA** **15 % RAP**

Plant Speed 300 TPH **COAC 6.40 %** **Percent Lime 1.0 %**

Sieve Size	7	89	W10	RAP	Fly Ash	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100	100.0	100
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	92.9	93
9.5 mm	45	99.1	100	98.4	100	100	70.1	70
4.75 mm	4.0	16.7	92.3	83	100	100	28.1	28
2.36 mm	1.4	8.1	84.1	75.2	100	100	23.7	24
300 um	1	3.1	6.2	47.4	99	100	18.2	18
75 um	0.8	0.5	4.4	9.5	84.3	100	10.5	11

Blending Problem – 1 – 12.5 mm SMA
Example: Start with the 2.36 mm Sieve

Sieve Size	7	89	W10	RAP	Fly Ash	Lime	Comb. Grad.	JMF
2.36 mm	**1.4**	**8.1**	**84.1**	**75.2**	**100**	**100**		**24**
Bin Pull %	54.0	21.0	0.0	15.0	9.1	0.9		
	1.4 x 0.54	8.1 x 0.21	0.0	75.2x 0.15	100 x 0.091	100 x 0.009		
	0.8	1.7	0.0	11.3	9.1	0.9	23.8	24
300 um	**1**	**3.1**	**6.2**	**47.4**	**99**	**100**		**18**
Bin Pull %	54	21	0	15	9.1	0.9		
	1 x 0.54	3.1 x 0.21	0	47.4 x 0.15	99 x 0.091	100 x 0.009		
	0.5	0.7	0	7.1	9	0.9	18.2	18

Blending Problem – 1 – 12.5 mm SMA

Sieve Size	7	89	W10	RAP	Fly Ash	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100	100.0	100
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	92.9	93
9.5 mm	45	99	100	98.4	100	100	70.1	70
4.75 mm	4.0	17	92	83	100	100	28.1	28
2.36 mm	1.4	8.1	84	75.2	100	100	23.7	24
300 um	1	3.1	6.2	47.4	99	100	18.2	18
75 um	0.8	0.5	4.4	9.5	84.3	100	10.5	11
	54	21	0	15	9.1	0.9	100	

Blending Problem 2 - 12.5 mm SP

Plant Type Drum

Mix Type 12.5 mm SP

Optimum AC 5.35 %

Drum

25 % RAP RAP AC 4.75 % Plant Speed 250 TPH

Percent Lime .9%

SIZE	007	089	w10		Rap	Lime		COMB.	JMF
SOURCE								GRAD.	
1 1/2"	100.0	100.0	100.0		100.0	100.0			100
1"	100.0	100.0	100.0		100.0	100.0			100
3/4"	100.0	100.0	100.0		100.0	100.0			100
1/2"	86.9	100.0	100.0		100.0	100.0			98
3/8"	43.9	99.1	100.0		98.4	100.0			86
#4	3.0	35.7	99.5		87.0	100.0			56
#8	1.4	7.1	84.1		71.8	100.0			43
#16	1.1	3.8	63.9		60.8	100.0			33
#30	1.0	2.0	46.2		48.2	100.0			26
#50	0.8	1.6	27.8		35.2	100.0			18
#100	0.7	1.0	12.6		21.9	100.0			11
#200	0.5	0.5	4.4		11.9	100.0			5.5
Pull									

COAC- Corrected Optimum AC

12.5 mm Superpave Mix with 5.35 % original optimum AC (OOAC) with 25 % and AC in 4.75 % RAP (25% RAP with RAP AC of 4.75%)

Using short cut method

4.75 x 0.25 x 0.40 = 0.48 % Non-credited Binder AC

Add 0.48 % + 5.35 % = 5.83 % COAC

The COAC is 5.83 % JMF COAC = 5.80%

Blending Problem – 2 – 12.5 mm SP

Sieve Size	7	89	W10	RAP	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100.0	100
25 mm	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	97.0	98
9.5 mm	44	99	100	98	100	86.5	86
4.75 mm	4.0	36	100	87	100	59.1	59
2.36 mm	1.4	7.1	84	72	100	43.7	43
75 um	0.8	0.5	4.4	12	100	5.4	5.5
	23	24	27	25	0.9	100	

Aggregate Moisture Sample Testing

Aggregate Bin	007	089	W10	RAP	
Aggregate Bin Pull %					
Initial Weight	500	500	500	500	
Final Dry Weight	484	472	463	459	

Aggregate Moisture Percent

Aggregate Bin	7	89	W10	RAP
Aggregate Bin Pull #	23	24	27.1	25
Initial Weight (A)	500	500	500	500
Final Dry Weight (B)	484	472	463	459
Difference	16	28	37	41
% Moisture = [(A - B)/B] x 100	(16/484) x 100	(28/472) x 100	(37/463) x 100	(41/459) x 100
% Moisture	3.31	5.93	7.99	8.93
Ex. Agg. % Moisture Blend				
Aggregate % Moisture Blend	0.76	1.42	2.17	2.23
Combined % Moisture	6.58			
	4.35	(Virgin Aggr.)		2.23 (RAP)

Calculate the extraction below:

Type of Mix: 12.5 mm Superpave		Temperature:	305
Total Weight	2257.4	Final Weight of Silica	258.8
Dry Weight		Beginning Weigh Silica	125.0
Difference Weight		Difference	
Percent AC		+ Dry Sample Weight	2014.0
Job Mix Formula AC	5.5	Total Dry Weight	

Calcualte the extraction below:

Type Of Mix	12.5 mm SP	Temperature	305
Total Weight of Sample	2257.40	Beginning Weight of Silica	125.00
Total Dry Sample Weight	2147.80		
		Final Weight of Silica	258.80
Difference	109.60		
		Difference	133.80
Percent of AC	4.86		
		Dry Sample Weight	2014.00
JMF Percent of AC	5.50		
		Total Dry Sample Weight	2147.80
Variation % from JMF	0.64		

You are producing the12.5 mm Superpave mix through a drum plant using 007, 089, 810, W10 and RAP

Calculate the extraction below:

Type of Mix	12.5 mm SP	Mix Temperature	300	
Total Weigth	1665.6	Final Wt. Silica	199.5	
Total Dry Weight	0	Beginning Wt. Silica	125	
Difference in Wt.	1665.6	Difference in Wt.		
Percent AC		+ Dry Weight	1502.8	
JMF AC %	5.50	Total Dry Weight		
0	Total Dry Weight of Sample			
SIEVES	WEIGHT	% RET.	% PASSING	JMF
19 mm	0	#DIV/0!	#DIV/0!	100
12.5 mm	22.18	#DIV/0!	#DIV/0!	98
9.5 mm	215.8	#DIV/0!	#DIV/0!	86
2.36 mm	986.5	#DIV/0!	#DIV/0!	43
75 um	1502.41	#DIV/0!	#DIV/0!	5.5

You are producing the 12.5 mm Superpave mix through a drum plant using 007, 089, 810, W10 and RAP

Calculate the extraction below:

Type of Mix	12.5 mm SP	Mix Temperature	300	
Total Weigth	1665.6	Final Wt. Silica	199.5	
Total Dry Weight	1577.3	Beginning Wt. Silica	125	
Difference in Wt.	88.3	Difference in Wt.	74.5	
Percent AC	5.30	+ Dry Weight	1502.8	
JMF AC %	5.50	Total Dry Weight	1577.3	
1577.3	Total Dry Weight of Sample			
SIEVES	WEIGHT	% RET.	% PASSING	JMF
19 mm	0	0	100	100
12.5 mm	22.18	1.4	98.6	98
9.5 mm	215.8	13.7	86.3	86
2.36 mm	986.5	62.5	37.5	43
75 um	1502.41	95.3	4.7	5.5

Does this sample meet GDOT specified requirements?

NO

Where are the specified mixture control tolerances found?

Section 828

A second QA sample was obtained on the 12.5 mm Superpave mix and the following sample information was obtained

Calculate the extraction below:

Type of Mix	12.5 mm SP	Mix Temperature	300
Total Weigth	1660.3	Final Wt. Silica	192.7
Total Dry Weight	0	Beginning Wt. Silica	125
Difference in Wt.	1660.3	Difference in Wt.	
Percent AC		+ Dry Weight	1500.5
JMF AC %	5.50	Total Dry Weight	

0	Total Dry Weight of Sample

SIEVES	WEIGHT	% RET.	% PASSING	JMF
19 mm	0	#DIV/0!	#DIV/0!	100
12.5 mm	21.8	#DIV/0!	#DIV/0!	98
9.5 mm	213.6	#DIV/0!	#DIV/0!	86
2.36 mm	981.5	#DIV/0!	#DIV/0!	43
75 um	1501.1	#DIV/0!	#DIV/0!	5.5

You are producing 12.5 mm Superpave mix through a drum plant using 007, 089, 810, W10 and RAP

Calculate the extraction below:

Type of Mix	12.5 mm SP	Mix Temperature	300	
Total Weigth	1660.3	Final Wt. Silica	192.75	
Total Dry Weigh	1568.25	Beginning Wt. Sili	125	
Difference in W	92.05	Difference in Wt.	67.75	
Percent AC	5.54	+ Dry Weight	1500.5	
JMF AC %	5.20	Total Dry Weight	1568.25	
1568.25	Total Dry Weight of Sample			

SIEVES	WEIGHT	% RET.	% PASSING	JMF
19 mm	0	0	100	100
12.5 mm	21.8	1.4	98.6	98
9.5 mm	213.6	13.6	86.4	86
2.36 mm	981.5	62.6	37.4	43
75 um	1501.1	95.7	4.3	5.5

Does this sample meet GDOT specified requirements?

NO

What must the contractor do at this point

Stop mixture production until a passing sample is obtained.

What about the mix in the silo?

Reject any mixture deviating > 10% in gradation or deviating > 0.7 % in AC content from JMF

How long are extracted aggregate from QA samples required to be stored at the asphalt plant?

b. Properly label the extracted aggregate, ensure that it is stored in an approved container and secured in a protected and enclosed environment. If samples meet a 1.00 pay factor and are not procured by the Department within three state funded production days, they may be discarded. If there is less than a 1.00 pay factor, the sample must be saved for seven state funded production days before being discarded.

Blending Problem 3 – 9.5 mm SP Type 2

Mix Type :	9.5 mm	Type 2				Percent of RAP 30%	AC in RAP 4.89 %
Plant Type	Drum					Percent of AC = 5.50% Lime %	0.9%
Plant Speed	300 TPH					COAC = ____________	

SIZE	7	89	W10	M10	RAP	Lime	COMB.	JMF	LIMITS
SOURCE							GRAD.		
1 1/2"	100	100	100	100	100	100		100	100
1"	100	100	100	100	100	100		100	100
3/4"	100	100	100	100	100	100		100	100
1/2"	71.0	100.0	100	100	99	100		100	98-100
3/8"	18	99	100	100	96	100		98	90-100
#4	2	39	99	99	76	100		70	55-75
#8	1.5	6	79	87	59	100		47	42-47
#16	1	4	56	67	48	100			
#30	1	3	41	52	40	100			
#50		2	24	35	30	100			
#100		1	10	20	20	100			
#200		1	3.1	11	11	100		6.0	5.0-7.0
					30%	0.9%			

COAC- Corrected Optimum AC

9.5 mm Superpave Mix with 5.50 % original optimum AC (OOAC) with 30 % and AC in 4.89 % RAP

Using short cut method

4.89 x 0.30 x 0.40 = 0.59 % Non-credited Binder AC

Add 0.59 % + 5.50 % = 6.09 % COAC

JMF COAC is 6.10 % Round to nearest tenth

Calculate the Percent of Lime in pounds/minute

Mix Type :	9.5 mm	Type 2				Percent of RAP 30% - AC in RAP 4.89 %
Plant Type	Drum					Percent of AC = 5.50%
Mix Type	GDOT					COAC = ________
Plant Speed	300 TPH					Lime % 0.9%

Calculate Percent of Hydrated Lime

0.9	equals % of Lime Required								
300	TPH	X	6.10	% AC =	18.3				
300	TPH -	18.3	TPH =	281.7	TPH Arregate + Lime				
281.7	TPH Aggregate		divided	1.009	% of Lime =		279.19	TPH Agg. - Lime	
281.7	TPH Aggregate -		279.19	TPH Aggregate - Lime =				2.51	TPH Lime
2.51	TPH Lime X		2000	lbs per	divided	60	Minutes per Hour		
Equal	83.8	lbs per minute Lime							

What about Anti-strip

What if Anti-strip additive was also required at a rate of 0.5 percent of neat AC. How many pounds per minute of additive will be required?

Calculate Percent of Anti-Strip Additive

0.5	% of Liquid Anti-Strip Additive Required (LASA)					6.10	% COAC	
30	equals % of RAP		4.89	equals % RAP AC		300	Tons of Mix per hour	
300	TPH Mi: X		0.30	% RAP	90.0	TPH of RAP		
90.0	TPH RAP X		4.89	% RAP AC =		4.40	TPH RAP AC	
300	TPH x	6.10	% Total	18.3	TPH Total AC			
18.30	TPH Total AC --			4.40	TPH of RAP AC =		13.90	TPH Neat AC
13.90	TPH TPH Neat AC x		0.0050	TPH LASA =		0.069	TPH LASA	
0.069	TPH LASA X		2000	lbs per / by		60	Minutes per Hour	
Equal	2.32	lbs per min LASA						

On what QPL are approved anti-stripping additives listed?

QPL 26

Blending Problem - 3 - 9.5 mm SP Type II

Sieve Size	7	89	W10	M10	RAP	Lime	Comb. Grad.	JMF
37 mm	100	100	100	100	100	100	100	100
25 mm	100	100	100	100	100	100	100	100
19 mm	100	100	100	100	100	100	100	100
12.5 mm	71	100	100	100	99	100	99.7	100
9.5 mm	18	99	100	100	96	100	98.4	98
4.75 mm	2	39	99	99	76	100	69.9	70
2.36 mm	1.5	6	79	87	59	100	46.8	47
75 um	0	1	3.1	11	11	100	6.2	6
	0	37	24	8.1	30	0.9	100	
							100	

Aggregate Bin Pull Calculations

Total Aggregate TPH	0					
Aggregate Type (size)	0	89	W10	810	RAP	Lime
Total Plant Production TPH (A)	0	0	0	0	0	0
Aggregate Bin Pull % (B)	0	37	24	8.1	30	0.9
Each Agg. % TPH (C = A x (B/100)	0.00	0.00	0.00	0.00	0.00	0.00
Convert Tons to Pounds (D = C x 20	0	0	0	0	0	0
Calculate PPM (E = D/60)	0.0	0.0	0.0	0.0	0.0	0.0

Total Calculated Aggregate TPH	0.00		Check	0	**Agg. TPH**
Total Calculated Aggregate PPM	0.0			0	**Agg PPM**

Using the information below, calculate the maximum and effective specific gravities

Flask Number	1	2	3	4
Percent of AC	5	5	5.5	5.5
Sample Wt in Air	1695.3	1693.4	1699.8	1700.9
Flask Wt in Air	454.1	454.2	453.9	455.1
Net Wt				
Sample Wt in Water	820.9	819.3	821.2	820.8
Flask Wt in Water	75.3	75.1	75.9	75.2
Net Wt in Water				
Difference				
Maximum SPG				
SPG of AC	1.033	1.033	1.033	1.033
Effective SPG				

Maximum SPG =
<u>(Air Weight)</u>

$$\text{Maximum SPG} = \frac{\text{(Air Weight)}}{\text{(Air Weight-Water Weight)}}$$

$$\text{Effective SPG} = \frac{\text{(\% Aggregate)}}{\text{(100/Maximum SPG) - (\% AC / AC SPG)}}$$

Calculate the Maximum and Effective Specific Gravities (SPG)

Flask Number	1	2	3	4
Percent of AC	5	5	5.5	5.5
Sample Wt in Air (A)	1695.3	1693.4	1699.8	1700.9
Flask Wt in Air (B)	454.1	454.2	453.9	455.1
Net Wt (C = A - B)	1241.2	1239.2	1245.9	1245.8
Sample Wt in Water (D)	820.9	819.3	821.2	820.8
Flask Wt in Water [E]	75.3	75.1	75.9	75.2
Net Wt in Water (F = D - E)	745.6	744.2	745.3	745.6
Difference (G = C - F)	495.6	495	500.6	500.2
Maximum SPG (H = C/G)	2.504	2.503	2.489	2.491
SPG of AC	1.033	1.033	1.033	1.033
Effective SPG {(% Agg)/[(100/H)-(% AC/SPG AC)]}	2.707	2.706	2.711	2.713

$$\text{Maximum SPG} = \frac{(\text{Air Weight (A)})}{(\text{Air Weight (A)} - \text{Water Weight (D)})}$$

$$\text{Effective SPG} = \frac{(\%\ \text{Aggregate})}{(100/\text{Maximum SPG (H)}) - (\%\text{AC}/\text{AC SPG})}$$

Tonnage Reduction

Combined Specific Gravity of Aggregate	2.779
Percent of Asphalt Cement	5.20 %
Percent of Hydrated Lime	0.90 %
Lot Tonnage	1250 tons

$$T1 = T \times \left\{ \frac{\%\ AC + \left(\dfrac{\%\ \text{Aggregate} \times 2.75}{\text{combined bulk Specific Gravity}} \right) + \%\ Y}{100} \right\}$$

T1	Pay weight, tonnage (Mg)
T=	Actual weight
% AC=	Percent asphalt cement by weight of total mixture
% Aggregate =	Percent aggregate by weight of total mixture minus the hydrated lime
Combined Bulk Sp. Gr.=	Calculated combined bulk specific gravity of various mineral aggregates used in the mixture
% Y=	Percent hydrated lime by weight of mineral aggregate

Asphalt Tonnage Reduction – Bulk Gravity

$$T1 = \boxed{1250}\ \text{Actual Wt} \times \left(\frac{\boxed{5}\ \%\ \text{AC} + \left(\dfrac{\boxed{93.90}\ \%\ \text{Agg.} \times 2.75}{\boxed{2.779}\ \text{Comb. BulK SPG}} \right) + \boxed{.90}\ \%\ \text{Y}}{100} \right)$$

$$T1 = \boxed{1250}\ \text{Actual Wt} \times \left(\frac{\boxed{5}\ \%\ \text{AC} + \left(\dfrac{\boxed{258.2}}{\boxed{2.779}\ \text{Comb. BulK SPG}} \right) + \boxed{.90}\ \%\ \text{Y}}{100} \right)$$

$$T1 = \boxed{1250}\ \text{Actual Wt} \times \left(\frac{\boxed{5}\ \%\ \text{AC} + \left(\boxed{92.92} \right) + \boxed{.90}\ \%\ \text{Y}}{100} \right)$$

$$T1 = \boxed{1250}\ \text{Actual Wt.} \times \boxed{0.99}$$

$$T1 = \boxed{1237.75}$$

Job Mix Formula (JMF) SOP 40

Original Job Mix Formula Approval

After the Contract has been awarded, Job mix Formulas must be submitted at least two weeks prior to the beginning of mixing operations in accordance with Section 400.1.03.C.

No asphaltic concrete work will be started until the Bituminous Technical Services Engineer has approved a Job Mix Formula for the mixture to be used. No mixture will be accepted until the Job Mix Formula is approved.

Revised Job Mix Formula Approval

The Contractor may request a revision to the original Job Mix Formula during the adjustment period in accordance with Section 400.3.06.B if improvement in density is required. The Bituminous Construction Technical Services Engineer may make revisions to the Job Mix Formula to address any mixture quality control issues.

Job Mix Formula revisions must be submitted in writing meeting the requirements of Section II

Job Mix Formulas will not be revised after the beginning of a lot of asphaltic concrete. If a revision is required during production, the lot will be closed and new one established prior to any revisions being used on the 159.

Who is responsible for submitting JMF?

QCT Manager…. QCT Level 2

What determines the JMF mix temperature?

Mixture control temperature chart provided by the Bituminous Control Unit

What is the temperature tolerance from the temperature specified on the JMF?

+ or – 20 degrees F

Request for Approval of Asphaltic Concrete Job Mix Formula

Company Name:

Project No.: County:

Contr. ID No.: PI No.:

Bituminous TSE: Date:

Area Engineer: District:

Plant Location: Plant No.:

Person Responsible for Quality Control:

Type of Mix	Original Mix Design ID	Agg. Size	Percentage	Source No.	Source/Location
SiteManager Mix ID #					
Material Code					
Type of Mix	Original Mix Design ID				
SiteManager Mix ID #					
Material Code					
Type of Mix	Original Mix Design ID				
SiteManager Mix ID #					
Material Code					

Grade of AC:	PG:	JMF Temp°F
Maximum Three (3) Sources per AC Grade	PG:	JMF Temp°F
	PG:	JMF Temp°F
	PG:	JMF Temp°F
	PG:	JMF Temp°F
	PG:	JMF Temp°F

Type of Anti-strip Additive	HydratedLime ☐
	Liquid A.S. ☐
Fiber	Mineral ☐
	Cellulose ☐

MIXTURE DATA

	Mix Type	Mix Type	Mix Type
1-1/2" / 37.5 mm			
1" / 25 mm			
3/4" / 19mm			
1/2" / 12.5 mm			
3/8" / 9.5 mm			
No. 4 /4.75 mm			
No.8 /2.36 um			
No.50 /300 um			
No. 200 /0.75 um			
Percent A.C.			
Theo. Spec. Gravity (Gmm)			
Calibration Factor			

Approved ☐

Disapproved ☐ BY: Date:

Remarks / Locations:

COPIES TO:

Only a ________ approved Mix Design can be used?

GDOT approved mix design

Who is responsible for approving the JMF?

Only Bituminous Technical Services Personnel can approve JMFs

What is the frequency for checking mixture temperature at the asphalt plant

Every sample load… and a minimum 1 per hour for Open-graded mix types

QA Samples and Plant Adjustments

Plant Adjustments – JMF 9.5 mm Superpave

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.9	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	73.3	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	45.9	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	6.3	6.0
AC								5.80
	0.0	31.0	32.1	11.0	25.0	0.9	100.0	

Is this a Type I or Type II 9.5 mm SP mix?

Type II 9.5 mm SP mix?

QA Sample - 1

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	98.0	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	78.7	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	53.4	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	7.3	6.0
AC							6.15	5.80

What Changes would you make?

Take 10 % from M10s and add 10 % to 89s – 0.35 % AC

QA Sample - 2

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.8	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	64.6	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	35.0	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	5.4	6.0
AC							5.60	5.80

What Changes would you make?

Take 15 % from 89s and add 10 % to W10s and 5 % to M10s + 0.20 % AC

QA Sample - 3

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.9	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	68.9	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	41.8	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	6.7	6.0
AC							5.77	5.80

What Changes would you make?

Take 8% from 89s and 7 % from M10s and add 15 % to W10s

QA Sample - 4

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	97.9	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	73.1	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	48.9	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	8.1	6.0
AC							5.95	5.80

What Changes would you make?

Take 15% from M10s and add 15 % to W10s – 0.15 % AC

QA Sample - 5

Sieve	7	89	W10	M10	RAP	Lime	Comb. Grad	JMF
37 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
25 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
19 mm	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12.5 mm	86.9	100.0	100.0	100.0	99.0	100.0	99.8	100.0
9.5 mm	43.9	99.0	100.0	100.0	93.0	100.0	98.0	98.0
4.75 mm	4.0	44.0	99.0	98.0	65.0	100.0	78.8	73.0
2.36 mm	1.6	5.0	69.0	80.0	50.0	100.0	52.8	46.0
75 um	0.5	1.0	4.4	11.0	10.0	100.0	7.0	6.0
AC							6.10	5.80

What changes would you make?

Take 5 % from W10s and 5% from M10s and Add to 89s and – 0.3 % AC.

Plant Adjustments – JMF 12.5 mm Superpave

Sieve	7	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	96.7	97
9.5 mm	44	99	100	100	98	100	85.3	85
4.75 mm	4	35	100	78	86	100	57.9	
2.36 mm	1.6	7.7	82	61	72	100	43.3	43
75 um	0.5	0.5	4.4	12	13	100	6.1	6
AC								5.6
	25	20	22	7.1	25	0.9	100.0	

QA Sample - # 1

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	95.2	97
9.5 mm	44	99	100	100	98	100	78.7	85
4.75 mm	4	35	100	78	86	100	54.2	
2.36 mm	1.6	7.7	82	61	72	100	42.6	43
75 um	0.5	0.5	4.4	12	13	100	6.1	6
AC							5.35	5.60

What Changes would you make?

Take 10% from # 7s and add 10% to 89s + 0.25% AC

QA Sample - # 2

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	86.9	100	100	100	100	100	98.0	97
9.5 mm	43.9	99.1	100	100	98.1	100	91.0	85
4.75 mm	4	35.1	99.5	78.3	86.3	100	75.2	
2.36 mm	1.6	7.7	82.3	61.1	72.1	100	60.3	43
75 um	0.5	0.5	4.4	11.7	12.6	100	6.9	6
AC							5.75	5.60

What Changes would you make?

Take 20 % from W10s and add 10 % to # 7s and 10 % to 89s – 0.15 % AC

QA Sample - # 3

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	97.4	97
9.5 mm	44	99	100	100	98	100	88.0	85
4.75 mm	4	35	100	78	86	100	55.9	
2.36 mm	1.6	7.7	82	61	72	100	39.5	43
75 um	0.5	0.5	4.4	12	13	100	6.0	6
AC							5.55	5.60

What Changes would you make?

Take 10 % from 89s and add 5 % to # 7s and 5 % to W10s

QA Sample - # 4

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	96.7	97
9.5 mm	44	99	100	100	98	100	85.4	85
4.75 mm	4	35	100	78	86	100	61.8	
2.36 mm	1.6	7.7	82	61	72	100	48.2	43
75 um	0.5	0.5	4.4	12	13	100	7.3	6
AC							5.88	5.60

What Changes would you make?

Take 12 % 810s and add 10 % to 89s and 2% to W10s – 0.28 % AC

QA Sample - # 5

Sieve	7	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	100	100	100	100	100	100	100.0	100
12.5 mm	87	100	100	100	100	100	95.4	97
9.5 mm	44	99	100	100	98	100	79.8	85
4.75 mm	4	35	100	78	86	100	52.3	
2.36 mm	1.6	7.7	82	61	72	100	40.2	43
75 um	0.5	0.5	4.4	12	13	100	6.9	6
AC							6.16	5.60

What Changes would you make?

Take 10 % from # 7s and 5% from 810s add 10% to 89s and 5 % to W10s -0.55 % AC

Plant Adjustments – JMF 19 mm Superpave

Sieve	6	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	95.0	95
12.5 mm	22	100	100	100	99	100	81.0	81
9.5 mm	8	99	100	100	90	100	75.2	75
4.75 mm	2	35	99	84	72	100	49.9	50
2.36 mm	1	6	81	65	55	100	33.2	33
75 um	0	1	3	10	11	100	5.2	5
AC								4.7
	24	28	14	8.1	25	0.9	100.0	

QA Sample - # 1

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	92.7	95
12.5 mm	22	100	100	100	99	100	72.5	81
9.5 mm	8	99	100	100	90	100	65.1	75
4.75 mm	2	35	99	84	72	100	46.2	50
2.36 mm	1	6	81	65	55	100	32.6	33
75 um	0	1	3	10	11	100	5.1	5
AC							4.35	4.7

What Changes would you make?

Take 10 % from # 6's and add to 89's + 0.35 % AC

QA Sample - # 2

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	95.8	95
12.5 mm	22	100	100	100	99	100	84.2	81
9.5 mm	8	99	100	100	90	100	78.9	75
4.75 mm	2	35	99	84	72	100	59.9	50
2.36 mm	1	6	81	65	55	100	43.7	33
75 um	0	1	3	10	11	100	5.9	5
AC							4.81	4.7

What Changes would you make?

Take 5 % from 810s and 10 % from W10s and add 5 % #6s and 10% 89s – 0.10 % AC

QA Sample - # 3

Sieve	6	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	96.9	95
12.5 mm	22	100	100	100	99	100	88.1	81
9.5 mm	8	99	100	100	90	100	83.4	75
4.75 mm	2	35	99	84	72	100	53.2	50
2.36 mm	1	6	81	65	55	100	34.2	33
75 um	0	1	3	10	11	100	5.7	5
AC							4.90	4.7

What Changes would you make?

Take 8 % from 89s and 5 % from 810s and add 8% to #6s and 5% to W10s -0.20 % AC

QA Sample - # 4

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	93.7	95
12.5 mm	22	100	100	100	99	100	76.4	81
9.5 mm	8	99	100	100	90	100	69.8	75
4.75 mm	2	35	99	84	72	100	53.2	50
2.36 mm	1	6	81	65	55	100	39.3	33
75 um	0	1	3	10	11	100	6.5	5
AC							5.11	4.7

What Changes would you make?

Take 5 % from # 6s and 10 % from 810s and add 10% to 89s and 5 % to W10s – 0.40 % AC

QA Sample - # 5

Sieve	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100.0	
25 mm	100	100	100	100	100	100	100.0	100
19 mm	79	100	100	100	100	100	95.0	95
12.5 mm	22	100	100	100	99	100	81.0	81
9.5 mm	8	99	100	100	90	100	75.3	75
4.75 mm	2	35	99	84	72	100	59.0	50
2.36 mm	1	6	81	65	55	100	44.1	33
75 um	0	1	3	10	11	100	6.6	5
AC							4.88	4.7

What Changes would you make?

Take 10 % from 810s and 3% from W10s and add 13% to 89s – 0.18 % AC

Plant Adjustments – JMF 25 mm Superpave

Sieve	5	6	89	W10	810	RAP	Lime	Comb. Grad	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.3	97
19 mm	27	79	100	100	100	100	100	85.1	85
12.5 mm	2	22	100	100	100	99	100	70.2	70
9.5 mm	2	8	99	100	100	93	100	65.9	
4.75 mm	1	2	35	99	84	72	100	46.7	
2.36 mm	1	1	6	81	65	55	100	33.0	33
75 um	0	0	1	3	10	11	100	4.9	5
AC									4.40
	15	19	18	16	6.1	25	0.9	100.0	

QA Sample - # 1

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	95.7	97
19 mm	27	79	100	100	100	100	100	78.5	85
12.5 mm	2	22	100	100	100	99	100	61.4	70
9.5 mm	2	8	99	100	100	93	100	57.2	
4.75 mm	1	2	35	99	84	72	100	43.6	
2.36 mm	1	1	6	81	65	55	100	32.5	33
75 um	0	0	1	3	10	11	100	4.8	5
AC								4.35	4.40

What Changes would you make?

Take 10 % from # 5s and add to 89s

QA Sample - # 2

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	96.6	97
19 mm	27	79	100	100	100	100	100	84.0	85
12.5 mm	2	22	100	100	100	99	100	73.3	70
9.5 mm	2	8	99	100	100	93	100	70.3	
4.75 mm	1	2	35	99	84	72	100	55.3	
2.36 mm	1	1	6	81	65	55	100	41.7	33
75 um	0	0	1	3	10	11	100	6.2	5
AC								4.64	4.40

What Changes would you make?

Take 5 % from # 5s and 8 % from 810s and add 5 % to # 6s and 8 % to 89s -0.24 % AC

QA Sample - # 3

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.3	97
19 mm	27	79	100	100	100	100	100	83.4	85
12.5 mm	2	22	100	100	100	99	100	64.0	70
9.5 mm	2	8	99	100	100	93	100	58.6	
4.75 mm	1	2	35	99	84	72	100	41.2	
2.36 mm	1	1	6	81	65	55	100	29.3	33
75 um	0	0	1	3	10	11	100	4.9	5
AC								4.19	4.40

What Changes would you make?

Take 10 % from # 6s and add 5 percent to 89s and 5 % to W10s + 0.20 % AC

QA Sample - # 4

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.7	97
19 mm	27	79	100	100	100	100	100	87.4	85
12.5 mm	2	22	100	100	100	99	100	75.3	70
9.5 mm	2	8	99	100	100	93	100	71.6	
4.75 mm	1	2	35	99	84	72	100	52.7	
2.36 mm	1	1	6	81	65	55	100	38.3	33
75 um	0	0	1	3	10	11	100	6.3	5
AC								4.29	4.40

What Changes would you make?

Take 12% from 810s and add 3 % to # 5s, 3 % to 89s and 6 % to W10s + 0.10 % AC

QA Sample - # 5

Sieve	5	6	89	W10	810	RAP	Lime	QA Sample	JMF
37 mm	100	100	100	100	100	100	100	100.0	100
25 mm	82	100	100	100	100	100	100	97.3	97
19 mm	27	79	100	100	100	100	100	85.1	85
12.5 mm	2	22	100	100	100	99	100	70.2	70
9.5 mm	2	8	99	100	100	93	100	65.9	
4.75 mm	1	2	35	99	84	72	100	46.7	
2.36 mm	1	1	6	81	65	55	100	33.0	33
75 um	0	0	1	3	10	11	100	4.9	5
AC								3.99	4.40

What Changes would you make?

Increase AC by 0.4 %

Appendix A – Specifications

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

Section 400—Hot Mix Asphaltic Concrete Construction

Delete Section 400 and substitute the following:

400.1 General Description

This work includes constructing one or more courses of bituminous plant mixture on the prepared foundation or existing roadway surface. Ensure the mixture conforms with lines, grades, thicknesses, and typical cross sections shown on the Plans or established by the Engineer.

This section includes the requirements for all bituminous plant mixtures regardless of the gradation of the aggregates, type and amount of bituminous material, or pavement use.

Acceptance of work is on a lot-to-lot basis according to the requirements of this Section and Section 106.

400.1.01 Definitions

Segregated Mixture: Mixture lacking homogeneity in HMA constituents of such magnitude there is a reasonable expectation of accelerated pavement distress or performance problems. May be quantified by measurable changes in temperature, gradation, asphalt content, air voids, or surface texture.

Wearing Course: The upper course of asphaltic concrete placed on a roadway, airport or other asphalt pavement.

Surface Course: The upper course of asphaltic concrete placed on a roadway, airport or other asphalt pavement and also includes the dense-graded asphaltic concrete mixture beneath Open Graded Friction Course (OGFC) or Porous Eureopean Mixture (PEM).

Intermediate (Binder) Course: The lift(s) of asphaltic concrete above the base course and below the wearing course.

Asphaltic Concrete Base Course: The lower lift(s) of asphaltic concrete generally placed on graded aggregate base (GAB), soil cement or other stabilized base material.

New Construction: A roadway section more than 0.5 mile (800 m) long that is not longitudinally adjacent to the existing roadway. If one or more lanes are added longitudinally adjacent to the existing lane, the lane(s) shall be tested under the criteria for a resurfacing project. If work is performed on the existing roadway including leveling, grade changes, widening and/or resurfacing then that lane shall be tested under the criteria for a resurfacing project.

Trench Widening: Widening no more than 4 ft. (1.2 m) in width.

Comparison Sample: Opposite quarters of material sampled by the Contractor.

Independent Sample (Quality Assurance Sample): A sample taken by the Department to verify an acceptance decision without regard to any other sample that may also have been taken to represent the material in question.

Referee sample: A sample of the material retained during the quartering process which is used for evaluation if a comparison of Contractor and Departmental split sample test results is outside allowable tolerances.

400.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials

Section 109—Measurement and Payment

Section 152—Field Laboratory Building

Section 413—Bituminous Tack Coat

Section 424—Bituminous Surface Treatment

Section 802—Aggregate for Asphaltic Concrete

Section 828—Hot Mix Asphaltic Concrete Mixtures

B. Referenced Documents

AASHTO T 324

AASHTO T 315

AASHTO T 209

AASHTO T 202

AASHTO T 49

Department of Transportation Standard Operating Procedure (SOP) 15

Department of Transportation Standard Operating Procedure (SOP) 27

Department of Transportation Standard Operating Procedure (SOP) 40

Department of Transportation Standard Operating Procedure (SOP) 46

GDT 38

GDT 39

GDT 42

GDT 59

GDT 73

GDT 78

GDT 83

GDT 119

GDT 125

GDT 126

GDT 134

GSP 15

GSP 21

QPL 1

QPL 2

QPL 7

QPL 26

QPL 30

QPL 39

QPL 41

QPL 45

QPL 65

QPL 67

QPL 70

QPL 77

QPL 88

QPL 91

QPL 92 (A, B, C)

QPL 97

400.1.03 Submittals

A. Invoices

Furnish formal written invoices from a supplier for all materials used in production of HMA when requested by the Department. Show the following on the Bill of Lading:

- Date shipped
- Quantity in tons (megagrams)
- Included with or without additives (for asphalt cement)

Purchase asphaltic cement directly from a supplier listed on Qualified Products List 7 and provide copies of Bill of Lading at the Department's request.

B. Paving Plan

Before starting asphaltic concrete construction, submit a written paving plan to the Engineer for approval. Include the following on the paving plan:

- Proposed starting date
- Location of plant(s)
- Rate of production
- Average haul distance(s)
- Number of haul trucks
- Paver speed feet (meter)/minute for each placement operation
- Mat width for each placement operation
- Number and type of rollers for each placement operation
- Sketch of the typical section showing the paving sequence for each placement operation
- Electronic controls used for each placement operation
- Temporary pavement marking plan

If staged construction is designated in the Plans or contract, provide a paving plan for each construction stage.

If segregation is detected, submit a written plan of measures and actions to prevent segregation. Work will not continue until the plan is submitted to and approved by the Department.

C. Job Mix Formula

Submit to the Engineer a written job mix formula proposed for each mixture type to be used based on an approved mix design. Furnish the following information for each mix:

- Specific project for which the mixture will be used

- Source and description of the materials to be used
- Mixture I.D. Number
- Proportions of the raw materials to be combined in the paving mixture
- Single percentage of the combined mineral aggregates passing each specified sieve
- Single percentage of asphalt by weight of the total mix to be incorporated in the completed mixture
- Single temperature at which to discharge the mixture from the plant
- Theoretical specific gravity of the mixture at the designated asphalt content
- Name of the person or agency responsible for quality control of the mixture during production

Do the following to have the Job Mix Formulas approved in accordance with SOP 40 “Approval of Contractor Job Mix Formulas” and to ensure their quality:

1. Submit proposed job Mix Formulas for review at least two weeks before beginning the mixing operations.
2. Do not start hot mix asphaltic concrete work until the Engineer has approved a job mix formula for the mixture to be used. No mixture will be accepted until the Engineer has given approval.
3. Provide mix designs for all SMA, Superpave and 4.75 mm mixes to be used. The Department will provide mix design results for other mixes to be used.
4. After a job mix formula has been approved, assume responsibility for the quality control of the mixtures supplied to the Department according to Subsection 106.01, “Source of Supply and Quantity of Materials.”

D. Quality Control Program

Submit a Quality Control Plan to the Office of Materials and Testing for approval. The Quality Control Program will be included as part of the certification in the annual plant inspection report.

400.2 Materials

Ensure materials comply with the specifications listed in Table 1.

Table 1—Materials Specifications

Material	Subsection
Asphalt Cement, Grade Specified	820.2
Coarse Aggregates for Asphaltic Concrete	802.2.02
Fine Aggregates for Asphaltic Concrete	802.2.01
Mineral Filler	883.1
Heat Stable Anti-Stripping Additive	831.2.04
Hydrated Lime	882.2.03
Silicone Fluid (When approved by the Office of Materials and Testing)	831.2.05
Bituminous Tack Coat: PG 58-22, PG 64-22, PG 67-22	820.2
Hot Mix Asphaltic Concrete Mixtures	828
Fiber Stabilizing Additives	819

When approved by the Office of Materials and Testing and required in the Contract, provide Uintaite material, hereafter referred to by the common trade name Gilsonite, as a reinforcing agent for bituminous mixtures. Supply a manufacturer’s certification that the Gilsonite is a granular solid which meets the following requirements:

Softening Point (AASHTO: T-53)	300-350 °F (150-175 °C)
Specific Gravity, 77 °F (25 °C) (AASHTO: T-228)	1.04 ± 0.02

Flash Point, COC (AASHTO: T-48)	550 °F (290 °C) Min.
Ash Content (AASHTO: T-111)	1.0% Max.
Penetration, 77 °F (25 ºC), 100 gm., 5 sec. (AASHTO: T-49)	0

400.2.01 Delivery, Storage, and Handling

Storage of material is allowed in a properly sealed and insulated system for up to 24 hours. Ensure Stone Matrix Asphalt (SMA), Open-Graded Friction Course (OGFC), or Porous European Mix (PEM) mixtures are not stored more than 12 hours. Mixtures other than SMA, OGFC, or PEM may be stored up to 72 hours in a sealed and insulated system, equipped with an auxiliary inert gas system, with the Engineer's approval. Segregation, lumpiness, drain-down, or stiffness of stored mixture is cause for rejection of the mixture. The Engineer will not approve using a storage or surge bin if the mixture segregates, loses excessive heat, or oxidizes during storage.

The Engineer may obtain mixture samples or recover asphalt cement according to GDT 119 or AASHTO T 324. AASHTO T 315, AASHTO T 202, or AASHTO T 49 will be used to perform viscosity and penetration tests to determine how much asphalt hardening has occurred. AASHTO T-324 will be used to perform Hamburg Wheel Tracking Device testing to determine rutting and moisture damage susceptibility.

A. Vehicles for Transporting and Delivering Mixtures

Ensure trucks used for hauling bituminous mixtures have tight, clean, smooth beds.

Follow these guidelines when preparing vehicles to transport bituminous mixtures:

1. Use an approved releasing agent from QPL 39 in the transporting vehicle beds, if necessary, to prevent the mixture from sticking to the bed. Ensure the releasing agent is not detrimental to the mixture. When applying the agent, drain the excess agent from the bed before loading. Remove from the project any transporting vehicles determined to contain unapproved releasing agents.
2. Protect the mixture with a waterproof cover large enough to extend over the sides and ends of the bed. Securely fasten the waterproof cover before the vehicle begins moving.
3. Insulate the front end and sides of each bed with an insulating material with the following specifications:
    - Consists of builders insulating board or equivalent;
    - Has a minimum "R" value of 4.0; and
    - Can withstand approximately 400 °F (200 °C) temperatures

    Install the insulating material so it is protected from loss and contamination. A "Heat Dump Body" may be used in lieu of insulation of the bed. "Heat Dump Body" refers to any approved transport vehicle capable of diverting engine exhaust and transmitting heat evenly throughout the dump body to keep asphalt at required temperature. Mark the "Heat Dump Body" clearly with "OPEN" and "CLOSE" position at the exhaust diverter. Install a padlock and lock it in the "OPEN" position when the "Heat Dump Body" is used to transport bituminous mixtures.
4. Mark each transporting vehicle with a clearly visible identification number.
5. Create a hole in each side of the bed so the temperature of the loaded mixture can be checked. Ensure the placement of these holes are located to assure the thermometer is being placed in the hot mix asphaltic concrete mixtures.

Ensure the mixture is delivered to the roadway at a temperature within ± 20 °F (± 11 °C) of the temperature on the job mix formula.

If the Engineer determines a truck may be hazardous to the Project or adversely affect the quality of the work, remove the truck from the project.

B. Containers for Transporting, Conveying, and Storing Bituminous Material

To transport, convey, and store bituminous material, use containers free of foreign material and equipped with sample valves. Bituminous material will not be accepted from conveying vehicles if material has leaked or spilled from the containers.

400.3 Construction Requirements

400.3. 01 Personnel

General Provisions 101 through 150.

400.3.02 Equipment

Hot mix asphaltic concrete plants producing mix for Department use are governed by Quality Assurance for Hot Mix Asphaltic Concrete Plants in Georgia, Laboratory Standard Operating Procedure No. 27.

The Engineer will approve the equipment used to transport and construct hot mix asphaltic concrete. Ensure the equipment is in satisfactory mechanical condition and can function properly during production and placement operations. Place the following equipment at the plant or project site:

A. Field Laboratory

Provide a field laboratory according to Section 152.

B. Plant Equipment

1. Scales

   Provide scales as follows:

   a. Furnish (at the Contractor's expense) scales to weigh bituminous plant mixtures, regardless of the measurement method for payment.

   b. Ensure the weight measuring devices provide documentation complying with Subsection 109.01, "Measurement and Quantities."

   c. Provide weight devices recording the mixture net weights delivered to the truck when not using platform scales. A net weight system will include, but is not limited to:

      - Hopper or batcher-type weight systems delivering asphaltic mixture directly to the truck
      - Fully automatic batching equipment with a digital recording device

   d. Use a net weight printing system only with automatic batching and mixing systems approved by the Engineer.

   e. Ensure the net weight scale mechanism or device manufacturer, installation, performance, and operation meets the requirements in Subsection 109.01, "Measurement and Quantities"

   f. Provide information on the Project tickets according to Department of Transportation SOP-15.

2. Time-Locking Devices

   Furnish batch type asphalt plants with automatic time-locking devices controlling the mixing time automatically. Construct these devices to ensure the operator cannot shorten or eliminate any portion of the mixing cycle.

3. Surge- and Storage-Systems

   Provide surge and storage bins as follows:

   a. Ensure bins for mixture storage are insulated and have a working seal, top and bottom, to prevent outside air infiltration and to maintain an inert atmosphere during storage. Bins not intended as storage bins may be used as surge bins to hold hot mixtures for part of the working day. However, empty these surge bins completely at the end of the working day.

   b. Ensure surge and storage bins can retain a predetermined minimum level of mixture in the bin when the trucks are loaded.

   c. Ensure surge and storage systems do not contribute to mix segregation, lumpiness, drain-down, or stiffness.

   d. Ensure the scale mechanism or device manufacture, installation, performance, and operation meets the requirements in Subsection 109.01"Measurement and Quantities".

4. Controls for Dust Collector Fines

   Control dust collection as follows:

a. When collecting airborne aggregate particles and returning them to the mixture, have the return system meter all or part of the collected dust uniformly into the aggregate mixture and waste the excess. The collected dust percentage returned to the mixture is subject to the Engineer's approval.

b. When the collected dust is returned directly to the hot aggregate flow, interlock the dust feeder with the hot aggregate flow, and meter the flow to maintain a constant, proportioned and uniform flow.

5. Mineral Filler Supply System

When mineral filler is required as a mixture ingredient:

a. Use a separate bin and feed system to store and proportion the required quantity into the mixture with uniform distribution.

b. Control the feeder system with a proportioning device meeting these specifications:

- Is accurate to within ± 10 percent of the filler required
- Has a convenient and accurate means of calibration
- Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes

c. Provide flow indicators or sensing devices for the mineral filler system and interlock them with the plant controls to interrupt the mixture production if mineral filler introduction fails to meet the required target value after no longer than 60 seconds.

d. Add mineral filler to the mixture as follows, according to the plant type:

- Batch Type Asphalt Plant: add mineral filler to the mixture in the weigh hopper.
- Continuous Plant Using Pugmill Mixers: feed the mineral filler into the hot aggregate before it is introduced into the mixer to ensure dry mixing is accomplished before the bituminous material is added.
- Continuous Plants Using the Drier-Drum Mixers: add the mineral filler to ensure dry mixing is accomplished before the bituminous material is added and ensure the filler does not become entrained into the air stream of the drier.

6. Hydrated Lime Treatment System

When hydrated lime is required as a mixture ingredient:

a. Use a separate bin and feed system to store and proportion the required quantity into the mixture.

b. Ensure the aggregate is uniformly coated with hydrated lime aggregate before adding the bituminous material to the mixture. Ensure the addition of hydrated lime will not become entrained in the exhaust system of the drier or plant.

c. Control the feeder system with a proportioning device meeting these specifications:

- Is accurate to within ± 10 percent of the amount required
- Has a convenient and accurate means of calibration
- Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes and to ensure mixture produced is properly treated with lime

d. Provide flow indicators or sensing devices for the hydrated lime system and interlock them with the plant controls to interrupt mixture production if hydrated lime introduction fails to meet the required target value after no longer than 60 seconds.

7. Net Weight Weighing Mechanisms

Certify the accuracy of the net weight weighing mechanisms by an approved registered scale serviceperson at least once every 6 months. Check the accuracy of net weight weighing mechanisms at the beginning of Project production and thereafter as directed by the Engineer. Check mechanism accuracy as follows:

a. Weigh a load on a set of certified commercial truck scales. Ensure the difference between the printed total net weight and weight obtained from the commercial scales is no greater than 4 lbs/1,000 lbs (4 kg/Mg) of load.

Check the accuracy of the bitumen scales as follows:

- Use standard test weights.
- If the checks indicate printed weights are out of tolerance, have a registered scale serviceperson check the batch scales and certify the accuracy of the printer.
- While the printer system is out of tolerance and before its adjustment, continue production only if using a set of certified truck scales to determine the truck weights.

b. Ensure plants using batch scales maintain ten 50 lb (25 kg) standard test weights at the plant site to check batching scale accuracy.

c. Ensure plant scales are used only to proportion mixture ingredients, and not to determine that pay quantities, are within two percent throughout the range.

8. Fiber Supply System

When stabilizing fiber is required as a mixture ingredient:

a. Use a separate feed system to store and proportion by weight the required quantity into the mixture with uniform distribution.

b. Control the feeder system with a proportioning device meeting these Specifications:

- Is accurate to within ± 10 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
- Has a convenient and accurate means of calibration.
- Provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds (kg) per minute, to verify feed rate.
- Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes.

c. Provide flow indicators or sensing devices for the fiber system and interlock them with the plant controls to interrupt the mixture production if fiber introduction fails or if the output rate is not within the tolerances given above.

d. Introduce the fiber as follows:

- When a batch type plant is used, add the fiber to the aggregate in the weigh hopper. Increase the batch dry mixing time by 8 to 12 seconds from the time the aggregate is completely emptied into the mixer to ensure the fibers are uniformly distributed prior to the injection of asphalt cement into the mixer.
- When a continuous or drier-drum type plant is used, add the fiber to the aggregate and uniformly disperse prior to the injection of asphalt cement. Ensure the fibers will not become entrained in the exhaust system of the drier or plant.

9. Crumb Rubber Modifier Supply System

When specified, crumb rubber modifier may be substituted at the Contractor’s discretion to produce a PG 76-22 asphaltic cement at the production facility in accordance with Section 820:

a. Use a separate feed system to store and proportion by weight of the total asphaltic cement, the required percentage of crumb rubber into the mixture.

b. Control the feeder system with a proportioning device meeting these Specifications:

- Is accurate to within ± 6 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
- Has a convenient and accurate means of calibration.
- Provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds per minute, to verify feed rate. Ensure the supply system reports the feed in 1 lb (454 gr.) increments using load cells enabling the user to monitor the depletion of the modifier. Monitoring the system volumetrically will not be allowed.
- Interlocks with the aggregate weigh system and asphaltic cement pump to maintain the correct proportions for all rates of production and batch sizes.

c. Provide flow indicators or sensing devices for the system and interlock them with the plant controls to interrupt the mixture production if the crumb rubber introduction output rate is not within the ± 6 percent tolerance given above. This interlock will immediately notify the operator if the targeted rate exceeds introduction tolerances. All plant production will cease if the introduction rate is not brought back within tolerance after 30 seconds. When the interlock system interrupts production and the plant has to be restarted, upon restarting operations; ensure the modifier system runs until a uniform feed can be observed on the output display. Ensure all mix produced prior to obtaining a uniform feed is rejected.

d. Introduce the crumb rubber modifier as follows:

- When a batch type plant is used, add the rubber to the aggregate in the weigh hopper. Increase the batch dry mixing time by 15 to 20 seconds from the time the aggregate is completely emptied into the mixer to ensure the modifiers are uniformly distributed prior to the injection of asphalt cement into the mixer. Increase the batch wet mix time by 15 to 20 seconds to ensure the crumb rubber modifier is uniformly blended with the asphaltic cement.
- When a continuous or drier-drum type plant is used, add the rubber to the aggregate and uniformly disperse prior to the injection of asphalt cement. The point of introduction in the drum mixer will be approved by the Engineer prior to production. Ensure the crumb rubber modifier will not become entrained in the exhaust system of the drier or plant and will not be exposed to the drier flame at any point after induction.

e. No separate measurement and payment will be made if Contractor elects to utilize crumb rubber.

10. Fiber-Reinforcement Supply System

When reinforcement fiber is specified in the contract as a mixture ingredient:

Ensure, that the reinforcement fiber is an approved material and listed on QPL 97" Georgia's List of Approved Reinforcement Fiber". Use a separate Fiber Meetering Device feed system to proportion by weight of the total asphaltic cement, the required percentage of fiber-reinforcement into the mixture.

a. Control the meetering system with a proportioning device meeting these Specifications:

- Is accurate to within ± 6 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
- Has a convenient and accurate means of calibration.
- Provides in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds, or (kg) per minute, to verify feed rate
- Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes.

b. Provide flow indicators or sensing devices for the fiber system and interlock them with the plant controls to interrupt the mixture production if fiber introduction fails or if the output rate is not within the tolerances given above.

c. Introduce the fiber as follows:

- When a batch type plant is used, add the fiber dossage to the aggregate in the weigh hopper. This may be done with loose fibers and a Fiber Meetering Device, or may be done by using pre-measured packages that are speciffically designed to disintegrate within the mixing cycle. Increase the batch dry mixing time by 8 to 12 seconds from the time the aggregate is completely emptied into the mixer to ensure the fibers are uniformly distributed prior to the injection of asphalt cement into the mixer.
- When a continuous or drier-drum type plant is used, add the fiber to the aggregate or RAP material at the beginning of the mixing cycle and uniformly disperse prior to the injection of asphalt cement. The final configuration of the fibers at the point when mixing begins, should closly resemble the fibers as they are packaged. Predistributing the fibers into their individual form should be avoided. Ensure the fibers will not become entrained in the exhaust system of the drier or plant. The producer should inspect their plant for any protrusions that may acumulate fibers and create the potential for fiber clumps.
- When a continuous or drier-drum type plant is used for limited production volumes, the addition of the fibers may be done by using pre-measured packages that are speciffically designed to disintegrate within the mixing cycle, and adding them directly into the RAP port of the plant. Because this is not an automated

process, a written protocol must be supplied by the producer to demonstrate how they will attain the dossage requirement, and documentation must be supplied by the material manufacturer assuring this method will produce the desired random fiber distribution.

C. Equipment at Project Site

1. Cleaning Equipment

   Provide sufficient hand tools and power equipment to clean the roadway surface before placing the bituminous tack coat. Use power equipment complying with Subsection 424.3.02.F, “Power Broom and Power Blower.”

2. Pressure Distributor

   To apply the bituminous tack coat, use a pressure distributor complying with Subsection 424.3.02.B, “Pressure Distributor.”

3. Bituminous Pavers

   To place hot mix asphaltic concrete, use bituminous pavers that can spread and finish courses that are:

   - As wide and deep as indicated on the Plans
   - True to line, grade, and cross section
   - Smooth
   - Uniform in density and texture

   a. Continuous Line and Grade Reference Control. Furnish, place, and maintain the supports, wires, devices, and materials required to provide continuous line and grade reference control to the automatic paver control system.

   b. Automatic Screed Control System. Equip the bituminous pavers with an automatic screed control system actuated from sensor-directed mechanisms or devices that will maintain the paver screed at a pre-determined transverse slope and elevation to obtain the required surface.

   c. Transverse Slope Controller. Use a transverse slope controller capable of maintaining the screed at the desired slope within ± 0.1 percent. Do not use continuous paving set-ups resulting in unbalanced screed widths or off-center breaks in the main screed cross section unless approved by the Engineer.

   d. Screed Control. Equip the paver to permit the following four modes of screed control. Ensure the method used is approved by the Engineer.

      - Automatic grade sensing and slope control
      - Automatic dual grade sensing
      - Combination automatic and manual control
      - Total manual control

      Ensure the controls are referenced with a taut string or wire set to grade, or with a ski-type device or mobile reference at least 30 ft (9 m) long when using a conventional ski. Approved non-contacting laser or sonar-type skis listed on QPL 91 “Georgia’s List of Approved Non-contacting Laser and Sonar-type Electronic Grade and Slope Controls” may be used in lieu of conventional 30 ft (9 m) skis. Under limited conditions, a short ski or shoe may be substituted for a long ski on the second paver operating in tandem, or when the reference plane is a newly placed adjacent lane.

      Automatic screed control is required on all Projects; however, when the Engineer determines that Project conditions prohibit the use of such controls, the Engineer may waive the grade control, or slope control requirements, or both.

   e. Paver Screed Extension. When the laydown width requires a paver screed extension, use bolt-on screed extensions to extend the screeds, or use an approved mechanical screed extension device. When the screed is extended, add auger extensions to assure a length of no more than 18 inches (0.5 m) from the auger to the end gate of the paver. Auger extensions may be omitted when paving variable widths. Ensure the paver is equipped with tunnel extensions when the screed and augers are extended.

NOTE: Do not use extendible strike-off devices instead of approved screed extensions. Only use a strike-off device in areas that would normally be luted in by hand labor.

4. Compaction Equipment

   Ensure that the compaction equipment is in good mechanical condition and can compact the mixture to the required density. The compaction equipment number, type, size, operation, and condition is subject to the Engineer's approval

5. Materials Transfer Vehicle (MTV)

   a. Use a Materials Transfer Vehicle (MTV) when placing asphaltic concrete mixtures on Projects on the state route system with the following conditions. If a project fails to meet any one of the following conditions, the MTV's use is not required other than during the placement of SMA, PEM and OGFC mixtures. MTVs are required during the placement of SMA, PEM and OGFC mixtures regardless of ADT, project length and mixture tonnage unless waived at the discretion of the Office of Materials and Testing.

      1) When to use:
         - The two-way ADT is equal to or greater than 6000
         - The project length is equal to or greater than 3000 linear feet (915 linear meters)
         - The total tonnage (megagrams) of all asphaltic concrete mixtures is greater than 2000 tons (1815 Mg)

      2) Where to use:
         - Mainline of the traveled way
         - Collector/distributor (C/D) lanes on Interstates and limited access roadways
         - Leveling courses at the Engineer's discretion

      3) Do not use the MTV for the following conditions:
         - A resurfacing project that only 9.5 mm mix is required.
         - A project with lane width that is equal or less than 11 feet (3.4 m).
         - A passing lane only project.
         - When noted on the plans.

   b. Ensure the MTV and conventional paving equipment meet the following requirements:

      1) MTV
         - Has a truck unloading system which receives mixture from the hauling equipment and independently deliver mixtures from the hauling equipment to the paving equipment.
         - Has mixture remixing capability approved by the Office of Materials and Testing and is listed on QPL 88 "Georgia's List of Approved Materials Transfer Vehicles".
         - Provides to the paver a homogeneous, non-segregated mixture of uniform temperature with no more than 20 °F (11 ºC) difference between the highest and lowest temperatures when measured transversely across the width of the mat in a straight line at a distance of one foot to twenty-five feet (0.3 m to 7.6 m) from the screed while the paver is operating. Ensure that the MTV is capable of providing the paver a consistent material flow that is sufficient to prevent the paver from stopping between truck exchanges.

      2) Conventional Paving Equipment
         - Has a paver hopper insert with a minimum capacity of 14 tons (13 Mg) installed in the hopper of conventional paving equipment when an MTV is used.

   c. If the MTV malfunctions during spreading operations, discontinue placement of hot mix asphaltic concrete after there is sufficient mix placed to maintain traffic in a safe manner. However, placement of hot mix asphaltic concrete in a lift not exceeding 2 in. (50 mm) may continue until any additional hot mix in transit at the time of the malfunction has been placed. Cease spreading operations thereafter until the MTV is operational.

d. Ensure the MTV is empty when crossing a bridge and is moved across without any other Contractor vehicles or equipment on the bridge. Move the MTV across a bridge in a travel lane and not on the shoulder. Ensure the speed of the MTV is no greater than 5 mph (8 kph) without any acceleration or deceleration while crossing a bridge.

400.3.03 Preparation

A. Prepare Existing Surface

Prepare the existing surface as follows:

1. Clean the Existing Surface. Before applying hot mix asphaltic concrete pavement, clean the existing surface to the Engineer's satisfaction.
2. Patch and Repair Minor Defects

   Before placing leveling course:

   a. Correct potholes and broken areas requiring patching in the existing surface and base as directed by the Engineer.

   b. Cut out, trim to vertical sides, and remove loose material from the areas to be patched.

   c. Prime or tack coat the area after being cleaned. Compact patches to the Engineer's satisfaction. Material for patches does not require a job mix formula, but must meet the gradation range shown in Section 828. The Engineer must approve the asphalt content to be used.
3. Apply Bituminous Tack Coat

   Apply the tack coat according to Section 413. The Engineer will determine the application rate, which must be within the limitations in Tables 2A and 2B.

Table 2A—Application Rates for Bituminous Tack, gal/yd² (L/m²)

Tack Uses	**Minimum**	**Maximum**
Under OGFC and PEM Mixes	0.06 (0.27)	0.08 (0.36)
All Other Mixes	0.04 (0.18)	0.06 (0.27)
Non-tracking Hot Applied Polymer Modifed Tack (NTHAPT) Note 2	0.06 (0.27)	0.18 (0.81)
Note 1: On thin leveling courses and freshly placed asphaltic concrete mixes, reduce the application rate to 0.02 to 0.04 gal/yd² (0.09 to 0.18 L/m²). Note 2: Use higher application rate (0.12 to 0.18) within the minimum and maximum range under OGFC and PEM Mixes		

Table 2B – Application Rates for Anionic Emulsified Asphalt or Cationic Emulsified Asphalt Bituminus Tack, gal/yd² (L/m²)

Tack-Uses	Minimum	Maximum
New Asphaltic Concrete Pavement to New Asphaltic Concrete Pavement or Thin Lift Leveling	0.05 (0.23)	0.08 (0.36)
New Asphaltic Concrete Pavement (≤ 25 % RAP) to Aged Existing Pavement or Milled Surface	0.06 (0.27)	0.10 (0.45)
New Asphaltic Concrete Pavement (> 25 % RAP) to Aged Existing Pavement or Milled Surface	0.08 (0.36)	0.12 (0.54)
Non-tracking Emulsified Asphalt	0.07 (0.32)	0.12 (0.54)
CQS-Special Modified Asphalt Emulsion Note 1	0.12 (0.54)	0.28 (1.27)
• Allow standard anionic emulsified asphalt or cationic emulsified asphalt to break per emulsion manufacturer's recommendation. Proceed with paving only after the anionic emulsified asphalt or cationic emulsified asphalt has cured to the satisfaction of the Engineer. • Do not use anionic emulsified asphalt or cationic emulsified asphalt, other than CQS-Special Modified Asphalt Emulsion in conjunction with a spray paver, under OGFC or PEM on interstates or limited access state routes.		

Note 1: Use higher application rate (0.22 to 0.28) within the minimum and maximum range under OGFC and PEM Mixes

B. Place Patching and Leveling Course

1. When the existing surface is irregular, bring the surface area to the proper cross section and grade with a leveling course of hot mix asphaltic concrete materials.
2. Place leveling at the locations and in the amounts directed by the Engineer.
3. Use leveling course mixtures meeting the requirements of the job mix formulas defined in:
   - Subsection 400.3.05.A, "Observe Composition of Mixtures"
   - Section 828
   - Leveling acceptance schedules in
     Subsection 400.3.06.A, "Acceptance Plans for Gradation and Asphalt Cement Content"
4. If the leveling and patching mix type is undesignated, determine the mix type by the thickness or spread rate according to Table 3, but do not use 4.75 mm mix on interstate projects.
5. If patching is required to correct mat deficiencies in the final surface layer, ensure patches extend full lane width and no less than the length of the affected area as determined by the Engineer.

Table 3—Leveling and Patching Mix Types

Thickness	Rate of Spread	Type of Mix
Up to 0.75 in (19 mm)	Up to 85 lbs/yd² (46 kg/m²)	4.75 mm Mix or 9.5 mm Superpave Type 1
0.75 to 1.5 in (19 to 38 mm)	85 to 165 lbs/yd²(46 to 90 kg/m²)	9.5 mm Superpave Type 2
1.5 to 2 in (38 to 50 mm)	165 to 220 lbs/yd² (90 to 120 kg/m²)	12.5 mm Superpave *
2 to 3 in (50 to 75 mm)	220 to 330 lbs/yd² (120 to 180 kg/m²)	19 mm Superpave **

Over 2.5 in (64 mm)	Over 275 lbs/yd² (180 kg/m²)	25 mm Superpave

* This mixture may be used for isolated patches no more than 6 in. (150 mm) deep and no more than 4 ft. (1.2 m) in diameter or length.

** This mixture may be used for patching no more than 4 in. (100 mm) deep in limited confined deep mill and patching locations.

400.3.04 Fabrication

General Provisions 101 through 150.

400.3.05 Construction

Provide the Engineer at least one day's notice prior to beginning construction, or prior to resuming production if operations have been temporarily suspended.

A. Observe Composition of Mixtures

1. Calibration of plant equipment

   If the material changes, or if a component affecting the ingredient proportions has been repaired, replaced, or adjusted, check and recalibrate the proportions.

   Calibrate as follows:

   a. Before producing mixture for the Project, calibrate by scale weight the electronic sensors or settings for proportioning mixture ingredients.

   b. Calibrate ingredient proportioning for all rates of production.

2. Mixture control

   Compose hot mix asphaltic concrete from a uniform mixture of aggregates, bituminous material, and if required, hydrated lime, mineral filler, or other approved additive.

   Ensure the constituents proportional to produce mixtures meeting the requirements in Section 828. The general composition limits prescribed are extreme ranges within which the job mix formula must be established. Base mixtures on a design analysis that meets the requirements of Section 828.

   Ensure the field performance of the in-place mixtures meet the requirements of Subsection 828.2B for Permeability, Moisture Susceptibility, Rutting Susceptibility and Fatigue. In-place mix may be evaluated for compliance with Subsection 828.2.B at the discretion of the State Bituminous Construction Engineer under the following conditions:

   - Deviates greater than 10 percent on gradation for mixture control sieves from the approved Job Mix Formula based on Acceptance or Independent Samples.
   - Deviates greater than 0.7 percent in asphalt cement content from the approved Job Mix Formula based on Acceptance or Independent Samples.
   - The calculated mean pavement air voids result in an adjusted pay factor less than 0.80 or any single sub lot result in mean pavement air voids exceeding 10.5 percent.
   - Mix produced not using an approved mix design and/or job mix formula.

   Remove and replace any material determined to not meet the requirements established in Section 828.2.B at the Contractor's expense.

   If control test results show the characteristic tested does not conform to the job mix formula control tolerances given in Section 828, take immediate action to ensure that the quality control methods are effective.

   Control the materials to ensure extreme variations do not occur. Maintain the gradation within the composition limits in Section 828.

B. Prepare Bituminous Material

Uniformly heat the bituminous material to the temperature specified in the job mix formula with a tolerance of ± 20 °F (± 11 °C).

C. Prepare the Aggregate

Prepare the aggregate as follows:

1. Heat the aggregate for the mixture, and ensure a mix temperature within the limits of the job mix formula.
2. Do not contaminate the aggregate with fuel during heating.
3. Reduce the absorbed moisture in the aggregate until the asphalt does not separate from the aggregate in the prepared mixture. If this problem occurs, the Engineer will establish a maximum limit for moisture content in the aggregates. When this limit is established, maintain the moisture content below this limit.

D. Prepare the Mixture

Proportion the mixture ingredients as necessary to meet the required job mix formula. Mix until a homogenous mixture is produced.

1. Add Mineral Filler

   When mineral filler is used, introduce it in the proper proportions and as specified in Subsection 400.3.02.B.5, “Mineral Filler Supply System.”

2. Add Hydrated Lime

   When hydrated lime is included in the mixture, add it at a rate specified in Section 828 and the job mix formula. Use methods and equipment for adding hydrated lime according to Subsection 400.3.02.B.6, “Hydrated Lime Treatment System.”

   Add hydrated lime to the aggregate by using Method A or B as follows:

   Method A—Dry Form—Add hydrated lime in its dry form to the mixture as follows, according to the type of plant:

   a. Batch Type Asphalt Plant: Add hydrated lime to the mixture in the weigh hopper or as approved and directed by the Engineer.
   b. Continuous Plant Using Pugmill Mixer: Feed hydrated lime into the hot aggregate before it is introduced into the mixer to ensure dry mixing is complete before the bituminous material is added.
   c. Continuous Plant Using Drier-Drum Mixer: Add hydrated lime so to ensure the lime will not become entrained into the air stream of the drier and to ensure thorough dry mixing will be complete before the bituminous material is added.

   Method B—Lime/Water Slurry—Add the required quantity of hydrated lime (based on dry weight) in lime/water slurry form to the aggregate. This solution consists of lime and water in concentrations as directed by the Engineer.

   Equip the plant to blend and maintain the hydrated lime in suspension and to mix the hydrated lime with the aggregates uniformly in the proportions specified.

3. Add Stabilizing Fiber

   When stabilizing fiber is included in the mixture, add stabilizing fiber at a rate specified in Section 819 and the Job Mix Formula. Introduce it as specified in Subsection 400.3.02.B.8, “Fiber Supply System.”

4. Add Gilsonite Modifier

   When approved by the Office of Materials and Testing and required by the Contract, add the Gilsonite modifier to the mixture at a rate to ensure eight percent by weight of the asphalt cement is replaced by Gilsonite. Use either PG 64-22 or PG 67-22 asphalt cement as specified in Subsection 820.2.01. Provide suitable means to calibrate and check the rate of Gilsonite being added. Introduce Gilsonite modifier by either of the following methods.

   a. For batch type plants, incorporate Gilsonite into the pugmill at the beginning of the dry mixing cycle. Increase the dry mix cycle by a minimum of 10 seconds after the Gilsonite is added and prior to introduction of the asphalt cement. For this method, supply Gilsonite in plastic bags to protect the material during shipment and handling and store the modifier in a waterproof environment. Ensure the bags are capable of being completely melted and uniformly blended into the combined mixture.

Gilsonite may also be added through a mineral filler supply system as described in Subsection 400.3.02.B.5, "Mineral Filler Supply System." Ensure the system is capable of injecting the modifier into the weigh hopper near the center of the aggregate batching cycle so the material can be accurately weighed.

b. For drier-drum plants, add Gilsonite through the recycle ring or through an acceptable means which will introduce the Gilsonite prior to the asphalt cement injection point. The modifier must proportionately feed into the drum mixer at the required rate by a proportioning device which shall be accurate within ± 10 percent of the amount required. Ensure the entry point is away from flames and the Gilsonite will not be caught up in the air stream and exhaust system.

5. Materials from Different Sources

Do not use mixtures prepared from aggregates from different sources intermittently. This will cause the color of the finished pavement to vary.

E. Observe Weather Limitations

Do not mix and place asphaltic concrete if the existing surface is wet or frozen. Do not lay asphaltic concrete OGFC mix or PEM at air temperatures below 60 ºF (16 ºC). When using a MTV, OGFC mix or PEM may be placed at 55 ºF (13 ºC) when approved by the Engineer. For other courses, follow the temperature guidelines in the following table:

Table 4—Lift Thickness Table

Lift Thickness	Minimum Temperature
1 in (25 mm) or less	55 °F (13 °C)
1.1 to 2 in (26 mm to 50 mm)	45 °F (8 °C)
2.1 to 3 in (51 mm to 75 mm)	40 °F (4 °C)
3.1 to 4 in (76 mm to 100 mm)	35 °F (2 °C)
4.1 to 8 in (101 mm to 200 mm)	32 °F (0 °C) and rising. Base Material must not be frozen.

F. Perform Spreading and Finishing

Spread and finish the course as follows:

Determine the maximum compacted layer thickness by the type mix being used according to Table 5.

Table 5— Mix Type Minimum, Maximum Layer and Total Thickness

Mix Type	Minimum Layer Thickness	Maximum Layer Thickness	Maximum Total Thickness
25 mm Superpave	2 1/2 in (64 mm)	5 in (125 mm) *	—
19 mm Superpave	1 3/4 in (44 mm)	3 in (75 mm) *	—
12.5 mm Superpave	1 3/8 in (35 mm)	2 1/2 in (64 mm)**/***	8 in (200 mm)
9.5 mm Superpave Type 2	1 1/8 in.(29 mm)	1 1/2 in (38 mm)***	4 in (100 mm)
9.5 mm Superpave Type 1	7/8 in (22 mm)	1 1/4 in (32 mm)	4 in (100 mm)
4.75 mm Mix	3/4 in (19 mm)	1 1/8 in (29 mm)	2 in (50 mm)
9.5 mm OGFC	75 lbs/yd² (41 kg/m²)	95 lbs/yd² (51 kg/m²)	—
12.5 mm OGFC	85 lbs/yd² (46 kg/m²)	110 lbs/yd² (60 kg/m²)	—

Mix Type	Minimum Layer Thickness	Maximum Layer Thickness	Maximum Total Thickness
12.5 mm PEM	110 lbs/yd² (60 kg/m²)	165 lbs/yd² (90 kg/m²)	—
9.5 mm SMA	1 1/8 in (29 mm)	1 1/2 in (38 mm)	4 in (100 mm)
12.5 mm SMA	1 3/8 in (35 mm)	3 in (75 mm)	6 in (150 mm)
19 mm SMA	1 3/4 in (44 mm)	3 in (75 mm)	—
* Allow up to 6 in (150 mm) per lift on trench widening. **Allow up to 4 in. (100 mm) per lift on trench widening of ≤ 2 ft. when no overlay is required.***Place 9.5 mm Superpave and 12.5 mm Superpave up to 4 in (100 mm) thick for driveway and side road transition.			

1. Unload the mixture into the paver hopper or into a device designed to receive the mixture from delivery vehicles.
2. Except for leveling courses, spread the mixture to the loose depth for the compacted thickness or the spread rate. Use a mechanical spreader true to the line, grade, and cross section specified.
3. For leveling courses, use a motor grader equipped with a spreader box and smooth tires to spread the material or use a mechanical spreader meeting the requirements in Subsection 400.3.02.C, "Equipment at Project Site."
4. Obtain the Engineer's approval for the sequence of paving operations, including paving the adjoining lanes. Minimize tracking tack onto surrounding surfaces.
5. Ensure the outside edges of the pavement being laid are aligned and parallel to the roadway center line.
6. For New Construction or Resurfacing Contracts containing multiple lifts or courses, arrange the width of the individual lifts so the longitudinal joints of each successive lift are offset from the previous lift at least 1 ft (300 mm). This requirement does not apply to the lift immediately over thin lift leveling courses.

   Ensure the longitudinal joint(s) in the surface course and the mix immediately underneath asphaltic concrete OGFC or PEM are at the lane line(s).

   NOTE: Perform night work with artificial light provided by the Contractor and approved by the Engineer.

7. Where mechanical equipment cannot be used, spread and rake the mixture by hand. Obtain the Engineer's approval of the operation sequence, including compactive methods, in these areas.
8. Keep small hand raking tools clean and free from asphalt build up. Do not use fuel oil or other harmful solvents to clean tools during the work.
9. Do not use mixture with any of these characteristics:
   - Segregated
   - Nonconforming temperature
   - Deficient or excessive asphalt cement content
   - Otherwise unsuitable to place on the roadway in the work
10. Remove and replace mixture placed on the roadway that the Engineer determines has unacceptable blemish levels from segregation, raveling, streaking, pulling and tearing, or other deficient characteristics. Replace with acceptable mixture at the Contractor's expense. Do not continually place mixtures with deficiencies.

    Do not place subsequent course lifts over another lift or course while the temperature of the previously placed mix is 140 °F (60 °C) or greater.
11. Obtain the Engineer's approval of the material compaction equipment. Perform the rolling as follows:
    a. Begin the rolling as close behind the spreader as possible without causing excessive distortion of the asphaltic concrete surface.
    b. Continue rolling until roller marks are no longer visible.
    c. Use pneumatic-tired rollers with breakdown rollers on all courses except asphaltic concrete OGFC, PEM and SMA or other mixes designated by the Engineer.

12. If applicable, taper or "feather" asphaltic concrete from full depth to a depth no greater than 0.5 in (13 mm) along curbs, gutters, raised pavement edges, and areas where drainage characteristics of the road must be retained. The Engineer will determine the location and extent of tapering.

G. Maintain Continuity of Operations

Coordinate plant production, transportation, and paving operations to maintain a continuous operation. If the spreading operations are interrupted, construct a transverse joint if the mixture immediately behind the paver screed cools to less than 250 ºF (120 ºC).

H. Construct the Joints

1. Construct Transverse Joints
   a. Construct transverse joints to facilitate full depth exposure of the course before resuming placement of the affected course.
   b. Properly clean and tack the vertical face of the transverse joint before placing additional material.

   NOTE: Never burn or heat the joint by applying fuel oil or other volatile materials.

   c. Straightedge transverse joints immediately after forming the joint.
   d. Immediately correct any irregularity that exceeds 3/16 in. in 10 ft (5 mm in 3 m).
2. Construct Longitudinal Joints

   Clean and tack the vertical face of the longitudinal joint before placing adjoining material. Construct longitudinal joints so that the joint is smooth, well sealed, and bonded.
3. Construction Joint Detail for OGFC and PEM Mixtures

   In addition to meeting joint requirements described above, construct joints and transition areas for 12.5 mm OGFC and 12.5 mm PEM mixtures as follows:

   a. For projects which do not have milling included as a pay item:
      1) Place OGFC mixture meeting gradation requirements of 9.5 mm OGFC as specified in Section 828 on entrance and exit ramp gore areas and end of project construction joints.
         - Taper mixture from 3/8 in (10 mm) at end of project to full plan depth within maximum distance of spread for one load of mixture.
         - Taper mixture placed on gore areas from thickness of the edge of the mainline to 3/8 in (10 mm) at the point of the ramp transverse joint.
      2) Construct the ramp transverse joint at the point specified in the plans or as directed by the Engineer.
      3) Mixture placed in the transition and gore areas will be paid for at the contract unit price for 12.5 mm OGFC or 12.5 mm PEM, as applicable.
   b. For projects which have milling included as a pay item:
      1) Taper milling for a distance of no less than 50 ft (15 m) to a depth of 2 1/4 in (59 mm) at the point of the transverse joint.
      2) Taper thickness, if needed, of the dense-graded surface mix within the 50 ft (15 m) distance to 1 1/2 in (40 mm) at the point of the transverse joint.
      3) Taper thickness of the 12.5 mm OGFC or 12.5 mm PEM to 3/4 in (19 mm) to ensure the material ties in at grade level with the existing surface at the point of the transverse joint

I. Protect the Pavement

Protect sections of the newly finished pavement from traffic until the traffic will not mar the surface or alter the surface texture. If directed by the Engineer, use artificial methods to cool the newly finished pavement to open the pavement to traffic more quickly.

J. Modify the Job Mix Formula

If the Engineer determines that undesirable mixture or mat characteristics are being obtained, the job mix formula may require immediate adjustment.

400.3.06 Quality Acceptance

A. Acceptance Plans for Gradation and Asphalt Cement Content

The Contractor will randomly sample and test mixtures for acceptance on a lot basis. The Department will monitor the Contractor testing program and perform comparison and quality assurance testing. The Contractor's Quality Control Technicians shall participate in the Department's Independent Assurance Systems Basis Program.

1. Determine Lot Amount

   A lot consists of the tons (megagrams) of asphaltic concrete produced and placed each production day. If this production is less than 500 tons (500 Mg), or its square yard (meter) equivalent, production may be incorporated into the next working day. The Engineer may terminate a lot when a pay adjustment is imminent if a plant or materials adjustment resulting in a probable correction has been made. Terminate all open lots at the end of the month, except for materials produced and placed during the adjustment period. The lot will be terminated as described in Subsection 400.5.01, "Adjustments".

   If the final day's production does not constitute a lot, the production may be included in the lot for the previous day's run; or, the Engineer may treat the production as a separate lot with a corresponding lower number of tests.

2. Determine Lot Acceptance

   Determine lot acceptance as found in Subsection 400.5.01, "Adjustments."

   The Department will perform the following task:

   Determine the pay factor by using the mean of the deviations from the job mix formula of the tests in each lot and apply it to Table 10 Mixture Acceptance Schedule for Surface Mixes or Table 11 Mixture Acceptance Schedule for Subsurface Mixes, whichever is appropriate. This mean will be determined by averaging the actual numeric value of the individual deviations from the job mix formula, disregarding whether the deviations are positive or negative amounts. Do not calculate lot acceptance using test results for materials not used in the Work. Determine the pay factor for each lot by multiplying the contract unit price by the appropriate pay factor from the Mixture Acceptance Schedule - Table 10 or Table 11. When two or more pay factors for a specific lot are less than 1.0, determine the adjusted payment by multiplying the contract unit price by the lowest pay factor.

   If the mean of the deviations from the job mix formula of the lot acceptance tests for a control sieve or for asphalt cement content exceeds the tolerances established in the appropriate Mixture Acceptance Schedule, and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the Engineer determines that the material is not acceptable to leave in place, the materials shall be removed and replaced at the Contractor's expense.

3. Provide Quality Control Program

   Provide a Quality Control Program as established in SOP 27 which includes:

   - Assignment of quality control responsibilities to specifically named individuals who have been certified by the Office of Materials and Testing
   - Provisions for prompt implementation of control and corrective measures
   - Provisions for communication with Project Manager, Bituminous Technical Services Engineer, and Testing Management Operations Supervisor at all times
   - Provisions for reporting all test results daily through the Office of Materials and Testing computerized Field Data Collection System, AASHTO Trns*port SiteManager, or approved computerized application; other checks, calibrations and records will be reported on a form developed by the Contractor and will be included as part of the project records
   - Notification in writing of any change in quality control personnel

   a. Certification Requirements:

- Use laboratory and testing equipment certified by the Department. (Laboratories which participate in and maintain AASHTO accreditation for testing asphaltic concrete mixtures will be acceptable in lieu of Departmental certification.)
- Provide certified quality control personnel to perform the sampling and testing. A Quality Control Technician (QCT) may be certified at three levels:
  1) Temporary Certification – must be a technician trainee who shall be given direct oversight by a certified Level 1 or Level 2 QCT while performing acceptance testing duties during the first 5 days of training. The trainee must complete qualification requirements within 30 Georgia Department of Transportation funded production days after being granted temporary certification. A trainee who does not become qualified within 30 Georgia Department of Transportation funded production days will not be re-eligible for temporary certification. A certified Level 1 or Level 2 QCT shall be at the plant at all times during production and shipment of mixture to monitor work of the temporarily certified technician.
  2) Level 1 – must demonstrate they are competent in performing the process control and acceptance tests and procedures related to hot mix asphalt production and successfully pass a written exam.
  3) Level 2 – must meet Level 1 requirements and must be capable of and responsible for making process control adjustments, and successfully pass a written exam.
     - Technician certification is valid for 3 years from the date on the technician's certificate unless revoked or suspended. Eligible technicians may become certified through special training and testing approved by the Office of Materials and Testing. Technicians who lose their certification due to falsification of test data will not be eligible for recertification in the future unless approved by the State Materials and Testing Engineer.

b. Quality Control Management

1) Designate at least one Level 2 QCT as manager of the quality control operation. Ensure the Quality Control Manager meets the following requirements:
   - Be accountable for actions of other QCT personnel.
   - Ensure all applicable sampling requirements and frequencies, test procedures, and Standard Operating Procedures are followed.
   - Ensure all reports, charts, and other documentation are completed as required

2) Provide QCT personnel at the plant as follows:
   - If daily production for all mix types is to be greater than 250 tons (megagrams), have a QCT person at the plant at all times during production and shipment of mixture until all required acceptance tests have been completed.
   - If daily production for all mix types will not be greater than 250 tons (megagrams), a QCT may be responsible for conducting tests at up to two plants, subject to random number sample selection.
   - Have available at the plant, or within immediate contact by phone or radio, a Level 2 QCT responsible for making prompt process control adjustments as necessary to correct the mix.

3) Sampling, Testing, and Inspection Requirements.

   Provide all sample containers, extractants, forms, diaries, and other supplies subject to approval of the Engineer.

   Perform daily sampling, testing, and inspection of mixture production that meet the following requirements:

   (a) Randomly sample mixtures according to GSP 15 and GDT 73 (Method C) and test on a lot basis. In the event less than the specified number of samples are taken, obtain representative 6 in (150 mm) cores from the roadway at a location where the load not sampled was placed. Take enough cores to ensure minimum sample size requirements are met for each sample needed.

(b) Maintain a printed copy of the computer generated random sampling data as a part of the project records.

(c) Perform sampling, testing, and inspection duties of GSP 21.

(d) Perform extraction or ignition test (GDT 83 or GDT 125) and extraction analysis (GDT 38). If the ignition oven is used, a printout of sample data including weights becomes a part of the project records. For asphalt cement content only, digital printouts of liquid asphalt cement weights may be substituted in lieu of an extraction test for plants with digital recorders. Calculate the asphalt content from the ticket representing the mixture tested for gradation.

(e) Save extracted aggregate, opposite quarters, and remaining material (for possible referee testing) of each sample as follows:

- Store in properly labeled, suitable containers.
- Secure in a protected environment.
- Store for three working days. If not obtained by the Department within three days, they may be discarded in accordance with GSP 21.

(f) Add the following information on load tickets from which a sample or temperature check is taken:

- Mixture temperature
- Signature of the QCT person performing the testing

(g) Calibrate the lime system when hydrated lime is included in the mixture:

- Perform a minimum of twice weekly during production
- Post results at the plant for review.
- Provide records of materials invoices upon request (including asphalt cement, aggregate, hydrated lime, etc.).

(h) Take action if acceptance test results are outside Mixture Control Tolerances of Section 828.

- One sample out of tolerance
  (1) Contact Level 2 - QCT to determine if a plant adjustment is needed.
  (2) Immediately run a process control sample. Make immediate plant adjustments if this sample is also out of tolerance.
  (3) Test additional process control samples as needed to ensure corrective action taken appropriately controls the mixture.
- Two consecutive acceptance samples of the same mix type out of tolerance regardless of Lot or mix design level, or three consecutive acceptance samples out of tolerance regardless of mix type.
  (1) Stop plant production immediately.
  (2) Reject any mixture in storage:
    - Deviating more than 10 percent in gradation from the job mix formula based on the acceptance sample.
    - Deviating more than 0.7 percent in asphalt content from the job mix formula based on the acceptance sample.
  (3) Make a plant correction to any mix type out of tolerance prior to resuming production.
    - Do not send any mixture to the project before test results of a process control sample meets Mixture Control Tolerances.
    - Reject any mixture produced at initial restarting that does not meet Mixture Control Tolerances.

NOTE: Determine mixture temperature at least once per hour of production for OGFC and PEM mixes.

4) Comparison Testing and Quality Assurance Program

Periodic comparison testing by the Department will be required of each QCT to monitor consistency of equipment and test procedures. The Department will take independent samples to monitor the Contractor's quality control program.

a) Comparison Sampling and Testing

Retain samples for comparison testing and referee testing if needed as described in Subsection 400.3.06.A.3.b.3. Discard these samples only if the Contractor's acceptance test results meet a 1.00 pay factor and the Department does not procure the samples within three working days.

The Department will test comparison samples on a random basis. Results will be compared to the respective contractor acceptance tests, and the maximum difference is as follows:

Table 6—Allowable Percent Difference Between Department and Contractor Acceptance Tests

Sieve Size	Surface	Sub-surface
1/2 in. (12.5 mm)		4.0%
3/8 in. (9.5 mm)	3.5%	4.0%
No. 4 (4.75 mm)	3.5%	3.5%
No. 8 (2.36 mm)	2.5%	3.0%
No. 200 (75 μm)	2.0%	2.0%
A.C.	0.4%	0.5%

(1) If test comparisons are within these tolerances:

- Continue production
- Use the Contractor's tests for acceptance of the lot

(2) If test comparisons are not within these tolerances:

- Another Departmental technician will test the corresponding referee sample.
- Results of the referee sample will be compared to the respective contractor and Departmental tests using the tolerance for comparison samples given above.

(a) If referee test results are within the above tolerances when compared to the Contractor acceptance test, use the Contractor's test for acceptance of the effected lot.

(b) If referee test results are not within the above tolerances when compared to the Contractor acceptance test, the Department will review the Contractor's quality control methods and determine if a thorough investigation is needed.

b) Independent Verification Sampling and Testing

(1) Randomly take a minimum of two independent samples from the lesser of five days or five lots of production regardless of mix type or number of projects.

(2) Compare test deviation from job mix formula to Mixture Control Tolerances in Section 828. If results are outside these tolerances, another sample from the respective mix may be taken.

If test results of the additional sample are not within Mixture Control Tolerances, the Department will take the following action:

- Take random samples from throughout the subject lot(s) as established in Subsection 400.3.06.A.3.b.3 and use these test results for acceptance and in calculations for the monthly plant rating. Applicable pay factors will apply and the contractor QCT test results will not be included in pay factor calculations nor in the monthly plant rating.
- Determine if the Contractor's quality control program is satisfactory and require prompt corrective action by the Contractor if specification requirements are not being met.
- Determine if the QCT has not followed Departmental procedures or has provided erroneous information.
- Take samples of any in-place mixture represented by unacceptable QCT tests and use the additional sample results for acceptance and in calculations for the monthly plant rating and apply applicable pay factors. The Contractor QCT tests will not be included in the pay factor calculations nor in the monthly plant rating.

NOTE: For leveling or dense graded surface courses less than 110 lb/yd² (60 kg/m²) having quality assurance test results outside the Mixture Control Tolerances of Section 828, use the Department's test results only and applicable pay factors will apply.

B. Compaction

Determine the mixture compaction using either GDT 39, GDT 59, or AASHTO T 331. The method of GDT 39 for “Uncoated Specimens, Dense Graded Mixtures Only” shall not apply when the water absorption of a sample exceeds 2.0 percent, as measured according to AASHTO T 166. In this case, either AASHTO T 331 or the paraffin method of GDT 39 shall apply. The compaction is accepted in lots defined in Subsection 400.3.06. A, “Acceptance Plans for Gradation and Asphalt Cement Content”, and is within the same lot boundaries as the mixture acceptance.

1. Calculate Pavement Mean Air Voids

The Department is responsible for pavement mean air void acceptance testing. The Contractor is responsible for establishing all roller patterns and any quality control testing. Upon written request by the Contractor, the Office of Materials and Testing will provide nuclear gauge testing assistance for compaction related issues.

The Department will calculate the pavement air voids placed within each lot as follows:

a. One test per sub-lot.
   - Lots $>$ 400 ton (400 Mg) of mix are divided into 5 sub-lots of equal distance.
   - Lots $\leq$ 400 tons (400 Mg) of mix are divided into a sub-lot or sub-lots of equal distance at a rate of one per 100 tons (100 Mg) mix each (Example: 299 tons of mix require 3 sublots and 301 tons of mix require 4 sublots). There will be less than 5 sub-lots.

b. Average the results of all tests run on randomly selected sites in that lot.

c. Select representative sites randomly using GDT 73.

Density tests are not required for asphaltic concrete placed at 90 lbs/yd^2 (50 kg/m^2) or less, 4.75 mm mix, asphaltic concrete OGFC, PEM, and mixes placed as variable depth or width leveling. Compact these courses to the Engineer’s satisfaction. Density tests will not be performed on turn-outs and driveways.

The targeted maximum Pavement Mean Air Void content for all Superpave and Stone Matrix Asphalt mixtures is 5.0 percent. Ensure that the maximum Pavement Mean Air Voids for all Superpave and Stone Matrix Asphalt mixtures does not exceed 7.0 percent. The maximum Pavement Mean Air Voids for 2 foot shoulder widening is 9.0 percent. The adjustment period for density is four lots or four production days, whichever is less, in order for the contractor to ensure maximum compactive effort has been achieved, which will yield no more than the specified maximum allowed Mean Air Voids. One additional lot or production day of adjustment may be given for a reduction in asphalt cement content on the JMF made by the Office of Materials and Testing for mix designs incorporating the Corrected Optimum Asphalt Content COAC.

If the contractor needs to adjust the mixture to improve density results, a change in the job mix formula may be requested for approval during the adjustment period so long as the following values are not exceeded:

- Coarse pay sieve ± 4%
- No. 8 (2.36 mm) sieve ± 2%
- No. 200 (75 μm) sieve ± 1%
- Asphalt Content ± 0.2%
- All value changes must still be within specification limits.

If the Office of Materials and Testing is satisfied that the contractor has exerted the maximum compactive effort and is not able to maintain Pavement Mean Air Voids at no more than 7.0%, the Engineer may establish a maximum target for Pavement Mean Air Voids.

Ensure mixture placed during the adjustment period for density meets the requirements for a 0.90 pay factor in Table 13 of Subsection 400.5.01.C, "Calculate Mean Pavement Air Voids." Mixture not meeting these density requirements is paid for using the applicable pay factor.

If the mean air voids of the pavement placed within a lot exceeds 100% of the maximum target air voids, if established, and the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer.

2. Obtain Uniform Compaction

For a lot to receive a pay factor of 1.00 for compaction acceptance, the air void range cannot exceed 5 percent for new construction or resurfacing projects. The range is the difference between the highest and lowest acceptance test results within the affected lot. If the air void range exceeds these tolerances, apply a Pay Factor of 95%.

The 5% reduced pay factor for the compaction range does not apply in these instances:

- The mixture is placed during the adjustment period as defined in Subsection 400.5.01.A, "Materials Produced and Placed During the Adjustment Period."
- All air void results within a given lot are less than 7.0%.
- A lot containing two sublot or less.
- On two foot trench widening.
- For sub-surfaces mixes including 19 mm and 25 mm Superpave mixes if all air void results within a given lot are >2.5 % <8 %.

When lots are reevaluated for range penalty, as shown in Subsection 106.03, "Samples, Tests, Cited Specifications," sampling and testing is according to GDT 73. Request for reevaluation must be made within 5 working days of notification of the lot results. The following procedures apply:

The Department will reevaluate the lot through additional testing by obtaining and testing three additional cores acquired in representative sites selected randomly throughout each sub-lot representing the high and low in-place air voids as detailed in GDT 73. The additional six cores (three cores from each sub-lot will be averaged) will replace the original five core results for range specified requirements only. The original five cores' results will be reported for Pavement Mean Air Voids for the lot. This will be the final evaluation for compaction range for the lot. Lots will not be re-evaluated for range when the Pavement Mean Air Voids result in a lower than 95% pay factor. Ensure requests for reevaluation are made within 5 working days of notification of the lot results.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the Table 7 Average Air Voids Range Acceptance Schedule:

Table 7—Average Air Voids Range For Acceptance Schedule

Pay Factor	Range between High and Low Air Void Original 5 cores	Re-evaluated Range between High and Low Air Void Cores New Cores obtained from High (3 cores) and Low location (3 cores)
100	≤ 5 %	≤ 4.50 %
0.95	> 5 %	> 4.50 %

C. Surface Tolerance

In this Specification, pavement courses to be overlaid with an OGFC or PEM are considered surface courses. All OGFC or PEM are to be evaluated after the roadway has been opened to traffic for a minimum of 5 days and a maximum of 15 days. Asphaltic Concrete paving is subject to straightedge and visual inspection and irregularity correction as shown below:

1. Visual and Straightedge Inspection

   Paving is subject to visual and straightedge inspection during and after construction operations until Final Acceptance. Locate surface irregularities as follows:

   a. Keep a 10 ft (3 m) straightedge near the paving operation to measure surface irregularities on courses. Provide the straightedge and the labor for its use.
   b. Inspect the base, intermediate, and surface course surfaces with the straightedge to detect irregularities.
   c. Correct irregularities that exceed 3/16 in. in 10 ft (5 mm in 3 m) for base and intermediate courses and surface courses.

   Mixture or operating techniques will be stopped if irregularities such as rippling, tearing, or pulling occur and the Engineer suspects a continuing equipment problem. Stop the paving operation and correct the problem. Correct surface course evaluations on individual Laser Road Profiler test sections, normally 1mile (1 km) long.

2. Target Surface Profile Smoothness

   The Department will use the Laser Road Profiler method to conduct acceptance testing for surface course tolerance according to GDT 126. This testing will be performed only on:

   - Surface courses on Projects with mainline traveled way measuring a minimum distance of 1 mile (1600 m)
   - Ramps more than 0.5 mile (800 m) long

Combine partial sections measuring less than 0.5 mile (800 m) with the previous full mile for acceptance.

Achieve the smoothest possible ride during construction. Do not exceed the target Laser Road Profiler smoothness index as shown below:

Table 8— Pavement Smoothness Target Requirements

Construction Description	Smoothness Index
All Asphaltic Concrete OGFC and PEM on interstate including resurfacing and new construction. Asphaltic Concrete OGFC and PEM placed on state routes as new construction.	750
Asphaltic Concrete SMA or dense-graded surface mixtures placed directly beneath the Asphaltic Concrete OGFC or PEM on interstates. Asphaltic Concrete OGFC and PEM placed on state routes as resurfacing. All new construction on state routes with exception of OGFC and PEM as stated above.	825
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	900
All Urban new construction and resurfacing on state routes within curb and gutter sections located in posted 40 miles per hour (MPH) or less speed zones.	1175

If the target values are not achieved, immediately adjust the operations to meet the target values. Placement operations may be suspended until a remedial plan to comply with target smoothness requirements is submitted and approved by the Engineer if adjustments do not satisfy target smoothness values.

Table 9— Pavement Smoothness Corrective Work Requirement

Construction Description	Smoothness Index
All Asphaltic Concrete OGFC and PEM placed on interstate including resurfacing and new construction. Asphaltic Concrete OGFC and PEM placed on state routes as new construction.	825
Asphaltic Concrete SMA or dense-graded surface mixtures placed directly beneath the Asphaltic Concrete OGFC or PEM on interstates. Asphaltic Concrete OGFC and PEM placed on state routes as resurfacing. All new construction on state routes with exception of OGFC and PEM as stated above.	900
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	1025
All Urban new construction and resurfacing on state routes within curb and gutter sections located in posted 40 miles per hour (MPH) or less speed zones.	1250

If surface tolerance deficiencies need correction, obtain the Engineer's approval of the methods and type mix used.

3. Bridge Approach Profile Smoothnes Quality

The following are subject to a ride quality test of roadway approaching each end of a bridge using the Laser Road Profiler, Rainhart Profiler or Lightweight Profiler:

- A state route with 4 lanes or more
- A 2-lane state route with a current traffic count two-way ADT-2,000 vpd or more
- Locations designated on the Plans

All other bridge approaches not meeting the above criteria shall meet the 3/16 in. in 10 ft (5 mm in 3 m) straightedge requirement. When the distance between the ends of two bridges, the end of a bridge and an intersection, or the end of a bridge and a vertical or horizontal curve is less than 540 ft (165 m) and locations where the testing vehicle cannot maintain minimum testing speed while taking profile measurements will not be tested and will be subject to straightedge requirements.

The bridge approaches will meet the straightedge requirements.

Test ride quality as follows:

For Resurfacing Projects:

a. The Department will determine a profile smoothness index value using the laser road profiler in accordance with test method GDT 126.

b. The Department will determine the Half Car Simulation (HCS) IRI for each HMA asphalt $1/10^{th}$ of mile (0.16 km) segments adjacent to each approach slab joint for each lane. The HCS IRI will be reported in $1/20^{th}$ of mile (0.08 km) segment readings that will be averged to calculate the final 1/10 mile section, in accordance with GDT 126.

  - Correct individual bumps or depression exceeding 3/16 in. in 10 ft (3 mm in 3 m) straightedge requirement as directed by the Engineer.
  - Ensure the profile smoothness index shows an improvement over pre-construction profile smoothness or meets a profile smoothness index of ≤ 1025 mm/km (66 inches/mile) for the average 1/10 mile(0.16 km) .

c. Ensure Resurfacing projects meet the profile smoothness index improvement requirement for the specified $1/10^{th}$ mile (0.16 km) segment of roadway up to the bridge approach/exit slab joint.

In accordance with Section 106.3.A.3, the Contractor may request reevaluation(s) for Laser Road Profiler Test results on Resurfacing Bridge Projects and straightedge measurement(s) on either that fail to meet specified requirements. Request for reevaluation shall be made to the Engineer within 5 working days of notification of failing results. At the Engineer's approval, reevaluation of failing results using the Lightweight Profiler Test, Laser Road Profiler Test and straightedge measurement(s) shall be conducted in conjunction with representatives from the Office of Materials and Testing in accordance with GDT 126 or GDT 134, whichever is applicable. The Department will perform ride quality testing up to two times on the bridge approaches/exits at no cost to the Contractor. For these reevaluations, evaluation of the bridge exit end may be taken testing towards the bridge against traffic if the contractor provides traffic control, at the contractors' expense, upon request.

For All New Construction Projects:

a. The Department will determine a profile index value according to test method GDT 78 or GDT 134.

b. The Department will average the profile index value from the right and left wheelpath for each 100 ft (30 m) section for each lane.

  - Keep the profile index value under 30 in/mile (475 mm/km), correct individual bumps or depressions exceeding 0.2 in. (5 mm) from blanking band on the profilograph trace.

c. Ensure New Construction projects meet the profile index value for the specified 100 ft (30 m) section of roadway up to the bridge joint.

d. Schedule the ride quality testing on All New Construction projects 5 days before needed by contacting the Office of Materials and Testing. Clean and clear obstructions from the test area.

Correct the sections that do not meet the ride quality criteria of this Specification. After correction, these sections are subject to retesting with the Lightweight Profiler. The Engineer direct the type of correction method, which may include:

- Milling
- Grinding
- Removing and replacing the roadway

No additional compensation will be made.

In accordance with Section 106.3.A.3, the Contractor may request reevaluation(s) for Lightweight Profiler Test results on newly construction bridge projects, Laser Road Profiler Test results on resurfacing bridge projects and straightedge measurement(s) on either that fail to meet specified requirements. Request for reevaluation shall be made to the Engineer within 5 working days of notification of failing results. At the Engineer's approval, reevaluation of failing results using the Lightweight Profiler Test, Laser Road Profiler Test and straightedge measurement(s) shall be conducted by representatives from the Office of Materials and Testing in accordance with GDT 134.

The Department will perform ride quality testing up to two times on the bridge approaches at no cost to the Contractor. Additional testing will be charged to the Contractor in accordance with Section 500.5.01.B.

4. Surface Smoothness Acceptance

When recommended by the Office of Materials and Testing, a pay reduction may be accepted in lieu of correction for roadways and bridge approaches that fail to achieve specified smoothness indexes in accordance with SOP 46 "Procedure for Calculating Pay Reduction for Failing Roadway and Bridge Approach Smoothness" Roadway and Bridge Approach Smoothness. The Office of Materials and Testing may recommend a waiver of profile smoothness requirements when improvement over pre-construction smoothness profile exceeds 25 percent for urban roadways, as defined in Table 9.

D. Reevaluation of Lots

When lots are reevaluated as shown in Subsection 106.03, "Samples, Tests, Cited Specifications," sampling and testing is according to GDT 73. Ensure request for reevaluation are made within 5 working days of notification of the lot results. The following procedures apply:

1. For ashaltic concrete mixtures other than OGFC and PEM mix types, thin lift courses < 110 lbs/yd^2 and mixture paid for as patching, the Department will take the same number of new tests using cores taken at randomly selected locations in accordance GDT 73. The Department will use only these test results for gradation and AC content

obtained using these cores for acceptance. For OGFC and PEM mix types, thin lift courses < 110 lbs/yd^2 and mixture paid for as patching, the retained opposite quarter shall be used for mixture acceptance reevaluation when requested by the Contractor. The Department will use the absolute average deviations from the job mix formula for these tests to determine acceptance based on the appropriate column in the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table 10 or 11.

2. Compaction Acceptance

   The Department will reevaluate the lot through additional testing by cutting the same number of cores originally obtained and averaging these results with the results from the original density tests. The Department will use the average to determine acceptance according to the Compaction Acceptance Schedule in Subsection 400.5.01.C, "Calculate Pavement Mean Air Voids."

Table 10—Mixture Acceptance Schedule—Surface Mixes

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
Asphalt Cement Content (Extraction, Ignition)	1.00	0.00 - 0.70	0.00 - 0.54	0.00 - 0.46	0.00 - 0.41	0.00 - 0.38	0.00 - 0.35	0.00 - 0.32	0.00 - 0.30
	0.95	0.71 - 0.80	0.55 - 0.61	0.47 - 0.52	0.42 - 0.46	0.39 - 0.43	0.36 - 0.39	0.33 - 0.36	0.31 - 0.34
	0.90	0.81 - 0.90	0.62 - 0.68	0.53 - 0.58	0.47 - 0.51	0.44 - 0.47	0.40 - 0.45	0.37 - 0.40	0.35 - 0.37
	0.80	0.91 - 1.00	0.69 - 0.75	0.59 - 0.64	0.52 - 0.56	0.48 - 0.52	0.44 - 0.47	0.41 - 0.44	0.38 - 0.41
	0.70	1.01 - 1.19	0.76 - 0.82	0.65 - 0.69	0.57 - 0.61	0.53 - 0.56	0.48 - 0.51	0.45 - 0.47	0.42 - 0.44
	0.50	1.20 - 1.40	0.83 - 0.85	0.70 - 0.72	0.62 - 0.64	0.57 - 0.59	0.52 - 0.55	0.48 - 0.51	0.45 - 0.48
3/8 in. (9.5 mm) Sieve (12.5 mm OGFC, 12.5 mm PEM, 12.5 mm Superpave)	1.00	0.00 – 9.0	0.00 - 6.6	0.00 - 5.6	0.00 - 5.0	0.00 - 4.6	0.00 - 4.2	0.00 - 3.9	0.00 - 3.6
	0.98	9.1 - 10.0	6.7 - 7.5	5.7 - 6.3	5.1 - 5.6	4.7 - 5.2	4.3 - 4.7	4.0 - 4.4	3.7 - 4.1
	0.95	10.1 - 11.9	7.6 - 8.4	6.4 - 7.0	5.7 - 6.3	5.3 - 5.8	4.8 - 5.3	4.5 - 5.0	4.2 - 4.6
	0.90	12.0 - 13.0	8.5 - 9.3	7.1 - 7.7	6.4 - 6.9	5.9 - 6.3	5.4 - 5.8	5.1 - 5.4	4.7 - 5.0
	0.85	13.1 - 14.0	9.4 - 10.2	7.8 - 8.6	7.0 - 7.6	6.4 - 6.9	5.9 - 6.3	5.5 - 5.9	5.1 - 5.5
	0.80	14.1 - 14.5	10.3 - 10.5	8.7 - 8.9	7.7 - 8.0	7.0 - 7.5	6.4 - 6.8	6.0 - 6.4	5.6 - 6.0
3/8 in. (9.5 mm) Sieve (12.5 mm SMA)	1.00	0.0 - 6.8	0.00 - 5.0	0.00 - 4.2	0.00 - 3.8	0.00 - 3.4	0.00 - 3.2	0.00 - 2.9	0.00 - 2.7
	0.98	6.9 - 7.5	5.1 - 5.6	4.3 - 4.7	3.9 - 4.2	3.5 - 3.9	3.3 - 3.5	3.0 - 3.3	2.8 - 3.1
	0.95	7.6 - 8.9	5.7 - 6.3	4.8 - 5.2	4.3 - 4.7	4.0 - 4.4	3.6 - 4.0	3.4 - 3.8	3.2 - 3.4
	0.90	9.0 - 9.8	6.4 - 7.0	5.3 - 5.8	4.8 - 5.2	4.5 - 4.8	4.1 - 4.4	3.9 - 4.1	3.5 - 3.8
	0.85	9.9 - 10.5	7.1 - 7.6	5.9 - 6.4	5.3 - 5.7	4.9 - 5.2	4.5 - 4.7	4.2 - 4.4	3.9 - 4.1
	0.80	10.6 - 10.9	7.7 - 7.9	6.5 - 6.7	5.8 - 6.0	5.3 - 5.6	4.8 - 5.1	4.5 - 4.8	4.2 - 4.5
No. 4 (4.75 mm) Sieve (9.5 mm OGFC, 9.5 mm Superpave)	1.00	0.00 - 9.0	0.00 - 6.7	0.00 - 5.7	0.00 - 5.2	0.00 - 4.8	0.00 - 4.4	0.00 - 4.1	0.00 - 3.8
	0.98	9.1 - 10.0	6.8 - 7.6	5.8 - 6.3	5.3 - 5.8	4.9 - 5.4	4.5 - 4.9	4.2 - 4.6	3.9 - 4.3
	0.95	10.1 - 11.9	7.7 - 8.5	6.4 - 6.9	5.9 - 6.4	5.5 - 5.9	5.0 - 5.4	4.7 - 5.0	4.4 - 4.7
	0.90	12.0 - 13.0	8.6 - 9.4	7.0 - 7.5	6.5 - 7.0	6.0 - 6.5	5.5 - 5.9	5.1 - 5.5	4.8 - 5.1
	0.85	13.1 - 14.0	9.5 - 10.2	7.6 - 8.0	7.1 - 7.6	6.6 - 7.0	6.0 - 6.4	5.6 - 5.9	5.2 - 5.5

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
	0.80	14.1 - 14.5	10.3 - 10.5	8.1 - 8.3	7.7 - 8.0	7.1 - 7.5	6.5 - 6.9	6.0 - 6.4	5.6 - 5.9
No. 4 (4.75 mm) Sieve (9.5 mm SMA)	1.00	0.00 - 6.8	0.00 - 5.0	0.00 - 4.3	0.00 - 3.9	0.00 - 3.6	0.00 - 3.3	0.00 - 3.1	0.00 - 2.8
	0.98	6.9 - 7.5	5.1 - 5.7	4.4 - 4.7	4.0 - 4.4	3.7 - 4.0	3.4 - 3.7	3.2 - 3.4	2.9 - 3.2
	0.95	7.6 - 8.9	5.8 - 6.4	4.8 - 5.2	4.5 - 4.8	4.1 - 4.4	3.8 - 4.0	3.5 - 3.8	3.3 - 3.5
	0.90	9.0 - 9.8	6.5 - 7.0	5.3 - 5.6	4.9 - 5.2	4.5 - 4.9	4.1 - 4.4	3.9 - 4.1	3.6 - 3.8
	0.85	9.9 - 10.5	7.1 - 7.7	5.7 - 6.0	5.3 - 5.7	5.0 - 5.2	4.3 - 4.8	4.2 - 4.4	3.9 - 4.1
	0.80	10.6 - 10.9	7.8 - 7.9	6.1 - 6.2	5.8 - 6.0	5.3 - 5.6	4.9 - 5.2	4.5 - 4.8	4.2 - 4.4
No. 8 (2.36 mm) Sieve (OGFC, PEM, Superpave and 4.75 mm mixes)	1.00	0.00 - 7.0	0.00 - 5.6	0.00 - 4.8	0.00 - 4.3	0.00 - 4.0	0.00 - 3.6	0.00 - 3.4	0.00 - 3.2
	0.98	7.1 - 8.0	5.7 - 6.3	4.9 - 5.4	4.4 - 4.8	4.1 - 4.5	3.7 - 4.1	3.5 - 3.8	3.3 - 3.6
	0.95	8.1 - 9.0	6.4 - 7.0	5.5 - 6.0	4.9 - 5.3	4.6 - 4.9	4.2 - 4.5	3.9 - 4.2	3.7 - 3.9
	0.90	9.1 - 10.9	7.1 - 7.7	6.1 - 6.6	5.4 - 5.8	5.0 - 5.4	4.6 - 4.9	4.3 - 4.6	4.0 - 4.3
	0.85	11.0 - 12.0	7.8 - 8.5	6.7 - 7.2	5.9 - 6.4	5.5 - 5.8	5.0 - 5.3	4.7 - 5.0	4.4 - 4.6
	0.75	12.1 - 12.5	8.6 - 8.8	7.3 - 7.5	6.5 - 6.8	5.9 - 6.3	5.4 - 5.7	5.1 - 5.3	4.7 - 4.9
No. 8 (2.36 mm) Sieve (12.5 mm SMA, 9.5 mm SMA)	1.00	0.00 - 5.3	0.00 - 4.2	0.00 - 3.6	0.00 - 3.2	0.00 - 3.0	0.00 - 2.7	0.00 - 2.6	0.00 - 2.4
	0.98	5.4 - 6.0	4.3 - 4.7	3.7 - 4.0	3.3 - 3.6	3.1 - 3.4	2.8 - 3.1	2.7 - 2.9	2.5 - 2.7
	0.95	6.1 - 6.8	4.8 - 5.3	4.1 - 4.5	3.7 - 4.0	3.5 - 3.7	3.2 - 3.4	3.0 - 3.2	2.8 - 2.9
	0.90	6.9 - 8.2	5.4 - 5.8	4.6 - 5.0	4.1 - 4.5	3.8 - 4.0	3.5 - 3.7	3.3 - 3.5	3.0 - 3.2
	0.85	8.3 - 9.0	5.9 - 6.4	5.1 - 5.4	4.6 - 4.8	4.1 - 4.4	3.8 - 4.0	3.6 - 3.8	3.3 - 3.4
	0.75	9.1 - 9.4	6.5 - 6.6	5.5 - 5.0	4.9 - 5.1	4.5 - 4.7	4.1 - 4.3	3.9 - 4.0	3.5 - 3.7
No. 8 (2.36 mm) Sieve for OGFC and PEM mixes: When the mean of the deviations from the Job Mix Formula for a particular lot exceeds the tolerance for a 1.00 pay factor in the appropriate column, the lot will be paid for at 0.50 of the Contract Price.									

Table 11—Mixture Acceptance Schedule—Subsurface Mixes

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
Asphalt Cement Content (Extraction, Ignition)	1.00	0.00 - 0.80	0.00 - 0.61	0.00 - 0.52	0.00 - 0.46	0.00 - 0.43	0.00 - 0.39	0.00 - 0.36	0.00 - 0.34
	0.95	0.81 - 0.90	0.62 - 0.68	0.53 - 0.58	0.47 - 0.51	0.44 - 0.47	0.40 - 0.43	0.37 - 0.40	0.35 - 0.37
	0.90	0.91 - 1.00	0.69 - 0.75	0.59 - 0.64	0.52 - 0.56	0.48 - 0.52	0.44 - 0.47	0.41 - 0.44	0.38 - 0.41
	0.80	1.01 - 1.19	0.76 - 0.82	0.65 - 0.69	0.57 - 0.61	0.53 - 0.56	0.48 - 0.51	0.45 - 0.47	0.42 - 0.44
	0.70	1.20 - 1.40	0.83 - 0.85	0.70 - 0.72	0.62 - 0.64	0.57 - 0.59	0.52 - 0.55	0.48 - 0.51	0.45 - 0.48
	0.50	1.41 - 1.60	0.86 - 0.88	0.73 - 0.75	0.65 - 0.67	0.60 - 0.63	0.56 - 0.60	0.52 - 0.56	0.49 - 0.52
1/2 in. (12.5 mm) Sieve (25 mm Superpave)	1.00	0.00 - 12.9	0.00 - 8.1	0.00 - 6.9	0.00 - 6.1	0.00 - 5.5	0.00 - 5.0	0.00 - 4.7	0.00 - 4.4
	0.98	13.0 - 14.0	8.2 - 9.1	7.0 - 7.7	6.2 - 6.8	5.6 - 6.1	5.1 - 5.6	4.8 - 5.2	4.5 - 4.9
	0.95	14.1 - 15.0	9.2 - 10.1	7.8 - 8.5	6.9 - 7.5	6.2 - 6.7	5.7 - 6.1	5.3 - 5.7	5.0 - 5.4
	0.90	15.1 - 16.0	10.2 - 11.1	8.6 - 9.3	7.6 - 8.2	6.8 - 7.4	6.2 - 6.7	5.8 - 6.3	5.5 - 5.9
	0.85	16.1 - 17.0	11.2 - 11.5	9.4 - 9.6	8.3 - 8.6	7.5 - 7.8	6.8 - 7.0	6.4 - 6.5	6.0 - 6.1
	0.80	17.1 - 18.0	11.6 - 11.9	9.7 - 9.9	8.7 - 9.0	7.9 - 8.1	7.1 - 7.3	6.6 - 6.8	6.2 - 6.4
1/2 in. (12.5 mm) Sieve (19 mm SMA)	1.00	0.00 - 9.7	0.00 - 6.0	0.00 - 5.2	0.00 - 4.6	0.00 - 4.1	0.00 - 3.8	0.00 - 3.5	0.00 - 3.3
	0.98	9.8 - 10.5	6.2 - 6.8	5.3 - 5.8	4.7 - 5.1	4.2 - 4.6	3.9 - 4.2	3.6 - 3.9	3.4 - 3.7
	0.95	10.6 - 11.2	6.9 - 7.8	5.9 - 6.4	5.2 - 5.6	4.7 - 5.0	4.3 - 4.6	4.0 - 4.3	3.8 - 4.0
	0.90	11.3 - 12.0	7.9 - 8.3	6.5 - 7.0	5.7 - 6.1	5.1 - 5.6	4.7 - 5.0	4.4 - 4.7	4.1 - 4.4
	0.85	12.1 - 12.8	8.4 - 8.6	7.1 - 7.2	6.2 - 6.5	5.7 - 5.9	5.1 - 5.3	4.8 - 4.9	4.5 - 5.6
	0.80	12.9 - 13.5	8.7 - 8.9	7.3 - 7.4	6.6 - 6.8	6.0 - 6.1	5.4 - 5.5	5.0 - 5.1	4.7 - 4.8
3/8 in. (9.5 mm) Sieve (19 mm Superpave, 12.5 mm Superpave)	1.00	0.00 - 10.0	0.00 - 7.5	0.00 - 6.3	0.00 - 5.6	0.00 - 5.2	0.00 - 4.7	0.00 - 4.4	0.00 - 4.1
	0.98	10.1 - 11.9	7.6 - 8.4	6.4 - 7.0	5.7 - 6.3	5.3 - 5.8	4.8 - 5.3	4.5 - 5.0	4.2 - 4.6
	0.95	12.0 - 13.0	8.5 - 9.3	7.1 - 7.7	6.4 - 6.9	5.9 - 6.3	5.4 - 5.8	5.1 - 5.4	4.7 - 5.0
	0.90	13.1 - 14.0	9.4 - 10.2	7.8 - 8.6	7.0 - 7.6	6.4 - 6.9	5.9 - 6.3	5.5 - 5.9	5.1 - 5.5
	0.85	14.1 - 14.5	10.3 - 10.5	8.7 - 8.9	7.7 - 8.0	7.0 - 7.5	6.4 - 6.8	6.0 - 6.4	5.6 - 6.0

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
	0.80	14.6 - 15.0	10.6 - 10.8	9.0 - 9.2	8.1 - 8.4	7.6 - 7.8	6.9 - 7.3	6.5 - 6.8	6.1 - 6.5
No. 4 (4.75 mm) Sieve (9.5 mm Superpave)	1.00	0.00 - 10.0	0.00 - 7.6	0.00 - 6.3	0.00 - 5.8	0.00 - 5.4	0.00 - 4.9	0.00 - 4.6	0.00 - 4.3
	0.98	10.1 - 11.9	7.7 - 8.5	6.4 - 6.9	5.9 - 6.4	5.5 - 5.9	5.0 - 5.4	4.7 - 5.0	4.4 - 4.7
	0.95	12.0 - 13.0	8.6 - 9.4	7.0 - 7.5	6.5 - 7.0	6.0 - 6.5	5.5 - 5.9	5.1 - 5.5	4.8 - 5.1
	0.90	13.1 - 14.0	9.5 - 10.2	7.6 - 8.0	7.1 - 7.6	6.6 - 7.0	6.0 - 6.4	5.6 - 5.9	5.2 - 5.5
	0.85	14.1 - 14.5	10.3 - 10.5	8.1 - 8.3	7.7 - 8.0	7.1 - 7.5	6.5 - 6.9	6.0 - 6.4	5.6 - 5.9
	0.80	14.6 - 15.0	10.6 - 10.8	8.4 - 8.6	8.1 - 8.4	7.6 - 8.0	7.0 - 7.4	6.5 - 6.8	6.0 - 6.3
No. 8 (2.36 mm) Sieve (All mixes except SMA)	1.00	0.00 - 8.0	0.00 - 6.3	0.00 - 5.4	0.00 - 4.8	0.00 - 4.5	0.00 - 4.1	0.00 - 3.8	0.00 - 3.6
	0.98	8.1 - 9.0	6.4 - 7.0	5.5 - 6.0	4.9 - 5.3	4.6 - 4.9	4.2 - 4.5	3.9 - 4.2	3.7 - 3.9
	0.95	9.1 - 10.0	7.1 - 7.7	6.1 - 6.6	5.4 - 5.8	5.0 - 5.4	4.6 - 4.9	4.3 - 4.6	4.0 - 4.3
	0.90	10.1 - 11.9	7.8 - 8.5	6.7 - 7.2	5.9 - 6.4	5.5 - 5.8	5.0 - 5.3	4.7 - 5.0	4.4 - 4.6
	0.85	12.0 - 13.0	8.6 - 8.8	7.3 - 7.5	6.5 - 6.8	5.9 - 6.3	5.4 - 5.7	5.1 - 5.3	4.7 - 4.9
	0.75	13.1 - 14.0	8.9 - 9.1	7.6 - 7.8	6.9 - 7.2	6.4 - 6.6	5.8 - 6.1	5.4 - 5.7	5.0 - 5.3
No. 8 (2.36 mm) Sieve (19 mm SMA)	1.00	0.00 - 6.0	0.00 - 4.7	0.00 - 4.1	0.00 - 3.6	0.00 - 3.4	0.00 - 3.1	0.00 - 2.9	0.00 - 2.4
	0.98	6.1 - 6.8	4.8 - 5.2	4.2 - 4.5	3.7 - 4.0	3.5 - 3.7	3.2 - 3.4	3.0 - 3.2	2.8 - 2.9
	0.95	6.9 - 7.5	5.3 - 5.8	4.6 - 5.0	4.1 - 4.4	3.8 - 4.0	3.5 - 3.7	3.3 - 3.5	3.0 - 3.2
	0.90	7.6 - 8.9	5.9 - 6.4	5.1 - 5.4	4.5 - 4.8	4.1 - 4.4	3.8 - 4.0	3.6 - 3.8	3.3 - 3.5
	0.85	9.0 - 9.8	6.5 - 6.6	5.5 - 5.6	4.9 - 5.1	4.5 - 4.7	4.1 - 4.3	3.9 - 4.0	3.6 - 3.7
	0.75	9.9 - 10.5	6.7 - 6.8	5.7 - 5.9	5.2 - 5.4	4.8 - 5.0	4.4 - 4.6	4.1 - 4.3	3.8 - 4..0

E. Segregated Mixture

Prevent mixture placement yielding a segregated mat by following production, storage, loading, placing, and handling procedures. Ensure needed plant modifications and provide necessary auxiliary equipment. (See Subsection 400.1.01, "Definitions.")

If the mixture is segregated in the finished mat, the Department will take actions based on the degree of segregation. The actions are described below.

1. Unquestionably Unacceptable Segregation

   When the Engineer determines the segregation in the finished mat is unquestionably unacceptable, follow these measures:

   a. Suspend Work and require the Contractor to take positive corrective action. The Department will evaluate the segregated areas to determine the extent of the corrective work to the in-place mat as follows:
      - Perform extraction and gradation analysis by taking 6 in (150 mm) cores from typical, visually unacceptable segregated areas.
      - Determine the corrective work according to Subsection 400.3.06.E.3.

   b. Require the Contractor to submit a written plan of measures and actions to prevent further segregation. Work will not continue until the plan is submitted to and approved by the Department.

   c. When work resumes, place a test section not to exceed 500 tons (500 Mg) of the affected mixture for the Department to evaluate. If a few loads show that corrective actions were not adequate, follow the measures above beginning with step 1.a. above. If the problem is solved, work may continue.

2. Unacceptable Segregation Suspected

   When the Engineer observes segregation in the finished mat and and the work may be unacceptable, follow these measures:

   a. Allow work to continue at Contractor's risk.

   b. Require Contractor to immediately and continually adjust operation until the visually apparent segregated areas are eliminated from the finished mat. The Department will immediately investigate to determine the severity of the apparent segregation as follows:
      - Take 6 in (150 mm) cores from typical areas of suspect segregation.
      - Test the cores for compliance with the mixture control tolerances in Section 828.

   When these tolerances are exceeded, suspend work for corrective action as outlined in Subsection 400.3.06.E.3.

3. Corrective Work

   a. Remove and replace (at the Contractor's expense) any segregated area where the gradation on the control sieves is found to vary 10 percent or more from the approved job mix formula, the asphalt cement varies 1.0% or more from the approved job mix formula, or if in-place air voids exceed 13.5% based on GDT 39. The control sieves for each mix type are shown in Subsection 400.5.01.B "Determine Lot Acceptance."

   b. Subsurface mixes. For subsurface mixes, limit removal and replacement to the full lane width and no less than 10 ft. (3 m) long and as approved by the Engineer.

   c. Surface Mixes. For surface mixes, ensure that removal and replacement is not less than the full width of the affected lane and no less than the length of the affected areas as determined by the Engineer.

   Surface tolerance requirements apply to the corrected areas for both subsurface and surface mixes.

400.3.07 Contractor Warranty and Maintenance

A. Contractor's Record

Maintain a dated, written record of the most recent plant calibration. Keep this record available for the Engineer's inspection at all times. Maintain records in the form of:

- Graphs

- Tables
- Charts
- Mechanically prepared data

400.4 Measurement

Thickness and spread rate tolerances for the various mixtures are specified in Subsection 400.4.A.2.b, Table 12, Thickness and Spread Rate Tolerance at Any Given Location. These tolerances are applied as outlined below:

A. Hot Mix Asphaltic Concrete Paid for by Weight

1. Plans Designate a Spread Rate
   a. Thickness Determinations. Thickness determinations are not required when the Plans designate a spread rate per square yard (meter).

   If the spread rate exceeds the upper limits outlined in the Subsection 400.4.A.2.b, Table 12, "Thickness and Spread Rate Tolerance at Any Given Location," the mix in excess will not be paid for.

   If the rate of spread is less than the lower limit, correct the deficient course by overlaying the entire lot.

   The mixture used for correcting deficient areas is paid for at the Contract Unit Price of the course being corrected and is subject to the Mixture Acceptance Schedule—Table 10 or 11.

   b. Recalculate the Total Spread Rate. After the deficient hot mix course has been corrected, the total spread rate for that lot is recalculated, and mix in excess of the upper tolerance limit as outlined in the Subsection 400.4.A.2.b, Table 12, "Thickness and Spread Rate Tolerance at Any Given Location" is not paid for.

   The quantity of material placed on irregular areas such as driveways, turnouts, intersections, feather edge section, etc., is deducted from the final spread determination for each lot.

2. Plans Designate Thickness

   If the average thickness exceeds the tolerances specified in the Subsection 400.4.A.2.b, Table 12, "Thickness and Spread Rate Tolerance at Any Given Location," the Engineer shall take cores to determine the area of excess thickness. Excess quantity will not be paid for.

   If the average thickness is deficient by more than the tolerances specified in the Thickness and Spread Rate Tolerance at Any Given Location table below, the Engineer shall take additional cores to determine the area of deficient thickness. Correct areas with thickness deficiencies as follows:

   a. Overlay the deficient area with the same mixture type being corrected or with an approved surface mixture. The overlay shall extend for a minimum of 300 ft (90 m) for the full width of the course.

   b. Ensure that the corrected surface course complies with Subsection 400.3.06.C.1, "Visual and Straightedge Inspection." The mixture required to correct a deficient area is paid for at the Contract Unit Price of the course being corrected.

   The mixture is subject to the Mixture Acceptance Schedule—Table 10 or 11 . The quantity of the additional mixture shall not exceed the required calculated quantity used to increase the average thickness of the overlaid section to the maximum tolerance allowed under the following table.

Table 12—Thickness and Spread Rate Tolerance at Any Given Location

Course	Thickness Specified	Spread Rate Specified
Asphaltic concrete base course	± 0.5 in (± 13 mm)	± 55 lbs/yd^2 (30 kg/m^2)
Intermediate and/or wearing course	± 0.25 in (± 6 mm)	± 27.5 lbs/yd^2 (15 kg/m^2)
Overall of any combination of 1 and 2	± 0.5 in (± 13 mm)	± 55 lbs/yd^2 (30 kg/m^2)

Note: For asphaltic concrete 9.5 mm OGFC and 12.5 mm OGFC, control the spread rate per lot within 7 lbs/yd^2 (4 kg/m^2) of the designated spread rate. For asphaltic concrete 12.5 mm PEM, control the spread rate per lot within 10 lbs/yd^2 (6 kg/m^2) of the designated spread rate.

Note: Thickness and spread rate tolerances are provided to allow normal variations within a given lot. Do not continuously operate at a thickness of spread rate not specified.

When the Plans specify a thickness, the Engineer may take as many cores as necessary to determine the average thickness of the intermediate or surface course. The Engineer shall take a minimum of one core per 1,000 ft (300 m) per two lanes of roadway. Thickness will be determined by average measurements of each core according to GDT 42.

If the average exceeds the tolerances specified in the Subsection 400.4.A.2.b, Table 12, “Thickness and Spread Rate Tolerance at Any Given Location,” additional cores will be taken to determine the area of excess thickness and excess tonnage will not be paid for.

B. Hot Mix Asphaltic Concrete Paid for by Square Yard (Meter)

1. The thickness of the base course or the intermediate or surface course will be determined by the Department by cutting cores and the thickness will be determined by averaging the measurements of each core.
2. If any measurement is deficient in thickness more than the tolerances given in the table above, additional cores will be taken by the Department to determine the area of thickness deficiency. Correct thickness deficiency areas as follows:
   a. Overlay the deficient area with the same type mixtures being corrected or with surface mixture. Extend the overlay at least 300 ft (90 m) for the full width of the course.
   b. Ensure the corrected surface course complies with Subsection 400.3.06.C.1, Visual and Straightedge Inspection” .
   c. The mixture is subject to the Mixture Acceptance Schedule—Table 10 or 11.
3. No extra payment is made for mixtures used for correction.
4. No extra payment is made for thickness in excess of that specified.

C. Asphaltic Concrete

Hot mix asphaltic concrete, complete in place and accepted, is measured in tons (megagrams) or square yards (meters) as indicated in the Proposal. If payment is by the ton (megagram), the actual weight is determined by weighing each loaded vehicle on the required motor truck scale as the material is hauled to the roadway, or by using recorded weights if a digital recording device is used.

The weight measured includes all materials. No deductions are made for the weight of the individual ingredients. The actual weight is the pay weight except when the aggregates used have a combined bulk specific gravity greater than 2.75. In this case the pay weight is determined according to the following formula:

$$T1 = T \times \left\{ \frac{\%\ AC + \left(\dfrac{\%\ \text{Aggregate} \times 2.75}{\text{combined bulk Specific Gravity}} \right) + \%\ Y}{100} \right\}$$

Where:

T1	Pay weight, tonnage (Mg)
T=	Actual weight
% AC=	Percent asphalt cement by weight of total mixture
% Aggregate =	Percent aggregate by weight of total mixture minus the hydrated lime
Combined Bulk Sp. Gr.=	Calculated combined bulk specific gravity of various mineral aggregates used in the mixture
% Y=	Percent hydrated lime by weight of mineral aggregate

D. Bituminous Material

Bituminous material is not measured for separate payment.

E. Hydrated Lime

When hydrated lime is used as an anti-stripping additive, it is not measured for separate payment.

F. Field Laboratory

The field laboratory required in this Specification is not measured for separate payment.

G. Asphaltic Concrete Leveling

Payment of hot mix asphaltic concrete leveling, regardless of the type mix, is full compensation for furnishing materials, bituminous materials, and hydrated lime (when required) for patching and repair of minor defects, surface preparation, cleaning, hauling, mixing, spreading, and rolling.

Mixture for leveling courses is subject to the acceptance schedule as stated in Subsection 400.3.06.A and Subsection 400.3.06.B.

H. Asphaltic Concrete Patching

Hot mix asphaltic concrete patching, regardless of the type mix, is paid for at the Contract Unit Price per ton (Megagram), complete in place and accepted. Payment is full compensation for:

- Furnishing materials such as bituminous material and hydrated lime (when required)
- Preparing surface to be patched
- Cutting areas to be patched, trimmed, and cleaned
- Hauling, mixing, placing, and compacting the materials

When mixture for patching is paid for by the Department, ensure the mixture is subject to the acceptance schedule as stated in Subsection 400.3.06.A.

400.4.01 Limits

When the asphaltic concrete is paid for by the square yard (meter) and multiple lifts are used, the number and thickness of the lifts are subject to the Engineer's approval and are used to prorate the pay factor for the affected roadway section.

400.5 Payment

When materials or construction are not within the tolerances in this Specification, the Contract Price will be adjusted according to Subsection 106.03, "Samples, Tests, Cited Specifications" and Subsection 400.3.06, "Quality Acceptance."

Hot mix asphaltic concrete of the various types are paid for at the Contract Unit Price per ton (megagram) or per square yard (meter). Payment is full compensation for furnishing and placing materials including asphalt cement, hydrated lime when required, approved additives, and for cleaning and repairing, preparing surfaces, hauling, mixing, spreading, rolling, and performing other operations to complete the Contract Item.

Payment will be made under:

Item No. 400	Asphaltic concrete type Superpave, group-blend, Including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type, Superpave, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type Superpave, group-blend, Including bituminous materials, Gilsonite modifier, and hydrated lime	Per ton (megagram)
Item No. 400	_______ inches asphaltic concrete, type Superpave, group-blend including bituminous materials, Gilsonite modifier and hydrated lime	Per square yard (meter)
Item No. 400	Asphaltic concrete type Stone Matrix Asphalt, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type OGFC, group 2 only, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type OGFC, group 2 only, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type Porous European Mix, group 2 only, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)

400.5.01 Adjustments

A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract. Asphaltic Concrete OGFC or PEM shall be granted an adjustment period for the first 500 tons (500 Mg) produced for the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the Mixture Acceptance Schedule—Table 10 or 11 .

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs/yd^2 (50 kg/m^2) or less is also used for the surface mix at a spread rate greater than 90 lbs/yd^2 (50 kg/m^2), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 10 or 11 for both asphalt content and gradation.
- Meets the minimum requirements for a 0.90 pay factor in Table 13 of Subsection 400.5.01C, "Calculate Mean Pavement Air Voids."

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm SMA	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm SMA	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm PEM	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm OGFC	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm SMA	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm OGFC	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

For projects which do not have milling quantities established as a Pay Item, the Department will pay for 12.5 mm OGFC and PEM placed on ramps and end of project transitions under the appropriate mixture pay item, but the mix shall be subject to the same gradation and control sieve requirements as asphaltic concrete 9.5 mm OGFC. Add polymer-modified bituminous material, hydrated lime, and stabilizing fiber to this mix.

The Department will perform the following tasks:

1. Using the Mixture Acceptance Schedule—Table 10 or 11, determine the mean of the deviations from the job mix formula per test results per lot.
2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table10 to determine acceptance of surface mixes and the Mixture Acceptance Schedule—Table 11 to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

1. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable Mixture Acceptance Schedule—Table 10 or 11.
2. Minimum requirements for a 0.90 pay factor in Table 13 of Subsection 400.5.01C, "Calculate Pavement Mean Air Voids."

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

Table 13 - Air Voids Acceptance Schedule

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1— 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 —172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When recommended by the Office of Materials and Testing, Lots receiving less than 0.5 pay factor shall be removed and replaced at the Contractor's expense.

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in Subsection 400.3.06.B.2.

D. Asphaltic Concrete For Temporary Detours

Hot mix asphaltic concrete placed on temporary detours not to remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price. Ensure the payment for this item covers all cost of construction, maintenance and removal of all temporary mix. Ensure hot mix asphaltic concrete placed as temporary mix meets requirements established in Subsection 400.3.05.F.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting \$0.75/ton (\$0.85/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting \$0.04/yd² (\$0.05/m²) per 1 in (25 mm) plan depth.

Further price adjustments required in Subsection 400.3.06, "Quality Acceptance," which are based on the appropriate adjusted Contract Price for mix used in the temporary detour work shall apply should temporary mix be left in place. Ensure hot mix asphalt produced as temporary mix containing no hydrated lime is removed and replaced with permanent mix containing hydrated lime.

E. Determine Lot Payment

Determine the lot payment as follows:

1. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.
2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the Mixture Acceptance Schedule—Table 10 or 11 and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the Air Voids Acceptance Schedule – Table 13, remove and replace the materials at the Contractor's expense.

If the Engineer determines the material is not acceptable to leave in place, remove and replace the materials at the Contractor's expense.

Section 402—Hot Mix Recycled Asphaltic Concrete

402.1 General Description

This work includes producing and placing hot mix recycled asphaltic concrete that incorporates reclaimed asphalt pavement (RAP), reclaimed asphalt shingles (RAS), virgin aggregate, hydrated lime, and neat asphalt cement.

402.1.01 Definitions

General Provisions 101 through 150.

402.1.02 Related References

A. Standard Specifications

Section 400—Hot Mix Asphaltic Concrete Construction

Section 800—Coarse Aggregate

Section 828—Hot Mix Asphaltic Concrete Mixtures

B. Referenced Documents

SOP 41 "Guidelines for RAP Stockpile Approval"

402.1.03 Submittals

A. Certified Weight Tickets

Notify the Engineer before removing RAP from a stockpile that belongs to the Department. Submit to the Engineer the certified weight tickets of materials removed from the stockpile.

B. Affidavit

Submit to the laboratory an affidavit stating the sources of stockpiled materials to be used on a State project. Include the following information in the letter:

- State project number
- Location from which the material was removed
- Approximate removal dates
- Mix types removed and the estimated quantity of each type in the stockpiles
- Other available information about the stockpiled material such as percentage of local sand in the RAP

Obtain specific approval from the laboratory to use RAP or RAS stockpiles.

Adhere to Guidelines for RAP Stockpile Approval.

402.2 Materials

A. RAP Material Composition

Use RAP materials from any of the following:

- Existing roadway
- Contractor's RAP stockpile that has been approved by the Department
- Department stockpile

NOTE: The location of Department RAP material stockpiles will be given on the Plans.

Do not use RAP materials that contain alluvial gravel or local sand in any mixture placed on interstate projects except for mixtures used in shoulder construction. When used in shoulder construction, limit RAP containing local sand or alluvial gravel so that the sand or gravel contributes no more than 20% of the total aggregate portion of the mix.

1. RAP Percentage

   For non-interstate projects, limit the percentage of RAP allowed in recycled mixes so that the overall amount of alluvial gravel does not exceed 5 percent of the total mix. The percentage of alluvial gravel, local sand, and Group I material in the RAP will be determined through petrographic analysis or available records.
2. RAP furnished to the Contractor but not used in the work remains the Contractor's property.

   RAP used in the recycled mixtures for mainline or ramps (if applicable) may make up from 0 to 40 percent of the mixture depending on the amount of RAP available, the production facilities, and whether the mixture meets the requirements in Section 828.

   The maximum ratio of RAP material to the recycled mixtures other than SMA is 40 percent for continuous mix type plants and 25 percent for batch type plants. The maximum ratio of RAP material to the recycled mixture is 15 percent for Stone Matrix Asphalt (SMA) mixes.
3. Process RAP Material

Process RAP material to be used in the recycled mixture so that 100 percent will pass the 2 in (50 mm) sieve. Additional crushing and sizing may be required if the RAP aggregate exceeds the maximum sieve size for the mix type as shown in Section 828. Obtain representative materials from the RAP stockpile for the mix design.

B. RAS Material

RAS materials are produced as a by-product of manufacturing roofing shingles and/or discarded shingle scrap from the reroofing of buildings.

1. Limit the amount of RAS material used in the recycled mixture to no greater than 5 percent of the total mixture weight.
2. Shred the RAS material before incorporating it into the mix to ensure that 100 percent of the shredded pieces are less than 1/2 in (12.5 mm) in any dimension.
3. Remove all foreign materials such as paper, roofing nails, wood, or metal flashing.
4. Provide test results for Bulk Sample Analysis, known as Polarized Light Microscopy, if post-consumer shingles are used to certify the RAS material is free of asbestos. Test stockpiles at the rate of one test per 1000 tons (megagrams) prior to processing.

Other than as specifically stated in this Subsection, ensure that RAS material is used according to the same requirements as described for RAP material.

C. Asphaltic Concrete Removed from an Existing Roadway

Asphaltic concrete removed from an existing roadway becomes the Contractor's property unless specified otherwise on the Plans. RAP material retained by the Department is designated on the Plans, and the RAP shall be stockpiled at the location specified on the Plans.

D. Local Sand and Group I Material in RAP

Use of local sand in recycled mixes is restricted as stipulated in Section 828 for the Project. However, RAP which contains local sand may be used in surface and intermediate layers of non-interstate projects so long as the RAP percentage used does not contribute more than 5% local sand to the total aggregate portion of the mix. The amount of local sand in the RAP material shall be considered when determining the percentage of local sand in the total mix.

Where Pay Items specify that Group II only aggregate is to be used, RAP which consists primarily of Group II aggregate, but contains some Group I aggregate, shall be limited such that the Group I aggregate makes up no more than 5% of the total aggregate portion of the mix. When a Blend I mix is specified, any Group I materials in the RAP will be considered when determining the Group I portion allowed in the total mix as specified in Subsection 828.2.A.2.

E. Asphalt Cement

Using laboratory evaluations, the Department will determine the asphalt cement grade to be used in the recycled mixture. The asphalt cement shall meet the requirements of Section 820.

When the asphalt cement is blended with asphalt cement recovered from the RAP material and after tests on residue from thin film oven tests, the asphalt cement shall have a viscosity of 6,000 to 16,000 poises (600 to 1600 Pa) or as approved by the Engineer. Recover asphalt cement from the recycled mixture to verify that the specified viscosity is being met.

If the Engineer determines during construction that the selected asphalt cement grade is not performing satisfactorily, the Department may change the asphalt cement grade in the mixture, with no change in the Contract Unit Price.

F. Recycled Mixture

The recycled mixture shall be a homogenous mixture of RAP or RAS material, virgin aggregate, hydrated lime, and neat asphalt cement. Ensure that the mixture conforms to an approved mixture design outlined in Section 828.

402.2.01 Delivery, Storage, and Handling

Separate the stockpiles by Project sources and by Group I and Group II aggregate types. Erect a sign on each stockpile to identify the source(s).

If RAP material from different project sources becomes intermixed in a stockpile, only use those materials when approved by the laboratory.

The Department may reject by visual inspection stockpiles that are not clean and free of foreign materials.

402.3 Construction Requirements

402.3.01 Personnel

General Provisions 101 through 150.

402.3.02 Equipment

A. Hot Mix Plant

Use a hot mix plant for the recycling process with necessary modifications approved by the Engineer to process recycled material. Design, equip, and operate the plant so that the proportioning, heating, and mixing yields a uniform final mixture within the job mix formula tolerances.

B. Cold Feed Bin

Proportion the RAP or RAS material using a separate cold feed bin. Ensure that the material meets the size requirements in Subsection 402.2, "Materials." The ratio of the RAP or RAS to virgin aggregate shall be controlled gravimetrically.

C. Electronic Belt Weighing Devices

Use electronic belt weighing devices to monitor the flow of RAP or RAS and the flow of virgin aggregate. For batch-type plants, the RAP or RAS portion of the mix may be weighed in a weigh hopper before incorporating it into the pugmill. The RAP shall be screened through a 2-inch maximum sized screen prior to crossing the cold feed weigh. Ensure the amount of RAP material incorporated into the asphalt plant does not change after this final measurement is processed by the asphalt plant computer.

D. Feeders and Conveyors

Equip plants with an interlocking system of feeders and conveyors that synchronize the RAP or RAS material flow with the virgin aggregate flow. Ensure that the electronic controls track the flow rates indicated by the belt weighing devices and develop the signal to automatically maintain the desired ratio at varying production rates. Design the RAP or RAS feeder bins, conveyor system, and auxiliary bins (if used) to prevent RAP material from segregating and sticking.

402.3.03 Preparation

General Provisions 101 through 150.

402.3.04 Fabrication

General Provisions 101 through 150.

402.3.05 Construction

Follow the requirements in Section 400 for hot mix recycled asphaltic concrete production and placement, materials, equipment, and acceptance plans except as noted or modified in this Specification.

402.3.06 Quality Acceptance

The Department may require additional quality control tests to determine the RAP stockpile consistency and the RAP aggregate quality. In this case, conduct at least three extraction/gradation tests from each individual source. Ensure that aggregate meets the quality standards in Section 800.

402.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

402.4 Measurement

Recycled asphaltic concrete mixture, complete in place and accepted, is measured in tons (megagrams). The weight is determined by recorded weights if an approved recording device is used. Or, the weight is determined by weighing each loaded vehicle on an approved motor truck scale as the material is hauled to the roadway.

402.4.01 Limits

General Provisions 101 through 150.

402.5 Payment

The work performed and the materials furnished as described in this Specification will be paid for at the Contract Unit Price per ton (megagram). Payment is full compensation for providing materials, hauling and necessary crushing, processing, placing, rolling and finishing the recycled mixture, and providing labor, tools, equipment, and incidentals necessary to complete the work, including hauling and stockpiling RAP or RAS material.

Payment will be made under:

Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, Type__, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete _______mm mix, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	__________in (mm) recycled asphaltic concrete type Superpave, group-blend, including bituminous materials	Per square yard (meter)
Item No. 402	__________in (mm) recycled asphaltic concrete type Superpave, group-blend, including bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	__________in (mm) recycled asphaltic concrete type Superpave, group-blend, including polymer-modified bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	__________in (mm) recycled asphaltic concrete ______ mm mix, group-blend, including bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	Recycled asphaltic concrete patching including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete patching including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete leveling including bituminous materials	Per ton (megagram)

Item No. 402	Recycled asphaltic concrete leveling including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete type Stone Matrix Asphalt, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)

A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the Mixture Acceptance Schedule—Table 9 or 10 .

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs/yd² (50 kg/m²) or less is also used for the surface mix at a spread rate greater than 90 lbs/yd² (50 kg/m²), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 9 or 10 for both asphalt content and gradation.
- Meets the minimum requirements for a 0.90 pay factor in Table 12 of Subsection 400.5.01C, "Calculate Mean Pavement Air Voids.

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm SMA	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm SMA	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm SMA	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

The Department will perform the following tasks:

1. Using the Mixture Acceptance Schedule—Table 9 or 10, of Subsection 400.3.06 to determine the mean of the deviations from the job mix formula per test results per lot.
2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table 9 or 10 of Subsection 400.3.06 to determine acceptance of surface mixes and the Mixture Acceptance Schedule—Table 10 of Subsection 400.3.06 to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

1. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable Mixture Acceptance Schedule—Table 9 or 10 ofSubsection 400.3.06.
2. Minimum requirements for a 0.90 pay factor in Table 12 of Subsection 402.5.01.C, "Calculate Pavement Mean Air Voids.

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

Table 12 - Air Voids Acceptance Schedule

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1— 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 —172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in Subsection 400.3.06.B.2.

D. Asphaltic Concrete for Temporary Detours

Hot mix asphaltic concrete placed on temporary detours that will not remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price. The payment for this item shall cover all cost of construction, maintenance and removal of all temporary mix. Hot mix asphaltic concrete placed as temporary mix shall meet requirements established in Subsection 400.3.05.F.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting $0.75/ton ($0.85/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting \$0.04/yd² (\$0.05/ m²) per 1-in (25-mm) plan depth.

Further price adjustments required in Subsection 400.3.06, “Quality Acceptance,” which are based on the appropriate adjusted Contract Price for mix used in the temporary detour work shall apply should temporary mix be left in place. Hot mix asphalt produced as temporary mix containing no hydrated lime shall be removed and replaced with permanent mix containing hydrated lime.

E. Determine Lot Payment

Determine the lot payment as follows:

1. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.
2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the Mixture Acceptance Schedule—Table 9 or 10 and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the Air Voids Acceptance Schedule – Table 12, remove and replace the materials at the Contractor’s expense.

If the Engineer determines that the material is not acceptable to leave in place, remove and replace the materials at the Contractor’s expense.

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

Section 415—Asphaltic Concrete Open Graded Crack Relief Interlayer

Delete Section 415 and substitute the following:

415.1 General Description

This work includes constructing a bituminous plant produced Asphaltic Concrete Open Graded Crack Relief Interlayer (OGI) over the existing roadway surface. The mixture shall serve as asphaltic concrete leveling over irregular surfaces and provide mitigation for reflective cracking prior to the placement of the final surface pavement. The mixture shall conform to the lines, grades, thicknesses, typical sections and cross sections shown on the Plans or established by the Engineer.

This section includes the requirements for Asphaltic Concrete Open Graded Crack Relief Interlayer mixtures regardless of the gradation of the aggregates, type and amount of bituminous material, or pavement use. Follow the requirements in Section 400, Section 402 and Section 828 for production and placement, materials, equipment, and acceptance plans except as noted or modified in this Specification.

Acceptance of work is on a lot-to-lot basis according to the requirements of this Section, Section 400, Section 402 and Section 106.

415.1.01 Definitions

Asphaltic Concrete Open Graded Crack Relief Interlayer: an open graded mixture placed at a lift thickness that yields stone on stone contact that provides in-place air void content of 18 to 23 percent to mitigate existing cracking within asphaltic concrete pavements.

415.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials

Section 109—Measurement and Payment

Section 152—Field Laboratory Building

Section 400 – Hot Mix Asphaltic Concrete Construction

Section 402 – Hot Mix Recycled Asphaltic Concrete

Section 413—Bituminous Tack Coat

Section 800 – Coarse Aggregate

Section 802 - Aggregate for Asphaltic Concrete

Section 820 – Asphalt Cement

Section 828—Hot Mix Asphaltic Concrete Mixtures

Section 831 – Admixtures

Section 882 – Lime

Section 883 – Mineral Filler

B. Referenced Documents

AASHTO T 209

AASHTO T 202

AASHTO T 49

AASHTO T 315

Department of Transportation Standard Operating Procedure (SOP) 27

Department of Transportation Standard Operating Procedure (SOP) 15

Department of Transportation Standard Operation Procedure (SOP) 40

GDT 38

GDT 73

GDT 83

GDT 114

GDT 119

GDT 125

GDT 126

GSP 15

GSP 21

QPL 1

QPL 2

QPL 7

QPL 26

QPL 39

QPL 41

QPL 45

415.1.03 Submittals

A. Invoices

Furnish formal written invoices from a supplier for all materials used in production of HMA when requested by Department. Show the following on the Bill of Lading:

- Date shipped
- Quantity in tons (megagrams)
- Included with or without additives (for asphalt cement)

Purchase asphaltic cement directly from a supplier listed on Qualified Products List 7 and provide copies of Bill of Lading at the Department's request.

B. Paving Plan

Before starting asphaltic concrete construction, submit a written paving plan to the Engineer for approval. Include the following on the paving plan:

- Proposed starting date
- Location of plant(s)
- Rate of production
- Average haul distance(s)
- Number of haul trucks
- Paver speed feet (meter)/minute for each placement operation
- Mat width for each placement operation
- Number and type of rollers for each placement operation

- Sketch of the typical section showing the paving sequence for each placement operation
- Electronic controls used for each placement operation
- Temporary pavement marking plan

If staged construction is designated in the Plans or contract, provide a paving plan for each construction stage.

If segregation is detected, submit a written plan of measures and actions to prevent segregation. Work will not continue until the plan is submitted to and approved by the Department.

C. Job Mix Formula

Submit to the Engineer a written job mix formula proposed for each mixture type to be used based on an approved mix design. Furnish the following information for each mix:

- Specific project for which the mixture will be used
- Source and description of the materials to be used
- Mixture I.D. Number
- Proportions of the raw materials to be combined in the paving mixture
- Single percentage of the combined mineral aggregates passing each specified sieve
- Single percentage of asphalt by weight of the total mix to be incorporated in the completed mixture
- Single temperature at which to discharge the mixture from the plant
- Theoretical specific gravity of the mixture at the designated asphalt content
- Name of the person or agency responsible for quality control of the mixture during production

Do the following to have the formulas approved in accordance with SOP 40 "Approval of Contractor Job Mix Formulas" and to ensure their quality:

1. Submit proposed job mix formulas for review at least two weeks before beginning the mixing operations.
2. Do not start hot mix asphaltic concrete work until the Engineer has approved a job mix formula for the mixture to be used. No mixture will be accepted until the Engineer has given approval.
3. Provide mix designs for all Asphaltic Concrete Open Graded Crack Relief Interlayer mixtures to be used.
4. After a job mix formula has been approved, assume responsibility for the quality control of the mixtures supplied to the Department according to Subsection 106.01, "Source of Supply and Quantity of Materials."

D. Quality Control Program

Submit a Quality Control Plan to the Office of Materials and Testing for approval. The Quality Control Program will be included as part of the certification in the annual plant inspection report.

415.2 Materials

The requirements established in Section 400 are to be followed for Asphaltic Concrete Open Crack Relief Interlayer production and placement, materials, equipment, and acceptance plans except as noted or modified in this Specification.

Ensure that materials comply with the specifications listed in Table 1.

Table 1—Materials Specifications

Material	Subsection
Asphalt Cement, Grade Specified	820.2
Coarse Aggregates for Asphaltic Concrete	802.2.02
Fine Aggregates for Asphaltic Concrete	802.2.01
Mineral Filler	883.1
Heat Stable Anti-Stripping Additive	831.2.04
Hydrated Lime	882.2.03
Silicone Fluid (When approved by the Office of Materials and Testing)	831.2.05
Bituminous Tack Coat: PG 58-22, PG 64-22, PG 67-22	820.2
Hot Mix Asphaltic Concrete Mixtures	828

415.2.01 Mix Design Requirements

The Open Graded Crack Relief Interlayer Mixture shall be formulated to contain approximately 18 to 23 percent in-place air voids after compaction. Use approved mixtures that meet the following mixture control tolerances and design criteria:

Table 2 – Asphaltic Concrete Open Graded Crack Relief Interlayer Mixture Design and Control

Sieve Size	Mixture Control Tolerance, %	Design Gradation Limits, % Passing
		Open Graded Crack Relief Interlayer
3/4 in (19 mm) sieve	±0.0	100
1/2 in (12.5 mm) sieve	±6.1	80 - 100
3/8 in (9.5 mm) sieve	±5.6	40 - 65
No. 4 (4.75 mm) sieve	±5.7	10 - 25
No. 8 (2.36 mm) sieve	±4.6	2 - 10
No. 200 (75 μm) sieve	±2.0	2 - 5
Range for % AC	±0.4	4.50 – 5.25
Class of stone (Section 800)		“A” only
Drain-down (AASHTO T305), %		<0.3
Design optimum air voids (%)		20% ± 2%
Control Sieves used in Acceptance Schedule		3/8 in., No. 8 (9.5 mm, 2.36 mm) and Asphalt Cement

Notes:

1. Use only PG 64-22 or PG 67-22 asphalt cement (specified in Section 820).
2. Use no less than 1.0% hydrated lime regardless of aggregates group or source(s) used.
3. Ensure no more than 10 percent Recycled Asphalt Pavement (RAP) is used in Asphaltic Concrete Open Graded Interlayer mixtures.
4. Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.
5. Range for % AC is Original Optimum AC (OOAC) at 25 blow Marshall prior to the Corrected Optimum

AC (COAC) calculation detailed in SOP 2 (Appendix D).

415.3 Construction Requirements

The requirements established in Section 400 are to be followed for asphaltic concrete mixture production and placement, materials, equipment, and acceptance plans except as noted or modified in this Specification.

415.3.01 Personnel

General Provisions 101 through 150.

415.3.02 Construction

Asphaltic concrete plants that produce mix for Department use are governed by Quality Assurance for Hot Mix Asphaltic Concrete Plants in Georgia, Laboratory Standard Operating Procedure No. 27.

Follow requirements established in Section 400 for production and placement, materials, equipment, acceptance plans and adjustments except as noted or modified in this Specification.

A. Apply a bituminous tack coat according to Section 413. The Engineer will determine the application rate, which must be within the limits of 0.06 gal/yd^2 to 0.10 gal/yd^2 (0.27 L/m^2 to 0.45 L/m^2) **(residual asphalt cement)**.

B. The mix shall be produced and placed at a temperature of 250°F with a tolerance of ± 20°F.

C. Place the mix to a compacted lift thickness of 1-inch (25 mm). For construction purposes, the target thickness will be converted to spread rate based on the bulk specific gravity of the asphaltic concrete mixture being used as shown in the following equation:

   Spread rate (lbs/yd^2) = $t * G_{mb} * 46.8$ (Spread rate (kg/ m^2) = $t * G_{mb}$)

   Where: t = Compacted lift thickness (inches, mm)

   G_{mb}= bulk specific gravity of the mix from the approved mix design

   The spread rate shall be controlled within 10 lbs/yd^2 (6 kg/m^2).

D. Do not place mix at air temperatures below 50 °F (10 °C).

E. The mix shall be compacted in a manner to achieve 18 to 23 percent in-place air voids. Steel wheel rollers operating in static mode ***only*** will be used to seat the lift of Asphaltic Concrete Open Graded Crack Relief Interlayer mixture. Pneumatic tire rollers shall not be allowed on the Asphaltic Concrete Open Graded Crack Relief Interlayer mat.

415.4. Measurement

Asphaltic Concrete Open Graded Crack Relief Interlayer mixture, complete, in place and accepted, is measured in tons (megagrams). If the spread rate exceeds the upper limits outlined in Subsection 415.3.02.C by > 15 lbs/yd^2, the mix in excess will not be paid for. If the rate of the spread is ≤ 10 lbs/yd^2 than the lower limit, the deficient course is subject to correction by overlaying the entire lot. The mixture used for correcting deficient areas is paid for at the Contract Unit Price of the course being corrected and is subject to mixture control requirements established in Table 2 – Asphaltic Concrete Open Graded Crack Relief Interlayer Mixture Design and Control**.** After the deficient course has been corrected, the total spread rate for that lot is recalculated, and the mix in excess of the upper limits outlined in Subsection 415.3.02.C will not be paid for.

415.5 Payment

Asphaltic Concrete Open Graded Crack Relief-Interlayer mix is paid for at the Contract Unit Price per ton (megagram). Payment is full compensation for furnishing and placing materials including asphalt cement, hydrated lime, approved additives, and for cleaning and repairing, preparing surfaces, hauling, mixing, spreading, rolling, and performing other operations to complete the Contract Item.

Payment will be made under:

Item No. 415	Asphaltic Concrete Open Graded Crack Relief Interlayer, group-blend, Including bituminous materials and hydrated lime	Per ton (megagram)

415.5.01 Adjustments

A. Materials Produced and Placed During the Adjustment Period

Follow requirements established in Section 400 for production and placement, materials, equipment, acceptance plans and adjustments except as noted or modified in this Specification.

Asphaltic Concrete Open Graded Crack Relief Interlayer shall be granted an adjustment period for the first Lot or day, whichever is less, produced for the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations. Test the mixture in accordance with Section 400.3.06. Maintain the asphalt cement content and gradation within the limits provided in Table 2 – Asphaltic Concrete Open Graded Interlayer Mixture Design and Control. The Engineer will not use these test results in the acceptance for payment decision but production and placement operations shall cease for failure to meet mixture control tolerances established in Table 2 – Asphaltic Concrete Open Graded Interlayer Mixture Design and Control.

415.5.02 Determine Lot Acceptance

The Engineer will accept the mixture based on visual inspection. The mixture shall be inspected for texture, segregation, bleeding, fat spots, raveling, delamination, tearing, targeted in-place air void content and slippage areas. Remove and replace any areas determined to be unacceptable to the Engineer.

Office of Materials and Testing

Section 432—Mill Asphaltic Concrete Pavement

432.1 General Description

This work includes milling existing asphaltic concrete pavement to restore proper grade and/or transverse slope, removing structurally unsound material, providing clearance for overlay in curb and gutter sections, or other purposes deemed necessary due to existing conditions. Perform the work according to these Specifications and Plan details.

432.1.01 Definitions

General Provisions 101 through 150.

432.1.02 Related References

A. Standard Specifications

Section 109—Measurement and Payment

B. Referenced Documents

GDT 126

432.1.03 Submittals

General Provisions 101 through 150.

432.2 Materials

432.2.01 Delivery, Storage, and Handling

When specified, stockpile the milled material at locations shown on the Plans.

1. Uniformly stockpile the materials approximately 6 – 8 ft (1.8 – 2.4 m) high.
2. Maintain the existing drainage pattern of water from the stockpile storage area.
3. Dress the reclaimed asphalt area to drain rainwater from the material.
4. Obtain the Engineer's approval of the stockpile locations and the method used to prevent milled material degradation, segregation, and reconsolidation.

432.3 Construction Requirements

432.3.01 Personnel

General Provisions 101 through 150.

432.3.02 Equipment

A. Milling Equipment

Use power-driven, self-propelled milling equipment that is the size and shape that allows traffic to pass safely through areas adjacent to the work. Also, use equipment that is:

- Designed to mill and remove a specified depth of existing asphalt paving
- Equipped with grade and slope controls operating from a stringline or ski and based on mechanical or sonic operation
- Capable of removing pavement to an accuracy of 1/8 in (3 mm)
- Furnished with a lighting system for night work, as necessary
- Provided with conveyors capable of side, rear, or front loading to transfer the milled material from the roadway to a truck

B. Dust Control

Provide power brooms, vacuum sweepers, power blowers, or other means to remove loose debris or dust. Do not allow dust control to restrict visibility of passing traffic or to disrupt adjacent property owners.

432.3.03 Preparation

General Provisions 101 through 150.

432.3.04 Fabrication

General Provisions 101 through 150.

432.3.05 Construction

A. Milling Operation

Follow the Plans to mill the designated areas and depths including bridge decks, shoulders, and ramps, as required. Ensure the following requirements are met:

1. Schedule the construction operation. Use milling methods that will produce a uniform finished surface and maintain a constant cross slope between extremities in each lane.
2. Provide positive drainage to prevent water accumulation on the milled pavement, as shown on the Plans or directed by the Engineer.

3. Bevel back the longitudinal vertical edges greater than 2 in (50 mm) that are produced by the removal process and left exposed to traffic. Bevel them back at least 3 in for each 2 in (75 mm for each 50 mm) of material removed. Use an attached mold board or other approved method.
4. When removing material at ramp areas and ends of milled sections, taper the transverse edges 10 ft (3 m) to avoid creating a traffic hazard and to produce a smooth surface.
5. Protect with a temporary asphaltic concrete tie-in (paper joint) vertical edges at other areas such as bridge approach slabs, drainage structures, and utility apputenance greater than 1/2 in that are left open to transversing vehicles. Place the temporary tie-in at taper rate of at least 6 to 1 horizontal to vertical distance.
6. Remove dust, residue, and loose milled material from the milled surface. Do not allow traffic on the milled surface and do not place asphaltic concrete on the milled surface until removal is complete.

The reclaimed asphaltic pavement becomes the Contractor’s property unless otherwise specified.

432.3.06 Quality Acceptance

Ensure that the milling operation produces a uniform pavement texture that is true to line, grade, and cross section.

Milled pavement surface acceptance testing will be performed using the Laser Road Profiler method in GDT 126. Milled pavement will be evaluated on individual test sections, normally 1 mile (1 km) long.

When the milled surface is to be left as the final wearing surface, ensure that indices do not exceed:

- 1025 on milled pavement surfaces on interstates when the milled surface will be the final wearing surface
- 1175 for other on-system routes when the milled surface will be the final wearing surface
- 1175 on Interstates and 1325 for other on-system routes if the milled surface will be overlaid

Remill mile (kilometer) areas to meet the specified limits when the indices are exceeded. Remill at no additional cost to the Department.

Milled pavement surfaces are subject to visual and straightedge inspection. Keep a 10 ft (3 m) straightedge near the milling operation to measure surface irregularities of the milled pavement surface. Remill irregularities greater than 1/8 in per 10 ft (3 mm in 3 m) at no additional cost to the Department.

Ensure that the cross slope is uniform and that no depressions or slope misalignments greater than 1/4 in per 12 ft (6 mm in 3.6 m) exist when the slope is tested with a straightedge placed perpendicular to the center line.

432.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

432.4 Measurement

Milling existing asphaltic concrete pavement is measured by the square yard (meter) as described in Subsection 109.01, “Measurement and Quantities.”

432.4.01 Limits

General Provisions 101 through 150.

432.5 Payment

Milling asphaltic concrete pavement, measured as specified, will be paid for at the Contract Unit Price bid per square yard (meter). The price bid for this item includes the credit value of all Reclaimed Asphalt Pavement (RAP) recovered, and no adjustment in the unit price for this item or other items will be considered for variations in the amount of RAP actually recovered.

Payment is full compensation for furnishing equipment, milling, hauling, stockpiling milled material, and satisfactorily performing the work.

Payment will be made under:

Item No. 432	Mill asphaltic concrete pavement, ___ in (mm) depth	Per square yard (meter)
Item No. 432	Mill asphaltic concrete pavement, variable depth	Per square yard (meter)

432.5.01 Adjustments

General Provisions 101 through 150.

[redacted]

[redacted]

Section 819—Fiber Stabilizing Additives

819.1 General Description

This Section covers the general requirements for fiber stabilizing additives incorporated into asphaltic concrete mixtures. These fibers are used to stabilize the asphalt film surrounding aggregate particles to reduce drain-down of the asphalt cement, use cellulose or mineral fiber stabilizer listed on QPL 77, Fiber Stabilizing Additives.

819.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

AASHTO T 245

ASTM D 128

ASTM C 612

GDT 127

GDT 130

QPL 77

819.2 Materials

Use an approved mineral or cellulose fiber stabilizing additive currently listed in QPL 77. Approved additives shall meet the requirements below. Dosage rates below are typical ranges. Use the dosage rate prescribed in the Job Mix Formula, as approved by the Office of Materials.

A. Requirements for all fiber types

1. Use a fiber stabilizer of the type and properties appropriate to the plant's metering and delivery system.
2. When tested in a standard mixture according to GDT 127, the fiber stabilizing additive shall limit drain-down to not more the 0.2% of the weight of the mixture. For the purpose of evaluating these additives, the following test conditions apply.
   - The mixture tested shall consist of a standard No. 7 stone and 6.4% asphalt cement.
   - Mixing and compaction temperatures for the test shall be as prescribed in AASHTO T 245, Section 3.3.1.
   - Wet mixing time shall be 60 ± 2 seconds.
   - Un-separated fibers, determined by visual inspection of the mixture after the drain-down test, shall not exceed 5% of total fiber content.

B. Cellulose Fibers

Add cellulose fibers at a dosage rate between 0.2% and 0.4% by weight of the total mix, according to the approved Job Mix Formula. Fiber properties shall be as follows:

- Ash Content by ASTM D 128: 23% maximum non-volatile content
- pH: 7.0 to 12.0
- Moisture Content: 5.0% maximum

C. Cellulose Pellets

Use cellulose fiber stabilizing additive in pellet form that meets the requirements of Subsection 819.2.A and Subsection 819.2.B. Use pellets that disperse sufficiently at mixing temperature to blend uniformly into the asphalt mixture. Use pellets that do not exceed 0.24 in (6.0 mm) average pellet diameter. Pellets may contain binder ingredients such as asphalt cement, wax, or polymer. Do not use pellets if the binder ingredient exceeds 20.0% of the total weight of the pellets. Use binder that produces no measurable effect on the properties of the asphalt cement. Do not use fiber pellets which soften or clump together when stored at temperatures up to 122 ^{0}F (50 ^{0}C).

Add approved palletized fiber stabilizing additive at a dosage rate between 0.2% and 0.4% by weight of the total mix, according to the approved Job Mix Formula established by the Office of Materials.

NOTE: If the binder material constitutes more than 3% of the pellet weight, the dosage rate shall be based upon the net fiber content.

D. Mineral Fibers

Use mineral fibers made from virgin basalt, diabase, slag or other silicate rock. Add the fiber at a dosage rate prescribed in the approved Job Mix Formula, between 0.3% and 0.6% by weight of the total mix. Use approved mineral fiber from QPL 77, not exceeding 25 % shot content in accordance with ASTM C 612, as tested according to GDT 130:

E. Materials Warranty

General Provisions 101 through 150.

[redacted]

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Section 820—Asphalt Cement

Delete Section 820 and substitute the following:

820.1 General Description

This section includes the requirements for asphalt cements prepared from crude petroleum.

820.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

Standard Operating Procedure (SOP 4)

AASHTO R 28

AASHTO T 48

AASHTO T 179

AASHTO T 240

AASHTO T 313

AASHTO T 314

AASHTO T 315

AASHTO T 316

AASHTO T 350

C. Definitions

Performance Grade (PG): Method of classifying an asphalt cement binder relative to its rated performance at different testing temperatures.

Polymer Modified Asphalt (PMA): Engineered asphalt cement which incorporates Styrene-Butadiene-Styrene (SBS) or Styrene-Butadiene (SB) polymers.

Highly Modified Polymer Asphalt (PG 76-22E): Engineered asphalt cement which incorporates significantly higher levels of Styrene-Butadiene-Styrene (SBS) or Styrene-Butadiene (SB) polymers than PMA.

Asphalt Rubber Binders (ARB): Engineered asphalt cement which incorporates Styrene Butadiene Rubber (SBR) or Ground Tire Rubber (GTR). The GTR may be incorporated into the asphaltic concrete mixture via a dry method when approved by the Office of Materials and Testing.

Hot Applied Non-tracking Bituminous Tack: A non-tracking engineered asphalt cement based bituminous tack coat material that is applied using a conventional heated distributor.

820.2 Materials

820.2.01 Asphalt Cement

A. Requirements

1. Type

Use a homogenous, free from water and deleterious material that will not foam when heated to 347 °F (175 °C). Ensure blend used to produce a specified performance grade meets the following requirements:

- Is uniform and homogeneous without separation
- Uses PG 64-22 or PG 67-22 described below for the base asphalt
- Consists of production materials not being "air-blown".
- Contains < 0.5% acid (Polyphosphoric Acid (PPA) modification, for PG 76-22 PMA, 76-22E and PG76-22 ARB only, when approved by the Office of Materials.
- Only additives or modifiers approved by the Office of Materials and Testing are used.

2. Grade

Use the various grades of asphalt cement meeting the requirements shown in the test requirements for Petroleum Asphalt Cements.

a. Add SBS or SB to neat asphalt to produce a binder meeting requirements for PG 76-22 PMA and PG 76-22E when roadway ADT is equal to or greater than 100,000 vpd for Stone Matrix Asphalt (SMA) and Porous European Mix (PEM) or Open Graded Friction Course (OGFC) Mixtures.

b. SBR or GTR modified PG 76-22 ARB is an acceptable alternative to SBS or SB modified asphalt cement at the contractor's discretion, when roadway ADT is less than 100,000 vpd, provided the SBR or GTR modified asphalt cement meets the tests' requirements specified in Table 7.

For SBR modified PG 64-22 or PG 67-22 to meet PG 76-22 ARB, use only SBR currently approved on QPL-65 "Georgia's List of Approved Latex Suppliers". For GTR modified PG 64-22 or PG 67-22 to meet PG 76-22 ARB, use 30 mesh size ambient or cryogenic ground tire rubber at minimum 10% of weight of neat asphalt cement content of the asphaltic concrete mixture. Ensure Trans-Polyoctenamer is added at 4.5% of the weight of the crumb rubber to achieve better particle distribution. Other approved workability additives may be used, at the discretion of the Office of Materials, provided the end product meets all specified requirements of PG76-22 ARB. Ensure the end product is homogenous and shows no separation or coagulation. Percentage of ambient or cryogenic ground tire rubber is neat asphalt source dependent and may require > 10 % to meet specification requirements for PG 76-22 ABR.

Superpave PG Binder Table 1 – Hot Applied Non-tracking Bituminous Tack

Test and Method	Test Temperature	Specification	Notes
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	147 °F (64 °C)	Minimum 1.00 kPa	
Test on Residue from Distillation Test: Penetration, 77 ºF (25 °C), 100 g, 5 sec., (dmm) AASHTO T49	77 °F (25 °C)	Maximum 25	
Softening Point (°F) AASHTO T53		Minimum 70	

Superpave PG Binder Table 2 – PG 58-22			
Test and Method	Test Temperature	Specification	Notes
Original Binder			
Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b, c
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	136 °F (58 °C)	Minimum 1.00 kPa	
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	136 °F (58 °C)	Minimum 2.20 kPa	
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	72 °F (22 °C)	Maximum 5000 kPa	
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa	
		m-value, Minimum 0.300	

Superpave PG Binder Table 3 – PG 64-22			
Test and Method	Test Temperature	Specification	Notes
Original Binder			
Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	147 °F (64 °C)	Minimum 1.00 kPa	
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	147 °F (64 °C)	Minimum 2.20 kPa	
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	77 °F (25°C)	Maximum 5000 kPa	
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa	
		m-value, Minimum 0.300	

Superpave PG Binder Table 4 – PG 67-22			
Test and Method	Test Temperature	Specification	Notes
Original Binder			

Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	153 °F (67 °C)	Minimum 1.00 kPa	
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	153 °F (67 °C)	Minimum 2.20 kPa	
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	80 °F (26.5 °C)	Maximum 5000 kPa	
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa	
		m-value, Minimum 0.300	

Superpave PG Binder Table 5 – PG 76-22 PMA			
Test and Method	Test Temperature	Specification	Notes
Original Binder			
Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	169 °F (76 °C)	Minimum 1.00 kPa	
Dynamic Shear, Phase Angle δ AASHTO T 315	169 °F (76 °C)	Maximum 75°	
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	169 °F (76 °C)	Minimum 2.20 kPa	
Multiple Stress Creep Recovery, Jnr, 3.2 AASHTO T 350	169 °F (76 °C)	Maximum 1.0 kPa^{-1} Maximum $J_{nr,diff}$ = 75 %	
Multiple Stress Creep Recovery, % Recovery AASHTO M 332	169 °F (76 °C)	$\%Recovery_{3.2} > 29.37 (J_{nr,3.2})^{-0.2633}$	
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	88 °F (31 °C)	Maximum 6000 kPa	
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa m-value, Minimum 0.300	

See 820 Special Provision following this 820 Supplemental Specification

Superpave PG Binder Table 6 – PG 76-22E			
Test and Method	Test Temperature	Specification	Notes
Original Binder			
Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 8.0 Pa·s	a
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b
Dynamic Shear, G*/sin δ AASHTO T 315	169 °F (76 °C)	Minimum 3.00 kPa	

10 rad/sec			
Dynamic Shear, Phase Angle δ AASHTO T 315	169 °F (76 °C)	Maximum 75°	
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	180 °F (82 °C)	Minimum 2.20 kPa	
Multiple Stress Creep Recovery, Jnr, 3.2 AASHTO T 350	180 °F (82 °C)	Maximum 0.50 kPa^{-1} Maximum $J_{nr,diff}$ = 75 %	
Multiple Stress Creep Recovery, % Recovery AASHTO M 332	180 °F (82 °C)	$\%Recovery_{3.2} > 29.37 (J_{nr,3.2})^{-0.2633}$	
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	88 °F (31 °C)	Maximum 5000 kPa	
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa	
		m-value, Minimum 0.300	

Superpave PG Binder Table 7 – PG 76-22 ARB			
Test and Method	Test Temperature	Specification	Notes
Original Binder			
Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a, d
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b, d
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	169 °F (76 °C)	Minimum 1.00 kPa	d, e
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	169 °F (76 °C)	Minimum 2.20 kPa	d, e
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	88 °F (31 °C)	Maximum 5000 kPa	d, e
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa	
		m-value, Minimum 0.300	
Polymer Separation Test ASTM D7173 Softening Point	(325.4 ± 9°F) 163 ± 5 ° C	Maximum 18 °F (10 °C) difference between top and bottom specimens	
AASHTO T 51, 5 cm per min, cm	77°F (25°C)	Ductility Minimum 19 cm	
ASTM D 5329, %	77°F (25°C)	Resilience Minimum 10 percent	

Notes:

a. The Department may waive this requirement if the supplier warrants the asphalt binder can be adequately pumped, mixed and/or sprayed at temperatures meeting all applicable safety standards.

b. Heat loss by AASHTO: T 179 may be accepted in lieu of mass loss by AASHTO: T 240.

c. The maximum Mass Loss shall be ≤ 1%, when used in conjunction with Bituminous Surface Treatment (Section 424).

d. PG 64-22 or PG 67-22 modified to meet PG 76-22 ARB using GTR, via the dry method, will be evaluated using complete analysis for compliance with PG 76-22 ARB requirements prior to mixture production using laboratory blended materials. PG 64-22 or PG 67-22 modified to meet PG 76-22 ARB using GTR via the dry method, will be evaluated for compliance with original DSR testing requirements for PG 76-22 ARB during mixture production using abson recovery in accordance with GDT 119 in compliance with AC sampling frequencies established in GSP 21 sub-section A.9.

e. AASHTO T 315 will be performed at a 2 mm gap for PG 76-22 ARB.

Thoroughly blend the composite materials at the supply facility prior to being loaded into the transport vehicle if modification is required in accordance with 820.2.01. Ensure all blending procedures, formulation, and operations are approved by the Office of Materials.

3. Certification:

Provide certified test results from an approved, certified laboratory of blends for proposed PG asphalt for each specification characteristic of the asphalt cement proposed for shipment. Provide the certified results to the State Materials Engineer as required in Standard Operating Procedure (SOP 4).

The State Materials Engineer may interrupt production until test results are known in the event there is reason to suspect a sample will be outside specification limits. Mixture placed incorporating modified binders determined to not meet specification requirements may be subject to removal at the recommendation of the State Materials Engineer.

B. Materials Warranty

General Provisions 101 through 150.

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION

Section 820—Asphalt Cement

Delete Subsection 820.2.01.A.2 Table 5 and substitute the following:

Superpave PG Binder Table 5 – PG 76-22 PMA			
Test and Method	Test Temperature	Specification	Notes
Original Binder			
Flash Point, AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa·s	a
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	169 °F (76 °C)	Minimum 1.00 kPa	
Rolling Thin Film Oven Test Residue (RTFO) AASHTO T 240			
Dynamic Shear, G*/sin δ AASHTO T 315 10 rad/sec	169 °F (76 °C)	Minimum 2.20 kPa	
Mass Loss (%) AASHTO T 240	325± 1.8 °F (163± 1°C)	Maximum 0.50	b,
Multiple Stress Creep Recovery, Jnr, 3.2 AASHTO T 350	147 °F (64°C)	Maximum 0.5 kPa^{-1} Maximum $J_{nr,diff}$ = 75 %	
Multiple Stress Creep Recovery, % Recovery AASHTO M 332, R 92	147 °F (64°C)	$\%Recovery_{3.2} > 29.371 (J_{nr,3.2})^{-0.2633}$	
Pressure Aging Vessel (PAV) AASHTO R 28			
Dynamic Shear, G* sin δ AASHTO T 315 10 rad/sec	88 °F (31 °C)	Maximum 5000 kPa	
Creep Stiffness AASHTO T 13 @ 60 sec	10 °F (-12 °C)	S (Stiffness), Maximum 300 MPa	d
		m-value, Minimum 0.300	

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

Section 828—Hot Mix Asphaltic Concrete Mixtures

Delete Section 828 and substitute the following:

828.1 General Description

This specification includes the requirements for hot mix asphaltic concrete mixtures, including:

- Open-graded surface mixtures (OGFC and PEM)
- Stone Matrix Asphalt mixtures (SMA)
- Superpave mixtures
- Fine-graded (4.75 mm) mixtures

828.1.01 Definitions

The Nominal Maximum Sieve Size is one standard sieve size larger than the first sieve to retain more than ten percent of the aggregate, per AASHTO R35. Mixture types in this section are identified according to Nominal Maximum Sieve Size.

828.1.02 Related References

A. Standard Specifications

Section 400-Hot Mix Asphaltic Concrete Construction

Section 402-Hot Mix Recycled Asphaltic Concrete

Section 800–Coarse Aggregate

Section 802–Aggregates for Asphaltic Concrete

Section 819–Fiber Stabilizing Additives

Section 820–Asphalt Cement

Section 831–Admixtures

Section 882–Lime

Section 883–Mineral Filler

B. Referenced Documents

AASHTO R30

AASHTO R35

AASHTO T 321

AASHTO T 112

AASHTO T 209

AASHTO T 305

AASHTO T 312

AASHTO T 245

AASHTO T 324

AASHTO T 340

SOP-36

SOP-2

GDT 1

GDT 56

GDT 63

GDT 66

GDT 114

GDT 115

GDT 123

QPL 1

QPL 2

QPL 7

QPL 26

QPL 41

QPL 77

QPL 81

828.2 Materials

A. Requirements

Use approved hot mix asphalt concrete mixtures that meet the following requirements:

1. Produce each asphalt mixture according to a Department approved Job Mix Formula and Asphalt Mix Design, see Subsection 400.1 for submittal and approval of Job Mix Formulas.
2. Ensure individual acceptance test results meet the Mixture Control Tolerances specified in the appropriate table below, Subsections 828.2.01 through 828.2.04.
3. Ensure the Engineer approves all materials used to prepare and place the mixtures before incorporating them into the Work. Use only the ingredients listed in the approved Asphalt Mix Design and Job Mix Formula. For virgin aggregates use sources meeting the requirements of Section 802 and are listed in QPL 1 or QPL 2; for mixes in which local sand is permitted, use the approved sand source identified in the mix design. For mixtures containing Reclaimed Asphalt Pavement (RAP), use only RAP from the approved stockpile identified in the mix design. Use asphalt cement meeting the requirements of Section 820, from a source listed in QPL 7.
4. Obtain approved SMA mix designs, Superpave mix designs and 4.75 mm mix designs from a mix design laboratory certified by the Department. Obtain approved mix designs for types PEM and OGFC mixtures from the Department's Office of Materials, which produces and furnishes these mix designs.
5. Ensure all SMA mix designs are designed in accordance with GDT-123 (“Determining the Design Proportions of Stone Matrix Asphalt Mixtures”). Ensure SMA mix designs are verified and approved by the Department prior to use. Ensure Superpave and 4.75 mm mix designs are designed in accordance with SOP-2 ("Control of Superpave Bituminous Mixture Designs") and are approved by the Department as provided therein. Ensure these mixes are designed by a laboratory and technician certified in accordance with SOP-36, ("Certification of Laboratories and Personnel for Design of SMA and Superpave Asphalt Mixtures").
6. Use only mixtures composed of the aggregate groups and blends indicated in the Proposal and Plans by their pay item designations, defined as follows:

Table 1 – Aggregate Groups

Pay Item Designation	Allowable Aggregate Groups

Group I or II	Group I, Group II, or Blend I
Group II only	Group II only
Blend I	Either 100% Group II material or a blend of Group I and Group II. Do not use Group I material for more than 60%, by weight, of the total aggregate nor more than 50%, by weight, of the coarse aggregate fraction.

7. For patching or leveling use Group I, Group II, or Blend I. Mix types for patching and leveling are specified in Subsection 400.3.03.B.
8. Include lime (hydrated lime) from an approved source and meeting the requirements of Section 882 in all paving courses except as otherwise provided in the Contract. For a list of approved sources of lime, see QPL 41.
   a. Add lime to each mixture at the rate prescribed in the approved mix design.
   b. Ensure mix designs using only virgin aggregate include lime at a minimum rate of 1.00 % of the total dry aggregate weight. Ensure mix designs using RAP include lime at a minimum rate equal to 1.00 % of the virgin aggregate fraction plus 0.50 % of the aggregate in the RAP fraction.
   c. Add more lime or add lime plus an approved Heat-Stable Anti-Stripping Additive meeting the requirements of Section 831, if necessary to meet requirements for mixture properties, and pursuant to an approved mix design. However, the Department will not make additional payment for these materials. For a list of sources of Heat-Stable Anti-Stripping Additives, see QPL 26.
   d. Where specifically allowed in the contract on LARP, airport, and parking lot projects, an approved Heat-Stable Anti-Stripping Additive meeting the requirements of Section 831 may be substituted for hydrated lime. Ensure the mix gradation is adjusted to replace the lime with an equivalent volume of fines passing the 0.075 mm sieve. Add Heat-Stable Anti-stripping Additive at a minimum rate of 0.5 percent of the asphalt cement portion.
9. Use performance grade PG 64-22 or PG 67-22 asphalt cement in all mix designs and mixtures except as follows:
   a. The State Materials Engineer will determine the performance grade to be used, based on Table 2 – Binders Selection Guideline for Reclaimed Asphalt Pavement (RAP) Mixtures, AASHTO M323 and laboratory testing results as required in Section 828.2.B for mixtures containing ≥ 25% equivalent binder replacement for RAP/RAS mixtures.
   b. Use only grade PG 76-22, excluding shoulder construction in the following mixes: all SMA, 12.5 mm PEM, 9.5 mm and 12.5 mm OGFC, 12.5 mm Superpave, on projects with two-way ADT greater than 25,000; and in all mixtures for which polymer-modified asphalt is specified in the pay item.
10. Use of local sand is restricted as follows:
   a. Do not place mixtures containing local sand on the traveled way of the mainline or ramps of the Interstate System. Mixtures with local sand may be used for shoulder construction on these facilities.
   b. Ensure local sand will not constitute more than 20 % of the total aggregate weight of any mix design or production mix.
   c. Subject to the above limits, 19 mm, 12.5 mm, and 9.5 mm Superpave mix designs and 4.75 mm mix designs containing local sand may be used on projects with a current ADT not exceeding 4,000 vpd providing that all performance testing meets specified requirements.
   d. 25 mm Superpave mix designs containing not more than 20 % local sand may be used on all facilities except the main line and ramps of the Interstate System.
   e. Obtain local sand for use in asphalt mixtures from a source approved by the Department.
   f. Approval of local sand sources: The Department will sample, test, and approve sources of local sand. Ensure local sand contains no more than 7.0 % clay by weight and is free of foreign substances, roots, twigs, and other organic matter. Ensure sand is free of clay lumps, as determined by AASHTO T 112, and has a sand equivalent value exceeding 25%, as determined by GDT 63.

B. Fabrication

1. Design procedures: For all Superpave and 4.75 mm mixes, ensure conformance with the Superpave System for Volumetric Design (AASHTO T 312 and AASHTO R30), as adapted in SOP-2. Ensure Superpave mixes are designed at a design gyration number (N_{des}) of 65 gyrations and initial gyration number (N_{ini}) of 6 gyrations.

Ensure 4.75 mm mixes, (N_{des}) are designed at 50 gyrations, and (N_{ini}) at 6 gyrations. Open-graded mix designs will be designed by the Department in accordance with GDT 114. In all cases, the procedure for measuring Maximum Specific Gravity (G_{mm}) is AASHTO T 209. In addition to gradation and volumetric analysis, ensure mix designs include the following performance tests, as applicable.

2. Performance Test:
   a. Permeability test: Ensure Superpave and Stone Matrix mix designs include testing according to GDT -1 Measurement of Water Permeability of Compacted Asphalt Paving Mixtures. Ensure specimen air voids for this test are 6.0 ±1.0 %. The average permeability of three specimens may not exceed 3.60 ft per day (125 $\times 10^{-5}$cm per sec).
   b. Moisture susceptibility test: Fabricate and test specimens in accordance with GDT 66, when required by the Office of Materials and Testing due to visible signs of stripping in laboratory fabricated or plant produced asphaltic concrete mixtures, Ensure specimen air voids for this test are 7.0 ±1.0% for all mixes excluding Stone Matrix mixes. Ensure specimen air voids for this test are 6.0 ± 1.0% for Stone Matrix mixes. The minimum tensile splitting ratio is 0.80, except a tensile splitting ratio of no less than 0.70 may be acceptable if all individual strength values exceed 100 psi (690 kPa). Ensure average splitting strength of the three conditioned and three controlled samples are not less than 60 psi (415 kPa) for either group. Ensure retention of coating as determined by GDT 56 is not less than 95%.
   c. Hamburg Wheel-Tracking Test for rutting and moisture susceptibility test: Ensure mix designs of all mix types except Open-graded Surface Mixes (OGFC and PEM), and Open-graded Crack Relief Interlayer (OGI) mix, include testing in accordance with AASHTO T 324. Ensure specimen air voids for this test are 7.0 ± 1.0% for all mix types and at a testing temperature of 50°C (122°F). Use the testing and acceptance criteria established in Table 2.

Table 2 – Hamburg Wheel Tracking Device Testing and Acceptance Criteria

Binder Performance Grade (PG)	Mix Type	Number of Passes	Maximum Rut Depth	Stripping Inflection Point
PG 64-22 and PG 67-22	4.75 mm, 9.5 mm SP Type I, and 9.5 mm SP Type II	15,000	≤ 12.5 mm	> 15,000
PG 64-22 and PG 67-22	12.5 mm SP, 19 mm SP and 25 mm SP	20,000	≤ 12.5 mm	> 20,000
PG 76-22	All Mix types	20,000	≤ 12.5 mm	> 20,000

   Tested specimens shall be inspected for any visible signs of stripping and any mix design's tested specimens that fail to maintain 95% of asphalt cement coating, as described in GDT 56 section D.2.d, will be required to meet specified requirements for GDT 66 as detailed in 828.2.B.2.b.

   d. Fatigue testing: The Department may verify dense-graded mix designs by fatigue testing according to AASHTO T 321 or other procedure approved by the Department.

C. Acceptance

See Subsection 106.03 and Section 400. Ensure individual test results meet the Mixture Control Tolerances listed in Subsections 828.2, 828.2.01 ,828.2.02, 828.2.03, or 828.2.04, whichever applies with the following exception. Ensure field verification results for rutting susceptibility tests performed on laboratory fabricated and/or roadway cores obtained from asphalt plant produced mixtures meet specified requirements for AASHTO T 324 as detailed in Subsection 828.2.B.2.c. All GDOT approved mix designs are required to have full field mix design verifications, using plant produced mixture, sampled by the contractor and submitted to the applicable GDOT laboratory (Central or District) at a minimum of once per two years. Field mix design verification results that fail to comply with performance testing specified in Subsection 828.2.B will require a complete laboratory mix design verification, to be completed by the original mix designer, for continued use of that design. If a mix design has not been produced within two years, a full field mix design verification will be sampled by the contractor and submitted to the applicable GDOT laboratory (Central or District) on the first Lot produced thereafter. Any mix design that fails to meet performance test requirements established in Subsection 828.2.B, using laboratory fabricated specimens due to failing field mix design results, may subject that mix design to invalidation after the field mix design verification results are confirmed with a second field mix design verification. Field mix design verifications as specified in Section 402, Section 400, SOP 2 and GSP 21, are not precluded by the requirements specified herein.

D. Materials Warranty

See General Provisions 101 through 150.

828.2.01 Open-Graded Surface Mixtures

A. Requirements

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure Open-Graded Surface Mixtures meet the following mixture control tolerances and mix design criteria:

Sieve Size	Mixture Control Tolerance, %	Design Gradation Limits, % Passing		
		9.5 mm OGFC	12.5 mm OGFC	12.5 mm PEM
3/4 in (19 mm) sieve	±0.0		100*	100*
1/2 in (12.5 mm) sieve	±6.1	100*	85-100	80-100
3/8 in (9.5 mm) sieve	±5.6	85-100	55-75	35-60
No. 4 (4.75 mm) sieve	±5.7	20-40	15-25	10-25
No. 8 (2.36 mm) sieve	±4.6	5-10	5-10	5-10
No. 200 (75 μm) sieve	±2.0	2-4	2-4	1-4
Range for % AC	±0.4	6.0-7.25	5.75-7.25	5.5-7.0
Class of stone (Section 800)		“A” only	“A” only	“A” only
Drain-down (AASHTO T305), %		<0.3	<0.3	<0.3

* Mixture control tolerance is not applicable to this sieve for this mix.

1. In 12.5 mm and 9.5 mm OGFC and 12.5 mm PEM mixes, use only PG 76-22 asphalt cement (specified in Section 820).
2. Ensure all OGFC and PEM mixes include a stabilizing fiber of the type (cellulose or mineral) specified in the mix design and meeting the requirements of Section 819. Ensure the dosage rate is as specified in the mix design and sufficient to prevent drain-down exceeding the above tolerance.

B. Fabrication

See Section 400.

828.2.02 Stone Matrix Asphalt Mixtures

A. Requirements

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure Stone Matrix Asphalt mixtures meet the following mixture control tolerances and mix design criteria:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing		
		9.5 mm SMA	12.5 mm SMA	19 mm SMA

1- in (25 mm) sieve	±0.0			100*
3/4 in (19 mm) sieve	±7.0	100*	100*	90-100
1/2 in (12.5 mm) sieve	±6.1	98-100**	85-100	44-70
3/8 in (9.5 mm) sieve	±5.6	70-100	50-75	25-60
No. 4 (4.75 mm) sieve	±5.7	28-50	20-28	20-28
No. 8 (2.36) mm sieve	±4.6	15-30	16-24	15-22
No. 50 (300 µm) sieve	±3.8	10-17	10-20	10-20
No. 200 (75 µm) sieve	±2.0	8-13	8-12	8-12
Range for % AC (Note 1)	±0.4 (Note 2)	6.0-7.5	5.8-7.5	5.5-7.5
Design optimum air voids (%)		3.5 ±0.5	3.5 ±0.5	3.5 ±0.5
% aggregate voids filled with AC (VFA)		70-90	70-90	70-90
Tensile splitting ratio after freeze-thaw cycle GDT-66		80%	80%	80%
Drain-down (AASHTO T305), %		<0.3	<0.3	<0.3

*Mixture control tolerance is not applicable to this sieve for this mix.

**Mixture control tolerance is ± 2.0% for this sieve for 9.5 mm SMA mixes placed at spread rates greater than 135 lb/yd^2. For 9.5 mm SMA mixes placed at spread rates of 135 lb/yd^2 or less, 100 % passing is required on this sieve.

Note 1: Range for % AC is Original Optimum AC (OOAC) at 35 gyrations (Gyratory compactor) or 50 blows (Marshall compactor) prior to Corrected Optimum AC (COAC) calculation detailed in GDT 123 (Appendix A)

Note 2: Quality Acceptance Test Results for AC content that deviate > ± 0.3% from the approved Job Mix Formula (JMF) consistently over three lots may subject the mix to a revised AC content on project JMF at the discretion of the State Materials Engineer based on statistical trend.

1. Ensure SMA mixtures are compacted at 35 gyrations with the Superpave Gyratory compactor or 50 blows with the Marshall compactor.
2. Ensure SMA mixtures contain mineral filler and fiber stabilizing additives and meet the following requirements:
   a. Asphalt cement grade PG-76-22 (specified in Section 820) is required in all SMA mixtures.
   b. Aggregates for SMA meet the requirements of Subsection 802.2.02.A.3.
   c. Use the approved mineral filler specified in the mix design and meeting the requirements of Section 883 Approved sources of mineral filler are listed in QPL 81.

   Use the approved Fiber Stabilizing Additive of the type (cellulose or mineral) specified in the mix design and meeting the requirements of Section 819. Approved sources of Fiber Stabilizing Additive are listed in QPL 77. The dosage rate will be as specified in the mix design and sufficient to prevent drain-down exceeding the above tolerance.

B. Fabrication

See Section 400.

828.2.03 Superpave Asphalt Concrete Mixtures

A. Requirements for Superpave Mixtures (except Parking Lot Mixtures)

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure Superpave Asphalt Concrete mixtures meet the following mixture control tolerances and mix design limits:

1. Gradation limits for Superpave mixtures are as follows:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing				
		9.5 mm Superpave Type I	9.5 mm Superpave Type II	12.5 mm Superpave (Note 1)	19 mm Superpave	25 mm Superpave
1½ in (37.5 mm)						100*
1- in (25.0 mm)	± 8.0			100*	100*	90-100
3/4 in (19.0 mm)	±8.0**	100*	100*	98-100****	90-100	55-89**
1/2 in (12.5 mm)	±6.0***	98-100****	98-100****	90-100	60-89***	50-70
3/8 in (9.5 mm)	±5.6	90-100	90-100	70-89	55-75	
No. 4 (4.75 mm)	±5.6	65-85	55-75			
No. 8 (2.36 mm)	±4.6	48-55	42-47	38-46	32-36	30-36
No. 200 (75 µm)	±2.0	5.0-7.0	5.0-7.0	4.5-7.0	4.0-6.0	3.5-6.0
Range for % AC (Note 3)	± 0.4 (Note 2)	5.50-7.25	5.25-7.00	5.00-6.25	4.25-5.50	4.00-5.25

* Mixture control tolerance is not applicable to this sieve for this mix.

** Ensure mixture control tolerance is within ± 10.0% for this sieve for 25 mm Superpave.

***Ensure mixture control tolerance is within ± 8.0% for this sieve for 19 mm Superpave.

***Ensure mixture control tolerance is within ± 2.0% for this sieve for 12.5 mm and 9.5 mm mixes.

Note 1: Use PG 76-22 in 12.5 mm Superpave, excluding shoulder construction, on all projects with ADT greater than 25,000 as detailed in the Contract Pay Item.

Note 2: Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.

Note 3: Range for % AC is Original Optimum AC (OOAC) at 65 gyrations prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D).

2. Volumetric limits are as follows:

Design Parameter	Mix Type	Limits

% of Max. Specific Gravity (Gmm) at design gyrations, (Ndes)	All	96%
% Gmm at the initial number of gyrations, Ni	All	91.5% maximum
% voids filled with asphalt (VFA) at Ndes	9.5 mm Type I	Min. 72; Max. 80
	9.5 Type II and 12.5 mm	Min. 72; Max. 76
	19 mm	Min. 71; Max 76
	25 mm	Min. 69; Max 76
Fines to effective asphalt binder ratio (F/Pbe)	9.5 mm Type I	0.6 to 1.4
	All other types	0.8 to 1.6
Minimum Film Thickness (microns)*	All	> 7.00
Minimum % Voids in Mineral Aggregate (VMA) Note: VMA shall be calculated using the effective specific gravity of the aggregate (Gse). See SOP-2SP.	25 mm	13.0
	19 mm	14.0
	12.5 mm	15.0
	9.5 Type I	16.0
	9.5 Type II	16.0

*Superpave Mixtures approved prior to January 31, 2012, may be adjusted to meet Minimum Film Thickness requirements by the State Materials Engineer.

B. Requirements for Superpave Parking Lot Mixes (NOT FOR STANDARD HIGHWAY/STREET PAVING)

1. Surface layers for parking facilities:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing		
		4.75 mm Mix	9.5 mm Superpave Type I	9.5 mm Superpave Type II
1- in (25.0 mm) sieve	± 8.0			
3/4 in (19.0 mm) sieve	±8.0**		100*	100*
1/2 in (12.5 mm) sieve	±6.0	100*	98-100****	98-100****
3/8 in (9.5 mm) sieve	±5.6	90-100	90-100	90-100
No. 4 (4.75 mm) sieve	±5.6	75-95	65-85	55-75
No. 8 (2.36 mm) sieve	±4.6	60-65	48-55	42-47
No. 50 (300 μm) sieve	+3.8	20-50		
No. 200 (75 μm) sieve	±2.0	4-12	5.0-7.0	5.0-7.0
Range for Total AC	+ 0.4	6.00 - 7.50	5.50 - 7.25	5.25 - 7.00

2. Subsurface layers for parking facilities:

Sieve Size	Mixture	Design Gradation Limits, Percent Passing

	Control Tolerance	12.5 mm Superpave	19 mm Superpave	25 mm Superpave
				100*
1- in (25.0 mm) sieve	± 8.0	100*	100*	90-100
3/4 in (19.0 mm) sieve	±8.0**	98-100****	90-100	55-89**
1/2 in (12.5 mm) sieve	±6.0***	90-100	60-89***	50-70
3/8 in (9.5 mm) sieve	±5.6	70-89	55-75	
No. 8 (2.36 mm) sieve	±4.6	38-46	32-36	30-36
No. 200 (75 µm) sieve	±2.0	4.5-7.0	4.0-6.0	3.5-6.0
Range for Total AC	+ 0.4	5.00 - 6.25	4.25 - 5.50	4.00 - 5.25

All * and notes apply to both 828.2.03.B.1 and 828.2.03.B.2.

*Mixture control tolerance is not applicable to this sieve for this mix.

**Ensure mixture control tolerance is within ±10.0% for this sieve for 25 mm Superpave mixes.

*** Ensure mixture control tolerance is within ±8.0% for this sieve for 19 mm Superpave mixes.

****Ensure mixture control tolerance is within ±2.0% for this sieve for 12.5 mm and 9.5 mm Superpave mixes.

Note 1: Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.

Note 2: Range for % AC is Original Optimum AC (OOAC) at 65 gyrations prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D)..

3. Volumetric limits for parking facilities are as follows:

Design Parameter	Mix Type	Limits
% of Max. Specific Gravity (Gmm) at design gyrations, Ndes)	All	96%
% Gmm at the initial number of gyrations, Ni	All	91.5 % maximum
% voids filled with asphalt (VFA) at Ndes	9.5 mm Type I	Min. 72; Max. 80
	9.5 Type II and 12.5 mm	Min. 72; Max. 78
	19 and 25 mm	Min. 71; Max 76
Fines to effective asphalt binder ration (F/Pbe)	9.5 mm Type I	0.6 to 1.4
	All other types	0.8 to 1.6
Minimum Film Thickness (microns)*	4.75 mm	> 6.00
	All other types	> 7.00
Minimum % Voids in Mineral Aggregate (VMA) Note: VMA shall be calculated using the effective specific gravity of the aggregate (Gse). See SOP-2	25 mm	13.0
	19 mm	14.0
	12.5 mm	15.0
	9.5 mm Types I, II	16.0

* Mixtures approved prior to January 31, 2012, may be adjusted to meet Minimum Film Thickness requirements by the State Materials Engineer.

C. Fabrication

See Section 400.

828.2.04 Fine-Graded Mixtures

A. Requirements

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure ~~that~~ fine-graded mixtures meet the following mixture control tolerances and design limits:

ASPHALTIC CONCRETE - 4.75 mm Mix		
Sieve Size	**Mixture Control Tolerance**	**Design Gradation Limits, % passing**
1/2 in (12.5 mm) sieve*	±0.0	100*
3/8 in (9.5 mm) sieve	±5.6	90-100
No. 4 (4.75 mm) sieve	±5.7	75-95
No. 8 (2.36 mm) sieve	±4.6	60-65
No. 50 (300 µm) sieve	±3.8	20-50
No. 200 (75 µm) sieve	±2.0	4-12
Range for % AC	±0.4	6.00 – 7.50
Design optimum air voids (%)		4.0 – 7.0
% Aggregate voids filled with AC		60 - 80
Minimum Film Thickness (microns)		> 6.00

* Mixture control tolerance is not applicable to this sieve for this mix.

Note 1: Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.

Note 2: Range for % AC is Original Optimum AC (OOAC) at 50 gyrations prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D).

B. Fabrication

See Section 400.

C. Acceptance

See Subsection 106.3 and Section 400. Ensure individual test results meet the Mixture Control Tolerances listed in Subsections 828.2, 828.2.01, 828.2.02, 828.2.03, 828.2.04, whichever applies.

D. Materials Warranty

See General Provisions 101 through 150.

Office of Materials

Appendix B - Standard Operating Procedures

Laboratory SOP 2 Issued November, 1996
Revised: April 12, 2012
Revised: August 14, 2014
First Use: January 1, 2019

Georgia Department of Transportation
Office of Materials and Testing

Standard Operating Procedure (SOP) 2
Control of Superpave Bituminous Mixture Designs

I. General

Monitoring the quality of Bituminous Mixtures used on Georgia Department of Transportation work is a responsibility of the Bituminous Construction Branch of the Office of Materials and Testing. This branch is under the direction of the State Bituminous Construction Engineer. The Bituminous Construction Branch comprises the Asphalt Design Unit, the Bituminous Control Unit, and the Bituminous Technical Services Unit.

The Asphalt Design Unit performs, verifies, and recommends approval of designs for Superpave mixtures, Open-Graded Friction Course (OGFC), Porous European Mix (PEM) mixtures, Stone Matrix Asphalt (SMA), slurry seals, sand-bituminous bases, micro-surfacing, and other asphalt mixtures as assigned.

The Asphalt Design Engineer oversees design activities statewide, including designs and verifications performed by the Office of Materials and Testing and Branch Laboratories. The Asphalt Design Engineer reviews and recommends approval of designs made in commercial laboratories which have been certified in accordance with SOP 36. Designs submitted by certified laboratories shall be prepared, verified and approved in accordance with this Standard Operating Procedure. The Asphalt Design Engineer forwards acceptable designs to the State Bituminous Construction Engineer with recommendation for approval or approval for provisional use, as appropriate. Once approved, a design shall be published and transmitted to the certified laboratory which performed the design. Designs found to be incorrect or deficient shall be referred back to the designer within two weeks of receipt . Designers may resubmit their designs for approval when appropriate changes or corrections have been made. The State Bituminous Construction Engineer may make field adjustments of the Job Mix formula and may require field verification of mix designs, as discussed below.

II. Approval Process

A. Governing Documents

Commercial laboratories wishing to perform mix designs for use in GDOT projects shall comply with SOP 36, *Certification of Laboratory and Personnel for the Design of Asphaltic Concrete Mixtures*.

All mix designs shall meet current contract specifications and shall be prepared in accordance with applicable standard methods, described below. Mix designs from commercial laboratories shall be approved only for work covered under state funded contracts, and designs for mix types and levels not specified for state work are not eligible for approval.

Aggregates used in Asphaltic Concrete mixes must meet the requirements of Sections 800 and 802 of the Specifications. Asphalt Cement used in the mixture shall meet the requirements of Section 820 for Superpave Asphalt Binder. All designs for publication must meet the requirements of Section 828, "Hot Mix Asphaltic Concrete Mixtures". All ingredients of asphalt mixtures shall be from sources approved by the Department. Approved aggregate sources, except proprietary RAP stockpiles and sand pits, are listed in Qualified Products Lists 1 and 2. Other approved sources are listed in their respective Qualified Products Lists.

Mix designs must be submitted using the GDOT approved mix design software. Completed design studies shall be submitted to the Asphalt Design Engineer by letter request, including the technician's certification required under SOP 36. The letter request should also identify any entity, other than the firm which produced the design, which is authorized to use it. Other required information is as follows:

1. Types and sources of aggregate ingredients
2. Asphalt binder grade and source
3. Gyratory compaction sheets
4. Results of ignition calibration tests, including worksheet and print-out
5. Test results required for the Superpave mix design study
6. RAP stockpile number, if RAP is included
7. Results of permeability test plus sample, as required

Test results for the mix design study shall be entered into the GDOT Mix Design Software and submitted as an Asphaltic Concrete Mix Design Report. Mix designs shall be approved which are correct and complete and which conform to the design criteria set forth in Section 828 of the Specifications.

Approved asphalt mix designs shall be identified by a mix identification number which will identify the designer, aggregate sources, mix type, and design level.

B. Verification of Designs

Mix designs shall be verified by the Office of Materials and Testing at a minimum frequency of ten percent of the designs submitted by each certified laboratory, or at the discretion of the State Bituminous Construction Engineer. These verifications shall be performed by a GDOT laboratory designated by the Asphalt Design Engineer. A verification will consist of replicating all or part of the design test procedures, as the Asphalt Design Engineer may require. Samples shall be tested at the asphalt and air void contents required for certain design tests or at optimum asphalt content or corrected optimum AC content, as appropriate. Sufficient quantities of stockpile samples shall be retained for at least two weeks after submittal of a design, or until approval of design is granted, whichever comes first. Results of the verification must match the design results within the tolerances below. In addition, when design volumetrics are verified by gyrating a full set of new samples, the resulting VMA and VFA must also fall within the tolerances specified in Section 828.

Test	Verification Tolerance
G_{mb} - AASHTO T-166	±0.03
G_{se} - AASHTO T-209 and T-308	±0.03
% VTM - AASHTO T-312	4% ± 1.0%
% G_{mm} @ N_{ini} - AASHTO T-312	± 1.0%
% G_{mm} @ N_{des} - AASHTO T-312	± 1.0%
VMA - AASHTO R 35	- 0.5% to +0.8%
VFA - AASHTO R 35	± 5%
Dust/AC Ratio - AASHTO T-312	± 0.2
Gradation:	
Upper Control Sieve - % Passing	+ 3.5 %
No. 8 (2.36 mm) Sieve – % Passing	± 2.5 %
No 200 (75 μm) Sieve –% Passing	± 1.6 %
Hamburg Wheel Tracking – T 324 (with GDOT revisions)	±2.0 mm, but not to exceed design limit
Retained Tensile Strength - GDT- 66	(average of three) ± 10 % must also meet design minimum for strength and % retained
Calibration Factor for ignition tests	± 0.12 %

Where G_{mb} is the bulk specific gravity of the mix, G_{se} is the effective specific gravity of the aggregate, and N_{ini} and N_{des} are the numbers of initial gyrations and design gyrations, respectively. VTM and VMA are the percent air voids and percent voids in the mineral aggregate, respectively, and VFA is percent voids filled with asphalt.

In applying the tolerances above for percent of G_{mm} at N_{ini} and percent of G_{mm} at N_{des} , the G_{mm} shall be re-calculated using the G_{se} determined in the verification.

If the verification result does not match the design values within the above tolerances, an investigation shall be initiated by the State Bituminous Construction Engineer. The investigation may include a review of design procedures and equipment calibrations as well as the results of a field verification. If the cause for the discrepancy cannot be resolved, approval of the design may be withdrawn.

C. Field Verification

All mix designs shall be subject to one or more field verifications during production at the discretion of the State Bituminous Construction Engineer. Verification shall consist of replicating certain mix design tests on samples of the mixture delivered to a state project, normally when the design is first used and subsequently in some cases, at the discretion of the State Bituminous Construction Engineer. Additionally, each mix design is to be verified at a minimum of once every two years as detailed in Section 828. Field verification tests shall normally include AASHTO T-209, AASHTO T 324, AASHTO T 166, and AASHTO T-312 to verify design volumetrics and may include, GDT-66, and other tests as the State Bituminous Construction Engineer may require. A field verification shall be acceptable when results fall within the tolerances in the table below. Designs which fail field verification shall be invalid unless an approved revision is made to correct the deficiency, or unless it is shown that the production sample was deficient and that the deficiency has been corrected.

Test	Field Verification Tolerance
G_{mb} - AASHTO T-166	± 0.03
AASHTO T 324	±2.0 mm, but not to exceed design limit
G_{se} - AASHTO T-209 (and GDT-125)	±0.03
GDT-66 (When required)	not to exceed specified design limits
Design Volumetrics - AASHTO R 35:	
VMA	not to exceed specified design limits
VTM (air voids) @ optimum AC	not to exceed specified design limits

D. Continuity and Cancellation of Mix Designs

An approved and field verified mix design may be used from project to project as long as the design meets current specifications, provided that satisfactory performance of the mixture is obtained, that the properties of the mixture remain consistent with the design values, and that no significant change occurs in the properties or approval status of the ingredients. The State Bituminous Construction Engineer may withdraw approval of a mix design on the basis of unsatisfactory or erratic test results, poor performance of the mixture in place, or evidence that the properties of the mixture differ substantially from the properties predicted in the design. In the case of RAP mixtures, approval will be withdrawn if the RAP stockpile is depleted or if the average gradation of the RAP, based on five random samples, varies to the extent that the combined gradation of the design is altered by more than one-half the mixture control tolerance.

E. Ownership, Use, and Disclosure of Mix Designs

Mix designs shall be made available only to the designer and to users authorized by the designer. Mix designs are considered to be proprietary information. They are not subject to public disclosure under the Georgia Open Records Act by virtue of O.C.G.A. 50-18-72(b)(1), which protects the confidentiality of trade secrets obtained from a business entity that are confidential and required to be submitted to a government agency.

III. Design Process

The object of an Asphaltic Concrete Design is to produce a combination of the proposed ingredients that will perform satisfactorily throughout the design life of the pavement. Such a mixture must contain sufficient asphalt cement to provide a thick film and limited air voids so the mix can resist stripping and weathering due to intrusion of water and air. The mix must also be stable enough to resist permanent deformation, flushing, excessive densification, and loss of friction properties. The volumetric design process is complicated by the facts that asphalt is thermoplastic and that specific elevated temperatures must be maintained in the design work. Superpave Mixtures are to be designed in accordance with AASHTO R 35 except as altered by Georgia Department of Transportation's specifications including but not limited to SOPs, GDTs and GSPs. Many design details are difficult to remember; therefore a ready reference entitled "Asphalt Hot Mix Design Reference Guide" can be found in Appendix A.

A. Sampling and Grading

Sampling of aggregates proposed for use in bituminous mix designs may be initiated by the Contractor, commercial laboratory, or materials supplier. The requesting party should submit the samples to the design laboratory. Materials sampled for design work must be representative of quarry production intended for use on the project. The average ingredient characteristics should be represented in the design. The designer shall resolve any discrepancies in the ingredient properties before beginning any design work.

Each aggregate sample submitted for design is initially dried, and sieve analysis is performed to determine its gradation. Grading of coarse aggregate samples is done using the appropriate sieves for the specific mix type involved. These sieve sizes can be found in Section 828 of the Specifications. In addition, appropriate "breaker" sieves must be used to prevent overloading the sieves. Each ingredient shall be batched individually. Bulk batching of aggregates is prohibited.

Aggregate used for batching Superpave specimens is not separated below the No. 8 (2.36 mm) sieve, with the exception that a washed gradation is performed on minus 2.36 mm portion by washing over the No 200 (75 μm) sieve.

If the coarse or fine aggregate is excessively dusty, soft, easily broken, or shows other signs of potential problems, the Asphalt Design Engineer should be consulted for investigation of the source, stockpiles, and operations. The Revised decision in such matters will rest with the State Materials and Research Engineer.

Once the appropriate blend, meeting requirements established in Section 828 and Appendix B, has been established, batches of Superpave design specimens to determine optimum asphalt content shall be prepared to produce a compacted Superpave specimen 115.0 ± 5.0 mm high and 150 mm in diameter for density testing. The height of test samples should be 95.0 ± 5.0 mm for tensile splitting specimens. Hamburg sample height may vary depending on the test equipment manufacturer. Designers should ensure that all samples, including those for gradation and specific gravities, will meet the minimum sample size requirements for their respective tests.

B. Preparing Superpave Specimens

1. Asphalt Cement

   Samples shall be heated to the appropriate temperature for the asphalt binder being used. Temperatures for preparing Superpave specimens are based on the viscosity of the asphalt cement involved. These values are very important; they can be found in the Asphalt Mixture Control Temperature Chart which is available from the Asphalt Design Engineer.

2. Short term Aging

   The short term aging procedure applies to laboratory-prepared loose mix only. The laboratory aging process is necessary to simulate mixture aging during typical plant production and placement. All samples for testing shall be aged by placing the mixture in a pan and spreading it to an even thickness of approximately 55 ± 5 lbs/yd^2 (30 ± 2 kg/m^2) immediately after sample mixing. Place the mixture and pan in a forced draft oven for 2 hours at compaction temperature.

C. Superpave Gyratory Compactor

A gyratory compactor meeting the requirements of AASHTO T-312 shall be used to compact density specimens for testing. The gyratory compactor may also be used for preparing samples for performance testing as detailed in Section 828. The gyratory compactor shall be calibrated and the operation of the data acquisition device shall be checked based on the interval established in AASHTO R18. The compaction pressure should be checked and set to the proper value; 600 ± 18 kPa, and the rate of revolution should be set at 30 gyrations per minute. The internal angle is to be set at 1.16 ±

0.02 degrees. It is recommended that the calibration be done for the internal angle using the Dynamic Angle Validator (DAV) if different brands or models of the gyratory compactor are being used.

Samples shall be gyrated to the number specified for the N_{des} level required in Section 828.

D. Testing Superpave Specimens

All testing shall be in accordance with the appropriate AASHTO or GDT procedure, as follows:

Test	Test Method
Volumetric Properties	**AASHTO T-312,** "Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of Superpave Gyratory Compactor" AASHTO R 35, "Superpave Volumetric Design for Hot Mix Asphalt (HMA)
Bulk Density	**AASHTO T-166,** "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens"
Short Term Aging	**AASHTO R-30,** "Mixture Conditioning of Hot Mix Asphalt (HMA)" Note: The procedure is modified for GDOT mix designs to require only two hours aging.
Maximum Density and Effective gravity	**AASHTO T-209** "Maximum Specific Gravity of Bituminous Paving Mixtures"
Aggregate Gravities	**AASHTO T-84** "Specific Gravity and Absorption of Fine Aggregate" and **AASHTO T-85,** "Specific Gravity and absorption of Coarse Aggregate" (The designer may obtain coarse aggregate gravities from GDOT or perform this test.)
Moisture Susceptibility (when required)	**GDT-66** "Method of Test for Evaluating the Moisture Susceptibility of Bituminous Mixtures by Diametral Tensile Splitting"
Rutting Susceptibility	AASHTO T 324 "Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)"
Permeability	**GDT-1** Measurement of Water Permeability of Compacted Paving Mixtures

Use the design calculations as outlined in AASHTO R 35 and T-312. However, replace G_{sb} with G_{se} when calculating VMA. When designing a Superpave mix containing RAP materials, the effective specific gravity (G_{se}) of the RAP shall be used in place of the bulk specific gravity (G_{sb}) in determining the combined aggregate bulk specific gravity for the blend. A method of calculating batch weights for RAP mixes is presented in Appendix C. Additionally, when designing Superpave mixtures containing RAP and/or RAS; a Corrected Optimum AC Content (COAC) is to be calculated and used as detailed in Appendix D.

E. Moisture Susceptibility

Moisture susceptibility will be determined by the tensile splitting method according to GDT 66. For these tests, the specimens will be fabricated at optimum asphalt cement content. All mixtures containing RAP and/or RAS shall be fabricated at the corrected optimum asphalt cement content **(COAC)**. The compactive effort for the specimens is to be reduced such that the air voids fall in a range required in Section 828. Specimens prepared for this test will include hydrated lime, or anti-stripping additive, or both, as specified for the ingredients proposed. For gyratory specimens that fail moisture susceptibility, Marshall specimens (4 inch) may be substituted.

F. Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)

Results of tests, including graphs and tables, shall be provided for all Superpave, SMA and 4.75 mm mixtures. The Hamburg Wheel-Tracking test will be conducted according to AASHTO T 324 and Section 828. For these tests, the specimens will be fabricated at optimum asphalt cement content. All mixtures containing RAP and/or RAS shall be fabricated at the corrected optimum asphalt cement content **(COAC)**. Two sets of two gyratory specimens should be tested for each mix design. If the average rut depth for the two sets exceeds specified limits, the asphaltic concrete mixture shall not be used in the work. The compactive effort for the specimens is reduced such that the air voids fall in a range required in Section 828. Test temperature for this test shall be 122 °F (50 °C)

G. Fatigue Testing

The Office of Materials and Testing may conduct a fatigue test on any Superpave asphalt mixture design or Superpave asphalt mixture used in construction to determine acceptability of the materials. The test shall be performed according to test procedure AASHTO T 321, or other procedure approved by the Office of Materials and Testing. All mixtures containing RAP and/or RAS; shall be fabricated at the corrected optimum asphalt cement content **(COAC)**.

H. Calibration Factor for Ignition Test

The designer shall, as part of the design process, perform calibration tests for use when testing the mixture in the ignition furnace, according to GDT 125. All results, including the worksheet and the print-out from the ignition furnace, shall be submitted with the design study and request for approval. All mixtures containing RAP and/or RAS shall be fabricated at the corrected optimum asphalt cement content (COAC).

Verification. The approved calibration factor shall remain in use unless, in the judgment of the State Bituminous Construction Engineer, the accuracy of the testing technique, calibration, or apparatus is found to be invalid or unreliable.

The contractor shall provide samples of the mix ingredients to the Department for verification of the CF on request. On receiving evidence that invalid or unreliable test results have been obtained, the State Bituminous Construction Engineer may suspend use of the ignition test on the mixture being produced until a correct calibration is obtained and until all other discrepancies involving calibration, apparatus and technique have been resolved. Where an incorrect CF has been applied in acceptance testing, results shall be corrected by applying a valid CF.

When a Job Mix Formula is submitted for approval prior to beginning production, the calibration factor of the mixture shall be included in the submittal. (This shall apply in all cases, regardless of the test method to be used for quality control testing.)

IV. Changes in Established Design Procedures, Criteria, or Mix Requirements

Changes in established procedures, criteria, and mix requirements are the prerogative of the State Materials and Research Engineer. Specifications, procedures, and other changes may apply to all bituminous mixtures, or only to a particular mixture. Any certified laboratory designing mixes for use in GDOT work will be placed on a list to receive information on revisions pertaining to bituminous mix design specifications and procedures.

V. Revisions of Approved Designs

Generally, when a particular ingredient of a mix design becomes unavailable, the contractor must provide a different design in order to continue work on a project. While the contractor is always responsible for the supply of materials, it is recognized that certain aggregate sizes may become unavailable due to unforeseeable causes. Often this interrupts paving work in progress, causing inconvenience to the public. In some instances, it may be possible to substitute one coarse aggregate ingredient for a similar material from a different source without affecting the quality of the mixture. In these cases only, the laboratory which designed the mix may submit a design revision for consideration. Design revisions will be subject to the following conditions:

A. Actual Shortage Required

The revision must be necessitated by an actual shortage, sufficient to delay work in progress, of a coarse aggregate ingredient of an approved design.

B. Similar Substitute Ingredient

The substitute ingredient must be similar to the replaced ingredient in mineralogy, particle size and shape, specific gravity, and abrasion resistance.

C. Revised Design Support Requirements

The proposed revised design shall be supported by volumetric tests on a minimum of two pairs of specimens, at asphalt content checkpoints above and below the optimum asphalt content of the original design. The State Bituminous Construction Engineer may require verification of previous tests for susceptibility to rutting, fatigue, and moisture when these properties of the design are marginal.

Monica L. Ho

State Materials Engineer

Director of Construction

Appendix A

Hot Mix Asphalt Design Reference Guide

(Note: Preparation and Testing requires the use of metric units only)

Sequence No.	Description
1	Dry incoming aggregate as described in AASHTO: T 27-93.
2	Grade aggregates as described in AASHTO: T 27-93. Use Gilson shaker and shake at least 10 minutes.
3	Calculate gradation of each aggregate type. Carry calculations to the nearest 0.1%. Compare to source average values and consider plant breakdown.
4	Calculate blend, keeping within control limits. Use AASHTO R 35 as a reference.
5	Batch aggregates as described in AASHTO 312 and AASHTO R 35. The design specimens must be 115 ± 5 mm high (95 mm for moisture susceptibility and manufacturers' requirements for Hamburg). Thoroughly mix the minus 2.36 mm aggregate during batching. Sample weights for AASHTO T-209 (maximum theoretical specific gravity) and gradation must be 2000 grams, except samples for 25 mm mixtures, which shall weigh at least 2500 g.
6	Heat the pans of aggregate to temperature specified on Mixing and Compaction Temperature Control Chart for the source of asphalt cement being used.
7	Heat the asphalt cement to temperature specified on Mixing and Compaction Temperature Control Chart for the source of asphalt cement being used. Heat only a half day's run. Never overheat or reheat AC.
8	Add and mix RAP material, if required, with the hot aggregates. Mix only until the RAP material is blended with the aggregate.
9	Add and mix hydrated lime. Add 1.0% by weight of the aggregate for virgin mixes or as calculated in Appendix C for RAP mixes. Add hydrated lime to the heated aggregate and mix until the aggregate is coated with lime.
10	Mix the heated AC and aggregate in a preheated bowl. The temperature at the time of mixing is very important. Care should be exercised to thoroughly coat the aggregate with AC.
11	When sample has been thoroughly mixed, place the mixture in a pan and spread it uniformly to approximately55 ± 5 lbs/yd^2 (30 ± 2 kg/m^2). Place the mixture and pan in a forced draft oven for 2 hours at the upper limit of the compaction temperature range. All samples for testing (with the exception of moisture susceptibility samples) shall be aged.
12	At least 30 minutes before compaction of the first specimen, place the compaction molds and base plates in an oven at compaction temperature.
13	At the end of the aging process, remove a mold and base plate from the oven. Assemble base plate and mold. Place a paper disk on top of the base plate. Place the aged mixture in the mold (do not spade). Be extremely careful to keep segregation to a minimum when transferring the sample to the heated mold. Place a paper disk on top of the sample.
14	Compact specimen using the Superpave Gyratory Compactor in accordance with AASHTO 312.
15	Remove the mold containing the compacted specimen from the compactor and extrude the specimen from the mold. A short cooling period is allowable to facilitate specimen removal to minimize sample damage. Remove the paper disks from the top and bottom of the specimen. Place the specimen on a flat, well supported surface where it will not be disturbed during cooling. A fan can be used to accelerate cooling, if necessary. Repeat this procedure for each specimen.
16	Determine G_{mb} in accordance with AASHTO T-166. Use balance accurate to 1.0 g. Be sure the water is clean and at correct temperature. Beware of specimens that release excessive bubbles when submerged. Such samples may prove misleading density values. Be sure the basket and suspension wire do not contact anything.

Appendix B

Ensure that Superpave Asphalt Concrete Mixtures Designs meet the following mix design limits:

Sieve Size	Design Gradation Limits, Percent Passing				
	9.5 mm Superpave Type I	**9.5 mm Superpave Type II**	**12.5 mm Superpave**	**19 mm Superpave**	**25 mm Superpave**
1½ in (37.5 mm)					100*
1- in (25.0 mm)			100*	100*	90-100
3/4 in (19.0 mm)	100*	100*	98-100****	90-100	55-89** (85 – 89)[1]
1/2 in (12.5 mm)	98-100****	98-100****	90-100	60-89*** (85 – 89)[1]	50-70
3/8 in (9.5 mm)	90-100	90-100	70-89 (85 – 89)[1]	55-75	
No. 4 (4.75 mm) s	65-85	55-75			
No. 8 (2.36 mm)	48-55	42-47	38-46 (42 – 45)[1]	32-36 (33 – 35)[1]	30-36 (33 – 35)[1]
No. 200 (75 µm)	5.0-7.0 (5.5 – 6.5)[1]	5.0-7.0 (5.5 – 6.5)[1]	4.5-7.0 (5.0 – 6.0)[1]	4.0-6.0 (4.5 – 5.2)[1]	3.5-6.0 (4.5 – 5.2)[1]
Range for % AC (Note 4)	5.4-7.25	5.25-7.00	5.00-6.25	4.25-5.50	4.00-5.25

Note 1 details the desired Mix Design combined gradation for each referenced sieve

Appendix C
Method of Calculating Batch Weights for Mix Designs With Recycled Asphalt

PURPOSE: To calculate the weights of reclaimed asphalt pavement (RAP), virgin aggregate, and liquid asphalt cement (AC) for preparing volumetric samples of asphalt mixtures.

Example calculations are for an aggregate batch weight of 4800 g. Assume mix will contain 30% RAP and RAP contains 6.3% AC by extraction. For this example, assume one point of the design will use 5.5% total AC.

#1. Total weight of mix = $\dfrac{\text{Agg. Wt.}}{100 - \%\ \text{AC}}$

Example: $\dfrac{4800\text{g}}{(100\% - 5.5\%)\ /100} = 5079\text{g}$

#2. Grams of RAP to batch = (Total Wt of mix)(% RAP)

Example: (5079)(30%) = (5079)(.30) = 1524 grams RAP

#3. (2)(% AC in RAP) = Grams of old AC from RAP

Example: (1524 grams)(6.4%) = (1524)(.064) = 97.5 grams old AC

#4. (#1) – Agg. Wt. – (#3) = Grams of new AC to add

Example: 5079 – 4800 –97.5 = 181.5 grams of new AC to add

#5. (#2) – #(3) = Grams of aggregate in RAP

Example: 1524 – 97.5 = 1426.5 grams

#6. % Aggregate contributed by RAP = $\dfrac{(5)}{\text{Agg. Batch}}$

Example: $\left(\dfrac{1426.5}{4800}\right)(100) = 29.7\%$ total aggregate from RAP

#7. % lime in mix = [100% - (#6)][1.0 %] + [(#6)][0.5%]

Example: (1.0%)(100% – 29.7%) + (0.5%)(29.7%) = 0.9 % Lime

NOTE: This step assumes 50% of RAP will have fractured faces which need to be treated with hydrated lime.

#8. % Aggregate available for other sizes = 100 – (#6) – (#7)

Example: 100 – 29.7 – 0.9 = 69.4% available for virgin aggregate

#9. Calculate Blend

Example: For this example, assume the following blend will be used:

29.7% - RAP aggregate

20.0% - 89 stone

25.0% - 810 screenings

24.4% - 777 (manufactured sand)

0.9% - hydrated lime

100% - Total aggregate

#10. Calculate Batch Weights

Batch wt. of virgin agg. = agg. batch wt. times % of blend

RAP	= (#2)	= 1524 grams
#89	= 4800 X 20%	= 960
#810	= 4800 X 25%	= 1200
#777	= 4800 X 24.4%	= 1171
Lime	= 4800 X 0.9%	= 43
New AC (for 5.5%)	= (4)	= 181.5
Total Wt.		= 5,079.5 grams (Differs from (#1) above due to round-off error.)

NOTE: As the total weight for each point of the design changes (Step #1), the grams of RAP to batch up in Step #2 will also change slightly, as will the available aggregate in Step #8. Therefore, use the AC content nearest the anticipated optimum (usually the third point of the design) as the value to use in Step #1 and on which the blend percentages and batch weights are to be calculated.

Steps #1 through #4 should be repeated for each point in the design to determine the amount of new AC.

NOTE: Use the extracted gradation (or gradation after burning in the ignition oven) of the RAP to calculate the mix blends; use the gradation of the RAP "as is" (from the Gilson shaker) to determine individual sizes for the batch weight. (See pages 1 and 3 of the design software.)

Appendix D

Method of Calculating Credited Asphalt Cement Content for Corrected Optimum AC Content for Asphaltic Concrete Mixtures Incorporating Reclaimed Asphalt Pavement (RAP) or Pre- or Post-Consumer Recycled Asphalt Shingles (RAS),

Purpose: To calculate the Credited AC Content (**CAC**) and Not Credited AC Content (**NCAC**) to be used to determine the Corrected Optimum AC Content **COAC** of Asphaltic Concrete Mixtures incorporating RAP and/or Pre- or Post-Consumer Recycled Asphalt Shingles (RAS), for all mixtures. The **CAC** and **NCAC** shall be used to determine the amount of additional new AC required to be added to an Asphaltic Concrete Mix Design's Original Optimum AC Content (**OOAC** as determined in AASHTO R 35-09 Section 10.5 at VTM = 4.0% air voids. **OOAC must meet the requirements of Section 828.2.03.A.** The **CAC** and **NCAC** shall be calculated using an applied factor as follows: the **CAC** shall be calculated using a factor of 0.60 while the **NCAC** is equivalent to 0.40 where 1.0 – 0.60 equals 0.40

The **COAC,** as determined using this procedure, shall be used in fabricating samples for all performance tests established in Section 828.2.B.2. Additionally, the **COAC** is to be listed on the Mix Design Summary Sheet **(as a note)** and used for JMF purposes.

Example:

Example calculations detailed are for a 12.5 mm Superpave Mix Type. Assume mix will contain 25% RAP and RAP contains 5.75% AC (RAP Stockpile Specific) determined using GDT-83 or GDT-125. For this example, assume the **OOAC**, as determined in AASHTO R 35-09 Section 10.5 is 5.10% total AC.

12.5 mm Superpave Mix with 5.10% **OOAC** (AASHTO R 35-09 Section 10.5 @ VTM 4% Air Voids). RAP = 25 % with 5.75% AC in RAP

1. Using Standard Mix Design Procedure RAP contributes 5.75 % x 0.25 = 1.44 % AC to the blended total AC of mix
2. Using factor to calculate **CAC** = 1.44 % x 0.60 = 0.864% AC
3. Using factor to calculate **NCAC** = 1.44 % - 0.864 % = 0.576 % AC
4. Add the 0.576 % **NCAC** to 5.10 % **OOAC** = 5.68 %
5. The **COAC** = 5.68 %
6. 5.68 % **COAC** shall be used for specimen fabrication for all performance test required in Section 828.2.B.2
7. **COAC** of 5.68 % will be listed as Corrected Optimum on Mix Design Summary Sheet as a note at the bottom.

Note: For asphaltic concrete mix designs incorporating RAP approved prior to December 1, 2018, the new COAC may be recalculated from an existing approved mix design. Upon first production of the recalculated surface mix design, field verifications using asphalt plant produced mixture will be required. Final approval of the recalculated surface mix design will be dependent on the field verified mixture meeting specified criteria using AASHTO T 324.

Note: All Required Performance Test as specified in Section 828.2.B.2 shall be conducted at the Corrected Optimum AC Content (COAC). Mix Design Summary Sheet will list the COAC as the Corrected Optimum AC Content.

Laboratory SOP 15
Revised: May 10, 1996
Reissued: December 6, 1996
Revised: February 21, 1997
Revised: June 28, 1999
Revised: July 1, 2003
Revised: November 29, 2004
Revised: March 18, 2010
Revised: May 25, 2013
Revised : May 6, 2015

GEORGIA DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TESTING

Standard Operating Procedure (SOP) 15

Certified Public Weighers

I. General

In order to assure accurate weights of materials supplied for Department work, a program is utilized whereby Certified Public Weighers will oversee the weighing of highway construction materials when they are weighed prior to delivery. While the Specifications will require essentially all such materials to be weighed by a Certified Public Weigher, some provisions will be made so that State personnel can supervise the weighing of small quantities of materials when it is unreasonable to require a Certified Public Weigher. Further, it is the intent of this program to attain uniform compliance with the State Law governing load limits of trucks. Refer to O.C.G.A §32-6-26 Weight of Vehicle and Load, SB54 (2011) and Subsection 107.14 of the Standard Specifications and the attached Bridge Formula Table.

The basic principles of the certification program will be as follows:

A. Certified Public Weigher

Certified Public Weighers will be provided by the materials producers or contractors to oversee the weighing of materials used in highway construction.

B. Rules and Regulations

Rules and Regulations for Georgia Certified Public Weighers are provided by Georgia Law under Official Code Georgia Annotated Section 10-2-5 of the Georgia Weights and Measures Act. This is administered by the Georgia Department of Agriculture.

Information about becoming a Certified Public Weigher in Georgia may be obtained from:

The Fuel and Measures Division
Georgia Department of Agriculture
Capitol Square
Atlanta, Georgia 30334
Telephone No. (404) 656-3704

C. Certified or Licensed Weighers from Other States

Requirements for certified or licensed weighers from other states shall be in accordance with applicable laws and regulations in those states. Documentation of weight tickets for materials shipped from other states shall be in accordance with Section IV of this Standard Operating Procedure.

Application to become a Certified or Licensed Weigher in Alabama, North Carolina, South Carolina, or Tennessee shall be made to:

Alabama Department of Agriculture
Division of Weights and Measures
P.O. Box 3336
Montgomery, Alabama 36109-0336
Attention: Sharon Boyd
Telephone: (334) 240-7171

North Carolina Department of Agriculture
Standards Division
P.O. Box 27647
Raleigh, North Carolina 27611
Telephone: (919) 733-3313

South Carolina Department of Agriculture
P.O. Box 11280
Columbia, South Carolina 29211
Telephone: (803) 734-2210

Tennessee Department of Agriculture
Office of Weights and Measures
P.O. Box 40627
Melrose Station
Nashville, Tennessee 37204
Telephone: (615) 360-0159

When materials are paid for based on weight and originate from a state which has no certified weigher program, such as Florida, the materials shall be weighed on approved scales located in the State of Georgia by a Certified Public Weigher.

D. License and Seal Required

Each Certified or Licensed Weigher must have a license and seal in accordance with applicable laws and regulations of the state in which they are located.

E. Certified Scales

All materials must be weighed on scales which have been approved for accuracy by the Fuel and Measures Division of the Georgia Department of Agriculture for materials weighed in Georgia and by the appropriate officials as required by laws and regulations in other states.

F. Tare Weights

It will be the responsibility of the producer or supplier to establish tare weights of all haul vehicles at random times during the day. A copy of the list of these weights will be provided to the Engineer when requested. Suppliers of materials weighed by approved net weight devices shall record the stored tare weights for the haul vehicles on a tare weight sheet with the date that tare weights were obtained. Also, the supplier shall include a comment that the material is being weighed on an approved net weight device. Suppliers of materials that obtain tare weights of individual loads will record the tare weight of the first load for each haul vehicle on a tare weight sheet. In this case, a comment that each load is to be individually tared shall be included on the tare weight list.

G. Certified Weights

The weighing of each load shall be observed by the Certified Public Weighers. The certified weights shall represent materials actually delivered to a project and used in the work. A material which is stockpiled must be weighed by a Certified Public Weigher when it is hauled from the stockpile and placed in the work. Unless notified in writing by the Office of Materials and Testing, the acceptable procedure for documenting the scale ticket on State projects shall be in accordance with Section IV of this Standard Operating Procedure.

H. Random Reweighing of Loads

At random times a Department of Transportation representative shall direct one or more loaded and/or unloaded vehicles to be reweighed. This requirement will be performed by Testing Management personnel at asphalt plants, and by Pit and Quarry Control personnel at aggregate sources or Contract Administration personnel at either source. The vehicle may be reweighed either on the scales on which the original weight was made or on another set of approved scales.

I. Posting of Certified Public Weigher's Certificate

The Certified Public Weigher's certificate shall be posted near the weigh indicator in full view.

J. Approved List of Certified Public Weighers

Approved lists of Certified Public Weighers will be maintained by the Fuel and Measures Division of the Department of Agriculture.

K. Exceptions

The requirements of Paragraph H above concerning weight checks of trucks is not applicable to the items of Portland cement, bituminous materials, and fertilizer mixed grade when these items are paid for separately by weight.

II. Invalid Weights

In the event a significant difference is discovered in weights recorded by the Certified Public Weigher and the checks made by the Department personnel, a full investigation will be made to determine if any significant shortages of material have occurred. If it is found that the Certified Public Weigher recorded an invalid weight, that person will not be allowed to certify further weights pending an investigation. In addition, the appropriate officials who administer the Certified Public Weigher Program in the state where the violation occurred will be notified so they can take any action they deem necessary.

III. Surveillance of Truck Weights for Legality

The Certified Public Weigher shall maintain sufficient checks on all vehicle weights to assure that trucks exceeding the gross weight limits are not dispatched; however, the Certified Public Weigher will not be required to assure compliance with axle and tandem limits. Issuance of a weight ticket by a Certified Public Weigher will not relieve the owner or operator of a truck from the responsibility of knowing and complying with maximum axle, maximum tandem, maximum gross, and applicable bridge formula limits.

Trucks traveling on the Interstate system will be limited to the maximum loads shown in the attached Bridge Formula Table. The Certified Public Weigher will be responsible for ascertaining from the driver whether a truck will be operating on the Interstate System, as well as its length from front to rear axle, so the maximum load can be determined from the Bridge Formula Table.

IV. Weight Ticket Requirements

The Department of Transportation will accept only the original copy of a weight ticket as the "copy of record" for payment except when a producer can demonstrate a compelling reason to retain the original copy, arrangements may be made to designate a certain copy as the "copy of record" for the producer.

The Office of Materials and Testing will maintain a list of exceptions to the requirement for the original copy of the weight ticket. Other exceptions, if necessary, will be approved through the Office of Contract Administration.

One copy of each weight ticket shall be retained by the Engineer as the "copy of record." The Certified Public Weigher will sign his or her official registered signature and place his or her seal number on each "copy of record" ticket.

If another Certified Public Weigher weighs and processes tickets during the day, he or she must use his or her official signature and seal number on each ticket.

The Certified Public Weigher must be the person actually operating the scale and weight recording equipment. Under no circumstances may a Certified Public Weigher place his or her seal and signature on a ticket for which he or she has not actually operated the scale and weight recording equipment.

Each ticket must be legibly marked by printer with the following:

1. Company name
2. Gross, Tare, and Net Weight (For aggregate shipments originating from a state having no certified weigher program, the ticket must also state where weighed in Georgia.)
3. Date
4. Time of batch or loading
5. Preprinted sequential ticket number (for Auto Ticketing Systems, computer generated sequential ticket number may be accepted when approved by the Office of Materials and Testing)

Each ticket must also be legibly marked, either by imprint, printer, or by hand, with all of the following information:

1. Source number and location
2. Load number
3. Truck number
4. Certified Public Weigher seal number
5. Certified Public Weigher signature (by hand or electronically affixed)
6. Project number
7. Description of material including mix type, mix design level (when applicable) and inclusion of hydrated lime/anti-stripping additive and asphalt cement PG grade. For example: 12.5 mm SP W/HL & PG76-22. This designation indicates that a 12.5 mm Superpave mix with hydrated lime and polymer modified asphalt cement is being used.

Payment will not be made for tickets lacking the information specified above. With response to the requirement for preprinted sequential ticket numbers, it is not a requirement that every ticket be in strict, unbroken sequence; however, tickets must be in reasonable sequence. The Department reserves the right not to accept tickets grossly out of sequence. Strikeovers by plant or contractor personnel of the above required information are generally not acceptable; however, isolated instances of Strikeovers initialed by the person making the correction, may be accepted at the Department's discretion.

State Materials Engineer

Director of Construction

Bridge Formula Table

Permissible gross loads for vehicles in regular operation
Based on weight formula W = 500(LN/N-1 + 12N + 36)

Where:
W = the maximum weight in pounds that can be carried on a group of two or more axles to the nearest 500 pounds
L = the distance in feet between the outer axles of any two or more consecutive axles
N = the number of axles being considered

Distance in feet between the extremes of any group of 2 or more consecutive axles	**Maximum load in pounds carried on any group of 2 or more consecutive axles**							
	2 axles	**3 axles**	**4 axles**	**5 axles**	**6 axles**	**7 axles**	**8 axles**	**9 axles**
4--------------------------	34,000	-------------	------------	------------	------------	------------	------------	------------
5--------------------------	34,000	-------------	------------	------------	------------	------------	------------	------------
6--------------------------	34,000	-------------	------------	------------	------------	------------	------------	------------
7--------------------------	34,000	-------------	------------	------------	------------	------------	------------	------------
8 and less----------------	34,000	34,000	------------	------------	------------	------------	------------	------------
More than 8--------------	38,000	42,000	------------	------------	------------	------------	------------	------------
9--------------------------	39,000	42,500	------------	------------	------------	------------	------------	------------
10-------------------------	40,000	43,500	------------	------------	------------	------------	------------	------------
11-------------------------	-----------	44,000	------------	------------	------------	------------	------------	------------
12-------------------------	-----------	45,000	50,000	------------	------------	------------	------------	------------
13-------------------------	-----------	45,500	50,500	------------	------------	------------	------------	------------
14-------------------------	-----------	46,500	51,500	------------	------------	------------	------------	------------
15-------------------------	-----------	47000	52,000	------------	------------	------------	------------	------------
16-------------------------	-----------	48,000	52,500	58,000	------------	------------	------------	------------

17--------------------------	-----------	48,500	53,500	58,000	------------	------------	------------	------------
18--------------------------	-----------	49,500	54,000	59,000	------------	------------	------------	------------
19--------------------------	-----------	50,000	54,500	60,000	------------	------------	------------	------------
20--------------------------	-----------	51,000	55,500	60,500	66,000	------------	------------	------------
21--------------------------	-----------	51,500	56,000	61,000	66,500	------------	------------	------------
22--------------------------	-----------	52,500	56,500	61,500	67,000	------------	------------	------------
23--------------------------	-----------	53,000	57,500	62,500	68,000	------------	------------	------------
24--------------------------	-----------	54,000	58,000	63,000	68,500	74,000	------------	------------
25--------------------------	-----------	54,500	58,500	63,500	69,000	74,500	------------	------------
26--------------------------	-----------	55,500	59,500	64,000	69,500	75,000	------------	------------
27--------------------------	-----------	56,000	60,000	65,000	70,000	75,500	------------	------------
28--------------------------	-----------	57,000	60,500	65,500	71,000	76,500	82,000	------------
29--------------------------	-----------	57,500	61,500	66,000	71,500	77,000	82,500	------------
30--------------------------	-----------	58,500	62,000	66,500	72,000	77,500	83,000	------------
31--------------------------	-----------	59,000	62,500	67,500	72,500	78,000	83,500	------------
32--------------------------	-----------	60,000	63,500	68,000	73,000	78,500	84,500	90,000
33--------------------------	-----------	-------------	64,000	68,500	74,000	79,000	85,000	90,500
34--------------------------	-----------	-------------	64,500	69,000	74,500	80,000	85,500	91,000
35--------------------------	-----------	-------------	65,500	70,000	75,000	80,500	86,000	91,500
36--------------------------	-----------	-------------	66,000	70,500	75,500	81,000	86,500	92,000
37--------------------------	-----------	-------------	66,500	71,000	76,000	81,500	87,000	93,000
38------------------------	----------	------------	67,500	71,500	77,000	82,000	87,500	93,500

--	-	-						
39--------------------------	-----------	-------------	68,000	72,500	77,500	82,500	88,500	94,000
40--------------------------	-----------	-------------	68,500	73,000	78,000	83,500	89,000	94,500
41--------------------------	-----------	-------------	69,500	73,500	78,500	84,000	89,500	95,000
42--------------------------	-----------	-------------	70,000	74,000	79,000	84,500	90,000	95,500
43--------------------------	-----------	-------------	70,500	75,000	80,000	85,000	90,500	96,000
44--------------------------	-----------	-------------	71,500	75,500	80,500	85,500	91,000	96,500
45--------------------------	-----------	-------------	72,000	76,000	81,000	86,000	91,500	97,500
46--------------------------	-----------	-------------	72,500	76,500	81,500	87,000	92,500	98,000
47--------------------------	-----------	-------------	73,500	77,500	82,000	87,500	93,000	98,500
48--------------------------	-----------	-------------	74,000	78,000	83,000	88,000	93,500	99,000
49--------------------------	-----------	-------------	74,500	78,500	83,500	88,500	94,000	99,500
50--------------------------	-----------	-------------	75,500	79,000	84,000	89,000	94,500	100,000
51--------------------------	-----------	-------------	76,000	80,000	84,500	89,500	95,000	100,500
52--------------------------	-----------	-------------	76,500	80,500	85,000	90,500	95,500	101,000
53--------------------------	-----------	-------------	77,500	81,000	86,000	91,000	96,500	102,000
54--------------------------	-----------	-------------	78,000	81,500	86,500	91,500	97,000	102,500
55--------------------------	-----------	-------------	78,500	82,500	87,000	92,000	97,500	103,000
56--------------------------	-----------	Gross }	79,500	83,000	87,500	92,500	98,000	103,500
57--------------------------	-----------	Weight Limit}	80,000	83,500	88,000	93,000	98,500	104,000
58--------------------------	-----------	-------------	------------	84,000	89,000	94,000	99,000	104,500
59--------------------------	-----------	-------------	------------	85,000	89,500	94,500	99,500	105,000

60--------------------------	-----------	-------------	------------	85,500	90,000	95,000	100,500	105,500

GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS AND RESEARCH

Standard Operating Procedure (SOP) 27
Quality Assurance for Asphaltic Concrete Plants in Georgia

I. General

The Office of Materials and Research and the Districts are responsible for verifying that Hot Mix Asphaltic Concrete produced for the Department's use meets the applicable Specifications. Asphaltic concrete plants will be inspected and each plant that meets specified minimum requirements will be shown in the Department's Qualified Products Manual, List of Approved Hot Mix Asphaltic Concrete Plants, (QPL 45).

II. Prerequisite for Plant Approval

A. Inspection of Equipment

The plant owner or manager shall schedule an inspection of the plant facilities with the Office of Materials and Research. All equipment for the production and the facilities and equipment for testing the materials shall meet the minimum requirements set forth in Subsection 400.3 and Subsection 400.4 of the Specifications and shall be approved by the Engineer. The equipment shall be maintained in a satisfactory operating condition and be capable of its intended function at all times during production.

B. Quality Control Program

Each plant on the QPL 45 shall have an approved quality control program and have a designated person to administer the program as set forth in the Specifications. This program shall include the testing and control of materials used and the final product produced at the plant. This shall be done in such a manner as to produce a uniform product, which meets Specification requirements.

C. Certified Public Weighers

At each plant producing asphaltic concrete for projects of the Department, at least one employee shall be a Certified Public Weigher. All asphaltic concrete mix to be used in projects of the Department shall be weighed in accordance with Laboratory SOP 15.

D. Statement of Certification

Owners of plants with facilities that are found to meet the Department's requirements shall provide the State Materials and Research Engineer with a statement that certifies that all asphaltic concrete supplied for Department work shall meet a design mix formula approved by the Office of Materials and Research and that all materials used in the production of the asphaltic concrete for the Department work are from approved sources. This statement should be signed by a responsible officer of the company who has authority to bind the company and shall be notarized.

III. List of Approved Hot Mix Asphaltic Concrete Plants

The Office of Materials and Research will publish a list of approved Hot Mix Asphaltic Concrete Plants. The list will be published periodically, and as plants are added or taken from the list, notice will be given by letter. The list will designate the name of the company, contractor number, location of the plant, type of plant, plant code and plant restrictions where applicable.

A. New Sources

Any producer of hot mix asphaltic concrete desiring a plant be added to the list of approved plants should send an application in writing to State Materials and Research Engineer. The request should include the following items:

1. The Plant location and telephone number, plant manger, superintendent, type and size of capacity of plant.
2. A list of certified public weighers showing their signatures and seal imprints.

Upon receipt of the Producer's application, the Office of Materials and Research will schedule an inspection of the plant. At the time of the inspection, the facilities of the plant and the quality control facilities will be reviewed.

B. Restrictions

1. At times due to the occurrence of unacceptable segregation, restrictions are placed on asphalt plants approved to produce mix for state funded construction projects. Once an asphalt plant is restricted, its restriction code and explanation will be listed in the QPL 45, "Georgia's List of Approved Hot Mix Asphaltic Concrete Producers". In order to assure that all asphalt plants are evaluated in a consistent and uniform manner, the following restriction evaluation procedure is provided.
2. In accordance with Subsection 400.3.06.E of the Specifications, whenever unquestionable unacceptable segregation is observed, the work shall automatically be suspended until positive corrective action is taken by the contractor. At this time 6 in (150 mm) cores will be obtained and evaluated for compliance with tolerances established in Section 828. Once an approved written plan of corrective measures or actions is submitted, the work will be allowed to continue. When work resumes, the Contractor will be allowed to place a test section not to exceed 500 tons (454 Mg) of the affected mixture. This mixture will be evaluated using core results. However, if it is apparent that the corrective measures were not effective, the work again will be suspended until a revised written plan of corrective measure or action is submitted for approval. In addition, the Office of Materials and Research will notify the hot mix producer that the asphalt plant is being evaluated for possible restrictions on the QPL 45.
3. Once the revised plan of correction is approved, the work will be allowed to resume with the placement of a test section not to exceed 500 tons (454 Mg). Should these corrections prove ineffective, the plant will be restricted on the QPL 45.
4. In accordance with Subsection 400.3.06.E, whenever unacceptable segregation is suspected, the Contractor may elect to continue work at his own risk until six-inch cores are obtained and evaluated for compliance with Section 828. If it is determined that the mixture is outside tolerances established in Section 828, the work will immediately be suspended for corrective action as outlined previously in the procedure established in the preceding steps 2 and 3. Failure to eliminate the segregation will be grounds for the asphalt plant's restriction in the QPL 45, "Georgia's List of Approved Hot Mix Asphaltic Concrete Plants".
5. Once an asphalt plant is restricted, a request for reevaluation may be submitted provided that extensive related modifications to the asphalt plant or plant operation is verified. If this request is approved, the reevaluation shall consist of several test sections on the placement of the restricted mixture(s) on multiple projects. This placement will be closely monitored and evaluated by the District Technical Services Engineer (TSE). If these evaluations determine that the restricted mixes are currently being placed in compliance with Sections 400 and 828, then the asphalt plant's restriction code will be revised to reflect a restriction code 13, which states that "although this plant has a history of segregation, the use of a Material Transfer Vehicle (MTV) may be waived due to plant modifications that contributed to non-segregated mixes, on a project to project basis with approval from the Office of Materials and Research." This revised restriction does not override the necessity of a MTV as required in Subsection 400.3.02.C of the Specifications. If it is observed at any time that the in-place mixture is not in compliance with Sections 400 and 828, then the asphalt plant's restriction will be revised to the original plant restriction and strictly enforced.

C. Removal from the Approved List

Failure to adhere to Specification requirements as set forth in Subsection 400.3.06 as related to quality control, Quality Control Manager and Quality Control Technician requirements may subject the producer to immediately be placed in a "probationary period." If this happens, the Producer may be notified that he is in a "probationary period." At this time he has ten working days (10) to respond in writing to the State Materials and Research Engineer, and explain why the Specification requirements were not met and what steps will be taken to prevent a similar occurrence in the future. Any future occurrence of failure to adhere to Subsection 400.3.06 shall subject the Producer to immediate removal from QPL 45, Georgia's "List of Approved Hot Mix Asphaltic Concrete Plants." The Producer may be subject to removal from the Qualified Products List (QPL 45) for any first offense deemed serious enough by the State Materials and Research Engineer.

Should an asphalt plant be identified as having recurring procedure problems, a 10-day "special control" will apply. During this 10-day period, a Georgia Department of Transportation Representative will be present at the plant fulltime and a fee will be charged to the producer.

The Department reserves the right to remove any plant from the Approved list at any time confidence is lost in the Producer's ability or intention to produce material of uniform characteristics complying with the Specifications.

An asphaltic concrete plant rating system has been developed based on the degree of quality control at each plant. From the extraction and gradation information, each plant will be rated on the following scale:

Rating	Quality Control Level
90 – 100	Excellent
80 - 89	Good
70 - 79	Marginal
Below 70	Unacceptable

The asphalt plant rating system for quality control at the plants was developed using the Mixture Control Tolerances established in Section 828 of Georgia's Specifications. This system is designed to provide Industry and the Department with a management tool for measuring the success of the Producer Certification Program and to promote consistency of products. The extraction and gradation test data is stored in the computer. The overall Quality Control Level Rating assigned to each plant will be based on the summary of all the test data from that particular plant and published semi-annually. The end of year rating will be based on Quality Control Level Ratings throughout the calendar year for plants with at least 10,000 tons (9070 Mg) produced.

Actual participation in the Quality Control Level Rating will be based on monthly evaluations. The Producers Quality Control Level Rating will be determined from the extraction and gradation data at the plant. An "Unacceptable" rating will immediately place the Producer in an "improvement period." If this happens, the Producer will be notified that he is in an improvement period and that he has fifteen (15) production days in which to upgrade his quality control procedures. During this period, the Producer will report all Quality Acceptance samples to the respective Testing Management Operations Supervisor. At the end of the improvement period, the Producer's Quality Control will be re-evaluated using these tests results and he will either be removed from the approved list or reinstated to normal status.

An acceptable Quality Control Level Rating does not preclude the requirement for the mixture produced on a daily basis to meet the Specifications. Acceptance of the work is based on a Lot to Lot basis in accordance with Section 106 and the requirements specified in the Acceptance Plans in Section 400 of the Specifications.

D. Reinstatement to the Approved List

Once removed from the approved list, a Producer may gain reinstatement in the following manner:

1. The Producer shall make a written request to the State Materials and Research Engineer asking to be reinstated to the approved list. The request should address the causes, which affected removal from the approved list. The Producer should state measures taken to upgrade his quality control in the production of the material. A detailed quality control program must be submitted listing the type and frequency of test proposed to control the plant and the name of the certified testing technician responsible for the program.
2. If the submitted quality control program is approved, the Producer will be placed on "Special Control". He will be carried on special control for a period of ten (10) production days. During this period, the Producer will report his Quality Acceptance results to the State Bituminous Construction Engineer's Office on a daily basis. In addition, a Georgia Department of Transportation Representative will be at the plant fulltime and a fee will be charged to the producer.
3. If the Producer's quality control program is adequate and the State Materials a Research Engineer finds that the Producer meets the requirements for approved plants; the Producer will be reinstated to the approved list.

IV. INSPECTION

Random visits will be made to all approved plants by inspectors from the Office of Materials and Research. These visits will be made to insure that the plant facilities are maintained in satisfactory operating condition. Annual visits will be made for the purpose of updating the plant for compliance as set forth in Section II of this SOP.

A. Materials Invoices

In accordance with Subsection 400.1.03, formal written invoices for all hydrated lime and Asphalt Cement that has been modified with either polymer or anti-strip additive will be copied and filed at each asphalt plant for a minimum time period of 3 months (90 days). These invoices are to be furnished to the Department upon request.

Georgene M. Geary, P.E.
State Materials and Research Engineer

Glenn W. Durrence, P.E.
Director of Construction

Laboratory SOP 36
Reissued April 30, 1998
Revised July 1, 2003
Revised November 3, 2008
Revised: July 15, 2010

Georgia Department of Transportation
Office of Materials and Research

Standard Operating Procedure (SOP) 36

Certification of Laboratory and Personnel For Design of SMA and/or Superpave Asphaltic Concrete Mixtures

I. General

This document provides information and outlines procedures for certifying private entities in the design of asphaltic concrete mixtures. Superpave mixes shall be designed in accordance with the SHRP Superpave System, except as otherwise specified. For Superpave volumetric mix designs, AASHTO T-312, *Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor* and AASHTO R-30, *Mixture Conditioning of Hot Mix Asphalt (HMA)* will be used. Stone Matrix Asphalt (SMA) mixtures shall be designed in accordance with GDT-123 "Determining the Design Proportions of Stone Matrix Asphalt Mixtures".

This document outlines the certification process for both the design laboratory and the SMA Mix Design and/or Superpave Mix Design Technician. Certification of mix design laboratories and technicians is a function of the Bituminous Construction Branch of the Office of Materials and Research (OMR) at Forest Park, Georgia.

II. Laboratory Certification

The design of asphaltic concrete mixtures is a very technical process requiring highly skilled testing personnel, precision testing equipment, and close adherence to design guidelines and test procedures to assure high quality mix designs.

It is a requirement for lab certification that the design equipment must meet all requirements and tolerances stated in the test procedures listed below. Equipment calibration records shall be furnished to OMR for review prior to initial certification and shall be available for inspection at all times. Equipment shall be calibrated at least semi-annually or as otherwise directed. The laboratory building used to fabricate asphaltic concrete mix designs should be large enough to accommodate all equipment with adequate space remaining to perform all design-related tasks in a safe manner.

Requests for laboratory certification shall be in the form of a letter to the State Materials and Research Engineer, providing the company name, lab location, telephone number, and names of laboratory personnel. After the request is received, the Office of Materials and Research will provide the requesting laboratory specific instructions for an on-site inspection and will establish an inspection date. After completion of the laboratory inspection, a letter will be sent approving or disapproving the laboratory. If the laboratory is approved, a certificate will be issued. If the laboratory is not approved, a detailed description will be provided identifying areas needing improvement.

Participation in applicable areas of AMRL certification programs may be accepted in lieu of OMR inspection. Other certification programs may be acceptable if approved by the Office of Materials and Research.

Re-certification of the Superpave mix design laboratory may be required bi-annually at the discretion of the Office of Materials and Research. Random laboratory inspections may also be made at any time. The Department reserves the right to revoke certification if the requirements described herein are not met at all times.

III. Test Procedures

AASHTO R-30, "Mixture Conditioning of Hot Mix Asphalt (HMA)" Note: The procedure is modified for GDOT mix designs to require only two hours aging.

AASHTO T-11, “Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates by Washing”

AASHTO T-27, “Sieve Analysis of Fine and Coarse Aggregates”

AASHTO T-30, "Mechanical Analysis of Extracted Aggregates"

AASHTO T-304, “Uncompacted Void Content of Fine Aggregate”

AASHTO T-84, “Specific Gravity and Absorption of Fine Aggregate”

AASHTO T-85, “Specific Gravity and Absorption of Coarse Aggregate”

AASHTO T-166, “Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens”

AASHTO T-209, “Maximum Specific Gravity of Bituminous Paving Mixtures”

AASHTO T-312, “Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of Superpave Gyratory Compactor”

ASTM PS-129 "Measurement of Permeability of Bituminous Paving Mixtures Using a Flexible Wall Permeameter"

GDT 22, “Method of Test for Sieve Analysis of Mineral Filler”

GDT 38, “Method of Test for Mechanical Analysis of Extracted Aggregate”

GDT 56, “Method of Test for Heat Stable Anti-Strip Additive”

GDT 63, “Method of Test for Sand Equivalent of Soil and Fine Aggregate”

GDT 66, “Method of Test for Evaluating the Moisture Susceptibility of Bituminous Mixtures by Diametral Tensile Splitting”

GDT 83, “Method of Test for Extraction of Bitumen from Paving Mixtures Using the Vacuum Extractor”

GDT 115, “Method of Test for Determining Rutting Susceptibility Using the Asphalt Pavement Analyzer”

GDT 123, “Determining the Design Proportion for Stone Matrix Asphalt Mixtures”

GDT 125, “Method of Test for Determining Asphalt Content by Ignition”

IV. Mix Design Cooperative Testing

All labs that are certified to design SMA and/or Superpave asphaltic concrete mixtures will be required to participate in annual cooperative testing and must receive minimum ratings of at least 3.0 according to the rating scale below. Tests may be assigned at the discretion of the Office of Materials and Research for maximum and effective specific gravity, Superpave mix design volumetrics, moisture susceptibility, asphalt content, aggregate gradation, rutting susceptibility, and other design-related procedures.

Rating	Test Results
5	Within 1.0 standard deviation of mean
4	Within 1.5 standard deviations of mean
3	Within 2.0 standard deviations of mean
2	Within 2.5 standard deviations of mean
1	Within 3.0 standard deviations of mean
0	Data 3.0 or more standard deviations of mean

Ratings less than 3.0 will require that an investigation be conducted by the SMA Mix Design and/or Superpave Mix Design Technician and a written explanation, describing the findings, and any corrective action taken, be submitted to the State Materials and Research Engineer. The investigation shall be conducted within a 15 working day period and may include additional testing of cooperative samples.

If the investigation reveals an acceptable level of quality control, the laboratory shall remain on approved status.

V. Review and Withdrawal of Certification

If the investigation reveals unacceptable accuracy or reliability, the laboratory shall be placed in a Temporary Improvement status during which time a special investigation will be conducted by the Office of Materials and Research .

In addition, a certified laboratory shall be subject to a special investigation when, in the finding of the State Materials and Research Engineer, the mix designs submitted from it are of marginal or doubtful accuracy or reliability. If the special investigation reveals one or more continuing, serious deficiencies in performance, training, or equipment, laboratory certification shall be withdrawn until, in the finding of the State Materials an Research Engineer, the deficiency has been satisfactorily resolved.

VI. Certification of Superpave Design Technicians

The SMA Mix Design and/or Superpave Mix Design Technician is responsible for all designs submitted to the Office of Materials and Research for consideration.

A. Certification Requirements

The Superpave Mix Design and/or SMA Mix Design Technician shall be certified through The National Center for Asphalt Technology (NCAT) in Auburn, Alabama, by taking a certification training course and completing a final exam with a score of 80 or better. Applicants who score at least 70 but less than 80 on their first exam may retake a final exam after 60 days without retaking the training course. An applicant who scores below 70 or fails the test more than once with scores of at least 70 make retake the exam only after a 60-day waiting period and retaking the training course. ***A Superpave Mix Design Certification is a prerequisite for SMA Mix Design Certification.***

B. Condensed Certification Course

Certification as a SMA Mix Design and/or Superpave Mix Design Technician by the Asphalt Institute or other approved training center or considerable experience in the area of Superpave mix design may be accepted in lieu of the above requirements. These applicants must attend a condensed training course by NCAT and complete a final exam with a score of 80 or better. The Office of Materials and Research will determine whether an applicant qualifies for the condensed course.

C. Certificate

Upon obtaining a satisfactory test score, the technician will be issued a certification number by the Office of Materials and Research.

D. Loss of Certification

SMA Mix Design and/or Superpave Design Technicians may lose their certification(s) by revocation. Reasons for revocation may include providing erroneous reports or records, negligence or incompetence, or inactivity in performing design duties for six consecutive months, as determined by the Office of Materials and Research. All reported incidents will be investigated, and determination of revocation will be made by the State Materials and Research Engineer. Superpave Design Technicians who lose their certification due to providing erroneous reports or records will not be eligible for re-certification unless approved by the State Materials and Research Engineer. Revocation for other reasons may require additional training, further experience approved by the Office of Materials and Research for certification, or a combination of such training and experience.

VII. Technician's Warranty

Completed designs and supporting worksheets from a certified laboratory shall be submitted along with a cover letter signed by the Superpave Design Technician when forwarding to the Bituminous Construction Branch of the Office of Materials and Research for approval. The mix design cover letter shall be notarized and contain the following statement:

" I_______________________________________, SMA Mix Design and/or Superpave (indicate type of mix design certification) Design Technician Certification Number______ for__________________________________, do attest to the best of my knowledge that the information contained in this design request is based on factual test results obtained under my supervision during the fabrication of this mix design."

Guidance for preparing and submitting designs is provided in SOP-2.

____
Georgene M. Geary, P.E.
State Materials and Research Engineer

____
Thomas B. Howell, P.E.
Director of Construction .

March 10, 2014

Georgia Department of Transportation
Office of Materials and Research

Standard Operating Procedure (SOP) 41
Approval of Recycled Asphalt Pavement (RAP) for use in Asphalt Mixtures

---

I. GENERAL

The Department approves RAP on a stockpile basis, following the process set forth in these guidelines. RAP from a currently approved stockpile may be included as an ingredient in dense-graded asphalt mixtures designed and approved under Section 828 of the Standard Specifications. The contractor's responsibilities in the process are as follows:

- To obtain the Department's approval of all RAP prior to its use on a State project and to deliver test data and samples as required
- To monitor and preserve the quality and uniformity of the approved material during storage and handling, adding no unapproved material to the existing stockpile except as authorized below
- To comply with the Department's requirements regarding replenishment of approved stockpiles

The Department will approve RAP based on its composition and variability in gradation and asphalt content, as explained below, and on visual inspections of the stockpile, which the Department may conduct at its discretion. The Department may withdraw approval of a stockpile if these Guidelines are not followed in good faith.

The Maximum Percentage Allowed in a mix design will be based on these criteria and on the category of the RAP source, as defined in Parts V and VIII below. The amount of RAP allowed in a mix is also limited according to the type of plant in which it will be produced.

Approval of a material pertains to its condition as tested and sampled after final processing. If an approved material is to be re-processed later in a manner which appreciably alters the gradation, the material must be re-approved in its reprocessed condition. This does not apply to removal or re-crushing of oversize particles during production.

Nothing in these guidelines shall relieve the contractor of responsibility for mixture quality or set aside any requirement of the Acceptance Plans for Gradation and Asphalt Content, Section 400.3 of the Standard Specifications.

II. APPROVAL PROCESS

Qualified asphalt producers (listed in QPL 45) may submit requests for RAP stockpile approval to the State Bituminous Construction Engineer, Office of Materials and Research, in the format given in the Attachment below. The requester shall deliver samples and test results as prescribed in Part III. The Office of Materials and Research will test the samples to identify their mineral components and to determine the effective specific gravity, gradation, asphalt cement content and viscosity, and variability of composition. The Office of Materials and Research may adjust the amount and nature of testing required according to the history and nature of the material.

Upon completion of testing and, if applicable, visual inspection, the State Materials and Research Engineer will approve or disapprove the material by letter and will assign a Stockpile Identification Number for each approved RAP stockpile. <u>Note:</u> The contractor's average gradation and asphalt content, as listed in the approval letter, shall be the gradation used in subsequent mix designs. The approval letter will state the applicable limits on the use of the material in mix designs and will summarize the Department's findings, listing the average gradation and asphalt content from the contractor's tests and the corresponding values found by the Department. Where the Maximum Percentage Allowed is low due to variability, the contractor may elect to improve the uniformity of the material by further processing and may again sample, test, and request approval for the material.

No material shall be added to a stockpile after it has been approved, except as provided in Parts V, VII, and VIII below.

III. SAMPLING, TESTING, AND SUBMITTALS

III.A. Standard approval procedure

Except as otherwise provided under Part E below, the contractor shall obtain random samples representative of the entire stockpile and shall have each sample tested for gradation and asphalt content according to GDT-38 and either GDT-83 or GDT-125. The material sampled must be in its final condition, after all crushing and screening. At least one sample shall be obtained for each 1,000 tons of RAP, with a minimum of five samples per stockpile. Sampling shall be performed according to GSP-2, "Sampling Procedure for Coarse Aggregates." The minimum sample size (after quartering) for tests on RAP samples is 1,500 g. except for samples containing particles more than one inch in diameter, for which the minimum is 2,000 g.

To request approval of a RAP stockpile, submit the following documents and samples to the Office of Materials and Research. It is the requester's responsibility to correctly address, label, and deliver these submittals:

- Contractor's Request for RAP Stockpile Approval (Complete the form attached to this document.)
- Test reports of the tests prescribed above
- A drawing of the plant site showing the location of the stockpile to be approved *and all other stockpiles on the premises*
- Five bagged samples (regardless of stockpile size), approximately 25 pounds each, taken randomly from five different points in the stockpile, numbered sequentially, and *labeled with the plant location and the name of the contractor*
- A quartered sample weighing 1500 to 2000 grams to be used for abson recovery testing is to be submitted with the five bagged samples
- Sample cards (DOT 170, which are available upon delivery) filled out by the requester and placed in each sample bag.

Mail or deliver the request form, with test reports and site drawing, to:

State Materials Engineer
ATTN: Asphalt Design Lab, Room 211
Office of Materials and Research
15 Kennedy Drive, Forest Park, GA 30297

Deliver fully labeled samples, with completed sample cards**,** to the Receiving Clerk, Loading Dock C, at the above address. (Sample cards may be obtained at Dock C.) Do not attach the request form, test reports, and site drawing to the samples or place them in the sample containers; they must be delivered as indicated above. The Department will not be accountable for samples not properly labeled or for samples not delivered to the Receiving Clerk in person. Samples may be delivered by mail or commercial parcel service, provided that the service requires a signed acknowledgement of delivery.

III.B. Tests and inspections by the Department

The Department shall have the right to observe the collection of samples or to perform the sampling. As a condition of approval, the Department may at any time inspect and sample RAP stockpiles for which approval has been requested and may perform additional quality control tests to determine the consistency and quality of the material. The Department will perform petrographic analyses to determine the aggregate group, percentage of local sand, and presence of deleterious materials and soft particles. For certain projects and applications, the Specifications restrict the use of mix designs which include local sand or Group I aggregates.

The approval letter issued by the Department will include the results of its mixture analysis and effective gravity. However, in preparing mix designs using the approved RAP, mix design technicians may compare their own results with the Department's data but should apply their own data in the design calculations.

IV. STOCKPILE IDENTIFICATION SIGNS

RAP stockpiles shall be identified with posted signs displaying the original stockpile number or the current replenishment number, whichever applies. These signs shall be made of weatherproof material and shall be highly visible. Numerals shall be easily readable from outside the stockpile area. If a stockpile exists in two or more parts, each part must have its own sign.

V. CATEGORIES OF RAP BY SOURCE

V.A. General

For all sources of RAP, the Maximum Percentage Allowed in a mix design will be limited by specification requirements and the criteria given in Part VI below. Requirements for approval of RAP from a single source may be modified in certain cases, and material from sources other than existing highway pavements may be unacceptable.

V.B. Single pavement source

Early approval of material from a single pavement source. When a new stockpile is to consist entirely of millings removed from one existing pavement, the stockpile may, other factors permitting, be approved on the basis of samples taken during the milling and processing operations, prior to completion of milling. The initial stockpile may be approved as either a new stockpile or a new stockpile in continual replenishment status.

Approval in Continual Replenishment status. If the contractor elects to place this stockpile in Continual Replenishment Status, five samples plus one additional sample per thousand tons shall be taken from the processed stockpile after it reaches at least 1,000 tons. The material sampled must be in its final condition, after crushing and screening. As prescribed in Part III above, the contractor shall test one sample per thousand tons and shall deliver the five remaining samples, together with a letter request for approval in Continual Replenishment status, to the address indicated. The stockpile shall be subject to initial approval as prescribed above in Part II. Once approved, it may be replenished without further approvals as provided in Part VIII below. For stockpiles approved for Continual Replenishment, the Maximum Percent Allowed shall remain at the percent determined according to Part VI below.

Approval at a higher Maximum Percent Allowed. For approval at a higher maximum rate, the stockpile shall be sampled as prescribed in Part III above, after the processed stockpile reaches at least 2,000 tons or when the milling and processing operations are at least 40 percent complete, whichever occurs first. The material sampled must be in its final condition, after crushing and screening. Five samples shall be delivered to the Office of Materials and Research with the contractor's test results and a letter request for approval, as prescribed in Parts II and III. The material milled and processed subsequent to the first stockpile shall be kept separate from the approved stockpile. The contractor may request approval of this material as replenishment of the original stockpile, in increments of 2,000 tons or more as it is processed.

V.C. Multiple sources

This category includes RAP from more than one project and also asphalt mixture produced but not placed, when the mixture is composed of acceptable ingredients. These materials should be processed and stockpiled so as to combine and blend them to the fullest practical extent. Criteria for approval and the Maximum Percentage Allowed in mix designs are given in Part VI below.

V.D. Heterogeneous or contaminated material not allowed

When milling to recycle asphalt pavement; traffic detection loops, raised pavement markers and other detrimental debris must be separated and discarded prior to stockpiling the RAP for approval for use in GDOT asphaltic concrete mixtures.

No material other than RAP from an approved stockpile shall be included in mixtures for State projects. The following materials are specifically excluded:

- Material contaminated with foreign matter such as liquids, soil, concrete, or debris
- Plant waste, especially waste containing abnormal concentrations of bitumen, drum build-up, or material from spills or plant clean-up operations

The following materials shall not be added to or placed in proximity to an approved stockpile but may be accumulated in a separate stockpile and submitted for approval according to Part III:

- Production mixtures returned to the plant for any reason
- Mis-proportioned mixtures, especially that generated at start-up.

VI. PERCENTAGE OF RAP ALLOWED

The Maximum Percent of RAP allowed in mix designs shall be the lowest percentage determined by the gradation, asphalt content, or asphalt viscosity of the RAP, as established under the criteria in 1 and 2 below. In addition, the use of RAP designs in certain applications may be restricted by the content of natural sand and Group I aggregate or by the plant type, as discussed in 3 and 4.

VI.A. Limits according to range in gradation and bitumen content

The Maximum Percent of RAP Allowed according to gradation and asphalt content shall be based on the ranges in these values as determined by the Department from at least five samples. The Department may base its finding on its own tests or on samples obtained and tested by the contractor. Apparent outliers shall not be considered in determining these ranges. Where one result appears to be unrepresentative of the whole, two or more additional samples shall be tested. The outlying value of all tests shall then be excluded from the range. The maximum percentage of RAP allowable shall be the lowest percentage determined according to Table 1 below**.**

Table 1: Maximum Percent RAP According to Range in Test Results

If ranges in asphalt content and gradation are equal to or less than:						
% asphalt cement	≤ 0.65	0.66 - 0.90	0.91 - 1.00	1.01 - 1.20	1.21 - 1.30	> 1.30
% passing No 200 Sieve	≤ 5.0	5.1 - 7.0	7.1 - 7.75	7.76 - 8.0	8.1 - 8.8	> 8.8
% passing control sieves	≤ 8.0	8.1 - 13	13.1 - 18	13.1 - 18	18.1 - 20.0	> 20.0
	the maximum % RAP allowed is:					
	Max	30%	25%	20%	15%	10%

***NOTE: These allowances notwithstanding, the Contractor is required to maintain the mixture within the Mixture Control Tolerances of Section 828.**

VI.B. Limits according to viscosity

For stockpiles to be approved at a Maximum Percent Allowed ≥ 20 percent, the Department will determine the viscosity of the asphalt cement in the RAP. The percentage allowable in mix designs shall be limited to meet the design criteria for viscosity established in the Standard Specifications.

VI.C. Limits on natural sands and Group I aggregates

Natural sand and Group I aggregates in RAP contribute to the total amounts of these materials in the combined mixture. These amounts are limited by the Specifications according to the type of road in which it may be placed. The Office of Materials and Research will determine these amounts by petrographic measurements and may restrict the use of mix designs accordingly.

VII. REPLENISHMENT OF STOCKPILES

An approved RAP stockpile may, with the approval of the Department, be replenished an unlimited number of times, provided that the material for replenishment meets all requirements for approval and remains within tolerances for gradation and uniformity. The stockpile number for the replenished stockpile shall consist of the original stockpile number plus the letter R and a number to denote the number of times the stockpile has been replenished. The last four digits will indicate the year in which the replenishment is approved.

VII.A. Procedure and approval criteria

The procedure for requesting approval of a stockpile replenishment shall be the same as for approval of an original stockpile, and the material for the replenishment shall meet all criteria for approval as a new stockpile. RAP proposed for replenishment shall be sampled and tested by the Contractor for gradation and asphalt cement as prescribed in Section VI above. The Laboratory shall review these results and perform its own tests, and the largest range shall determine the Maximum Percent Allowed in future mix designs, according to the Table 1 above.

VII.B. Effect of replenishment on existing approved mix designs

Replenishment of a stockpile may render certain mix designs invalid, depending on the percent RAP required in the design and on the difference in average gradation between the old and new stockpiles. A replenished stockpile may be used as the RAP ingredient in an existing approved design provided that:

1. The amount of natural sand in the replenishment stockpile does not cause the design to exceed specified limits. Note: An increase in Group I material present may further restrict the use of designs for surface mixes.

2. the Maximum Percent Allowed for the replenishment stockpile equals or exceeds the percent RAP called for in the mix design. In no case may the Maximum Percent Allowed be exceeded.

However, if a mix design calls for up to 5.0 percent more than the Maximum Percent Allowed for the replenishment, the *design* may be adjusted, with approval, to use the lower percent allowed, provided that the production mixture continues to meet all acceptance criteria. For example, a design which calls for 20 percent RAP may be adjusted and produced with 15 percent if it continues to meet for acceptance.

c. the difference between the new RAP gradation and the RAP gradation of the design does not change the combined gradation of the design by more than the following limits, where **F** is the RAP fraction of the existing design, expressed in hundredths:

F times the difference on the No. 8 sieve shall not exceed <u>2.0 percent</u>, and
F times the difference on the other control sieves shall not exceed <u>2.5 percent</u>.

Example: A particular design includes 20% RAP, and the replenished stockpile is 9.0 % finer (or coarser) on the No. 8 sieve than the RAP gradation of the design. Then, $0.20 \times 9.0\ \% = 1.8\%$, and the design remains valid.

If, upon replenishment, an existing approved mix design becomes invalid under the above provisions, it may be re-designed and submitted for approval by an approved laboratory using the allowed percentage and gradation of the replenished material in place of the previous percentage and gradation. The re-design shall be based on a minimum of two checkpoints. However, if the maximum percentage of RAP allowed has been reduced by fifteen percent or more, a complete new design shall be required.

VIII. CONTINUAL REPLENISHMENT WITHOUT RE-APPROVAL

At the request of the contractor, a previously approved stockpile may be placed in Continual Replenishment Status and may be replenished any number of times without re-approval provided that:

a. The contractor shall continue to monitor and test the materials added to the stockpile and shall forward these results to the State Asphalt Design Engineer for every 1000 tons of RAP added to the stockpile.

b. The Contractor shall certify that the replenishment material will not contain heterogeneous plant waste or contaminants.

c. The Department shall be notified by letter to the State Bituminous Construction Engineer that the stockpile is being replenished on a continual basis. A stockpile in Continuous Replenishment status may not revert to its previous status.

d. The amounts of local sand and Group I aggregate in all mixtures shall remain within specified limits. Mix designs containing both RAP and local sand as ingredients will be invalidated if the total sand content exceeds 20.0 percent. Mixtures containing local sand are not permitted on the traveled way of the mainline or ramps of the Interstate System.

e. The Maximum Percent Allowed (defined in F above) shall be limited to 10.0, 15.0, or 30.0 percent of the total mix, according to the category of continual replenishment that applies, defined as follows:

(1) Ten percent status. The maximum for stockpiles tested and approved at 10.0 percent shall remain at that limit, and mix designs based on a previous higher limit become invalid. However, a *mix design* which calls for up to 5.0 percent more than the percent allowed (15.0 percent or 10.0 percent, as applicable) may, with approval, be adjusted and produced with the lower percent allowed, provided that the production mixture continues to meet all acceptance criteria.

(2) Fifteen percent status. A stockpile tested and approved at 15.0 percent or more may be placed in continual replenishment status at this limit and may not be used in existing mix designs requiring more than fifteen percent RAP, except as provided in (a) above.

(3) Special Replenishment status. A stockpile tested and approved at ≤ 30 percent may be placed in Special Replenishment status subject to the following conditions: (1) The contractor agrees to test each 1,000 ton increment of RAP to be added and to FAX all test results to the Department on a timely basis. The Department will maintain a history of these results on an electronic spreadsheet. (2) Opposite quarters of samples representing every 5,000 tons tested shall be delivered to the Department along with each test result. (3) the RAP stockpile and all replenishment material shall be processed and managed according to recognized industry standards and best practices.

Note: One 20 pound sample bag of RAP for each Continual Replenishment Stockpile shall be submitted to the Central Laboratory at The Office of Materials and Research for petrographic analyses every six months.

The Department may inspect, sample, and test such stockpiles at its discretion and may, upon determining that the stockpile is unsuitable, withdraw approval of the material and all mix designs which include it. Approval of the stockpile may be withdrawn at any time based upon extreme or erratic ingredient proportions, unsuitable ingredients, or poor performance, as determined by the State Materials and Research Engineer. The Department will conduct periodic comparison testing on the opposite quarters of sample submitted by the Contractor for special replenishment approval category. The approval of the stockpile may be withdrawn if erroneous information was found on the contractor’s testing and/or improper sampling procedures were involved after a thorough investigation.

IX. DEPLETION OF STOCKPILE AND EXPIRATION OF APPROVAL

When a stockpile has been fully depleted, the Contractor may replenish it within 24 months after the date of depletion; a depleted stockpile not replenished after 24 months will be removed from the approved list and may not be replenished.

Approval of a stockpile may be withdrawn if, in the finding of the State Materials and Research Engineer, the total amount of material used in new mixtures equals the total tonnage of the original stockpile plus all approved replenishments. Six years from the original approval of a stockpile or from its most recent replenishment, a stockpile shall be presumed to be depleted, and its approval shall expire. This shall apply to all stockpiles, regardless of status or history of use.

X. RECORDS

The Contractor shall maintain records at the plant site on all RAP stockpiles. These records shall be available for inspection by representatives of the Department and shall include the following:

- All test results.
- The Department's approval letter for each stockpile and replenishment, together with the Contractor's requests for approval and all data submitted therewith.
- A current drawing of all stockpile locations at the plant site, including unapproved stockpiles, showing stockpile numbers of all stockpiles approved for State work.

XI. RELOCATION OF STOCKPILE

If material from an approved RAP stockpile is to be moved to another location, the contractor shall seek approval from the Department prior to its further use on State projects. A letter request shall be submitted to the Office of Materials and Research indicating the current stockpile number of the material, the total quantity of material to be moved, and the amount, if any, to remain in the current location. The Office of Materials and Research will issue an approval letter with a new stockpile number applicable to the new location and will, at the request of the contractor, revise existing designs to re-identify the stockpile at the new location. The contractor should submit with the request a list of the designs which should be revised.

____
State Materials Engineer

____
Director of Construction

CONTRACTOR'S REQUEST FOR RAP STOCKPILE APPROVAL

To: State Bituminous Construction Engineer
Office of Materials and Research
15 Kennedy Drive
Forest Park, Georgia 30297

From: ____

____

____
(Name and address of person to receive approval letter)

Date: __________________________

Subject:

____ Request for Approval of Stockpile, **or**
____ Request for Approval to Replenish Stockpile No.______________________

Approval is requested as indicated above. I certify that, to the best of my knowledge, the material conforms to the Specifications and is as represented in the information, test results, and samples submitted herewith.

Plant Number ___ Location ___________________________________ County __________________

RAP Category:

_____ Multiple sources, or

_____ Single known pavement source. Show route, project number, and project limits:

____

____

Quantity:

Quantity of material _________ tons, based on ___ estimate ___ survey ___ project records __ other

Replenishment status:

We request continual replenishment status in (check one if applicable): ___15% status ; Special replenishment status.
Name and signature of authorized representative of firm:

____

____

Sworn and subscribed before me this_____day of ___________________, year_________

Notary Public and seal ____

Enclosures: Test results
Map of stockpile areas

Georgia Department of Transportation
Office of Materials and Testing

Standard Operating Procedure (SOP) 46

Procedure for Calculating Pay Reduction for Failing Roadway and Bridge Approach Smoothness

I. General

It is the responsibility of the Bituminous Construction Branch of the Office of Materials and Testing to monitor the quality of all Bituminous Materials used and placed on asphaltic concrete constructed roadways on Georgia Department of Transportation (GDOT) projects. All on-system roadway and resurfacing bridge approach projects establish specified smoothness requirements in Section 400.3.06.C. In accordance with Section 400.3.06.C.4, *"when recommended by the Office of Materials and Testing, a pay reduction may be accepted in lieu of correction for roadways and bridge approaches that fail to achieve specified smoothness indexes. The Office of Materials and Testing may recommend a waiver of profile smoothness requirements when improvement over pre-construction smoothness profile exceeds 25 percent for urban roadways, as defined in Table 9, and 15 percent for bridge approaches"*.

Standard Operating Procedure 46 exists to reference the procedure used by the Bituminous Branch of the Office of Materials and Testing to determine all asphaltic concrete related roadway and resurfacing bridge approaches pay factor reductions for smoothness related failures. Under no circumstances shall roadways or bridge approaches receiving greater than a 0.25 pay factor reduction meet the criteria for a recommended pay reduction. In these circumstances corrective work, up to and including removal and replacement, will be required to improve the smoothness for the failing sections. Additionally, in accordance with Section 400.3.06.C.3.b, correct individual bumps or depression exceeding 1/8 in. in 10 ft (3 mm in 3 m) straightedge requirement as directed by the Engineer. Please note that the Office of Materials and Testing may recommend a waiver for specified smoothness requirements when pre-construction smoothness testing indicate that improvement necessary to meet specified requirements is not possible under the work as Let.

II. Specified Smoothness Requirements Section 400.3.06.C For Roadways

Table 1 — Pavement Smoothness Target Requirement

Construction Description	Smoothness Index
All Asphaltic Concrete OGFC and PEM on interstate including resurfacing and new construction. Asphaltic Concrete OGFC and PEM placed on state routes as new construction.	750
Asphaltic Concrete SMA or dense-graded surface mixtures placed directly beneath the Asphaltic Concrete OGFC or PEM on interstates. Asphaltic Concrete OGFC and PEM placed on state routes as resurfacing. All new construction on state routes with exception of OGFC and PEM as stated above.	825
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	900
All Urban new construction and resurfacing on state routes within curb and gutter sections located in posted 35 miles per hour (MPH) or less speed zones.	1175

Table 2 — Pavement Smoothness Corrective Work Requirement

Construction Description	Smoothness Index
All Asphaltic Concrete OGFC and PEM placed on interstate including resurfacing and new construction. Asphaltic Concrete OGFC and PEM placed on state routes as new construction.	825
Asphaltic Concrete SMA or dense-graded surface mixtures placed directly beneath the Asphaltic Concrete OGFC or PEM on interstates. Asphaltic Concrete OGFC and PEM placed on state routes as resurfacing. All new construction on state routes with exception of OGFC and PEM as stated above.	900
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	1025
All Urban new construction and resurfacing on state routes within curb and gutter sections located in posted 35 miles per hour (MPH) or less speed zones.	1250

A. Method of Calculating Pay Reduction For Roadway Smoothness Pay Factor Reduction

An applied pay factor reduction will be determined by calculating a percentage using the specified corrective work required smoothness requirement and the actual smoothness that is then subtracted from the 1.0 pay quantity. This calculation will be provided for each failing mile section. The overall project smoothness will not be used. The contract unit price per ton for the surface mix will be used to determine a cost per square yard and the calculated pay factor reduction will be applied to the square yards in the failing mile section(s). Table 3 displays examples of applied pay factor reductions for various failing sections.

Table 3 –Roadway Smoothness Pay Reduction Calculation Example

MP From	MP To	Correct. Smoothness	Actual Smoothness	Pay factor	$ Per Ton	Spread Rate	SY cost	Linear Distrace	Width	SY mix	Pay for mix	Reduction Pay
A	B	C	D	E	F	G	H	I	J	K	L	M
				1-(C/D)				|A-B|*5280		(I*J)/9	(H*K)	(E*L)
1	2.25	1025	1125	0.089	$77.25	165	$6.37	6600.00	12.00	8800.00	$56,056.00	$4,988.98
2	3	1025	1275	0.196	$81.25	135	$5.48	5280.00	12.00	7040.00	$38,579.20	$7,561.52
1	2	1025	1026	0.001	$82.00	135	$5.54	5280.00	12.00	7040.00	$39,001.60	$39.00
1	2	1250	1350	0.074	$68.52	165	$5.65	5280.00	12.00	7040.00	$39,776.00	$2,943.42
2	3	1025	1375	0.255	$71.50	165	$5.90	5280.00	12.00	7040.00	$41,536.00	*
* Corrective Work Requried Without Waiver Recommendation												

III. Specified Smoothness Requirements Section 400.3.06.C For Bridge Approaches (Resurfacing Projects)

For Resurfacing Projects:

a. The Department will determine a profile index value using the laser road profiler in accordance with test method GDT 126.

b. The Department will determine the Half Car Simulation (HCS) IRI for each HMA asphalt 1/10th of mile (0.16 km) segments adjacent to each bridge joint for each lane. The HCS IRI will be reported in 1/20th of mile (0.08 km) segment readings in accordance with GDT 126.

- **Keep the Target profile index value under 825 mm/km and correct profile locations exceeding 900 mm/km using the Laser Road Profiler. Correct individual bumps or depression exceeding 1/8 inch in 10 ft (3 mm in 3 m) straightedge requirement as directed by the Engineer.**

c. Ensure Resurfacing projects meet the profile index value for the specified 1/10th mile (0.16 km) segment of roadway up to the bridge joint.

B. **Method of Calculating Pay Reduction For Bridge Approach Smoothness (Resurfacing Projects) Pay Factor Reduction**

An applied pay factor reduction will be determined by calculating a percentage using the specified corrective work required smoothness requirement and the actual smoothness that is then subtracted from the 1.0 pay quantity with an additional 2.5 times the pay factor reduction. This calculation will be provided for each failing bridge approach. The contract unit price per ton for the surface mix will be used to determine a cost per square yard and the calculated pay factor reduction will be applied to the square yards in the failing bridge approach section(s). Table 3 displays examples of applied pay factor reductions for various failing bridge approaches.

Table 4 – Bridge Approach Smoothness Pay Reduction (Resurfacing Project) Calculation Example

BA/BE	BE/BA	Correction Smoothness	Actual Smoothness	Pay factor	$ Per Ton	Spread Rate	SY cost	Linear Distrace	Width	SY mix	Pay for mix	Reduction Pay
A	B	C	D	E	F	G	H	I	J	K	L	M
				1-(C/D)				|A-B|*5280		(I*J)/9	(H*K)	(E*L)*2.5
0	0.1	900	950	0.053	77.25	165	$6.37	528	12	704	$4,484.48	$594.19
0	0.1	900	1060	0.151	81.25	135	$5.48	528	12	704	$3,857.92	$1,456.36
0.1	0	900	1175	0.234	82	135	$5.54	528	12	704	$3,900.16	$2,281.59
0.1	0	900	1225	0.265	68.52	165	$5.65	528	12	704	$3,977.60	*
* Corrective Work Required Without Waiver Recommendation												

IV Report

The Office of Materials and Testing will provide a letter of recommendation to the District Engineer to include a pay factor reduction cost or specified smoothness waiver for all failing smoothness projects. The Director of Construction, State Construction Engineer, Area Engineer and OMAT's Material Audits Unit will be copied all letters of recommendation.

____

State Materials Engineer

____

Director of Construction

Appendix C - Sampling Procedures

GSP 02

Back to Table of Contents

General Description

Use this procedure to sample coarse and fine aggregates.

Obtain samples at the frequencies listed in the Sampling, Testing, and Inspection Manual. Samples from multiple points must be combined into a composite sample. If necessary, reduce composite samples in accordance with AASHTO T-248. Acquire a minimum sample weight of 45 lbs (20 kg) for coarse aggregate and 20 lbs (10 kg) for fine aggregate. Use a square pointed shovel unless otherwise noted. Obtain samples according to the procedures outlined below.

1. **Conveyor Belts**

   Obtain a minimum of three cuts from stopped conveyors that are being used to off load railcars or from conveyors that are being charged by a front-end loader or truck. Obtain the samples a minimum of 15 ft (5 m) apart and combine them to produce a composite sample. Start and stop short conveyors as necessary to insure that the three cuts are a minimum of 15 ft (3 m) apart. Sample the conveyor belt between support rollers where possible.

   Obtain one cross sectional cut from other stopped conveyors, such as at aggregate production plants, etc.

   a. Stationary Level Belts

      Remove all material from each of the cross sectional cuts.

   b. Stationary Inclined Belts

      Remove and discard all material in a cross sectional cut to create a clear opening on the belt. Sample material from the down-slope side including all fines. Discard any particles that roll from the upper portion of the belt.

   c. Moving Belts

      Use a coal scuttle bucket or an approved alternate. Obtain the sample by swiping the bucket from one side to the other (perpendicular to the direction of the belt, not front to back) through the entire flow of material being discharged from the belt without slowing down, stopping or overfilling the container.

2. **Individual Trucks and Individual Railcars** (Figure 1)

   Do not disturb material before sampling. Push shovel straight in at 90° and as far as it will go. Remove shovel carefully to minimize spilling.

   Sample in a direction approximately 45° from one corner diagonally across to the opposite corner at the following points:

   at one-third the way between a front corner and the top;

   at the top of the pile just away from extremely fine material;

   at one-third the way between the bottom of the opposite corner and the top.

   Combine to produce a composite sample.

3. **Single Lift Stockpiles Consisting of Multiple Truck Dumps** (Figure 2)

   Use this procedure for sampling surface treatment stone stockpiled on a project, for instance. Use the same procedure as above for individual truck dumps, except that each sampling point is on a separate truck dump.

4. Multiple (or Single) Lift Stockpiles of Graded Aggregate Base (Figures 3 and 4)

Sample from an active loading face using the back drag method.

Create a loading face if there is not one by removing enough material to cause the entire face to slough.

Use a front end loader and remove three loader buckets of material. Dump them on top of each other.

Back drag material with the loader to approximately 12-24 inches (300 - 600 mm) in height.

Sample the back third of the back drag at three locations across its width equidistant from each other and combine to produce a composite sample.

Avoid sampling in loader tracks.

5. Conical Shaped Stockpiles

a. Concrete Sand (Figure 5)

Sample at equal points around the cone at a point that is approximately one-half the height of the stockpile and combine to produce a composite sample.

b. All Other Materials

Restock from conical shaped stockpiles before they are used or sampled.

6. All Other Aggregates (including stockpiles at concrete plants) (Figure 6)

This procedure may include single and multiple lift stockpiles.

Sample directly from the slough area at an active loading face.

Sample in a diagonal direction, approximately 45°from the bottom to the top of the slough.

Sample three points that are approximately equidistant from each other and the bottom and top edges of the slough and combine to produce a composite sample.

The sample area should be no more than two times the width of the loader bucket.

Sample concrete sand with a sampling tube that has a diameter of 2 to 3½ inches (50 to 89 mm) and a minimum length of 2½ ft (762 mm).

7. Sampling Graded Aggregate Base from the Roadway

Sample at three points across the roadway equidistant from each other and combine to produce a composite sample. Narrow lanes and/or shoulders may be sampled parallel to the lane, preferably in the center.

Extract material to full depth of the lift being sampled. Extract in a manner that will leave the sides of the holes straight edged and at approximately a 90° angle to the underlying subgrade. If necessary, reduce material to sample size (See AASHTO T-248, Method B).

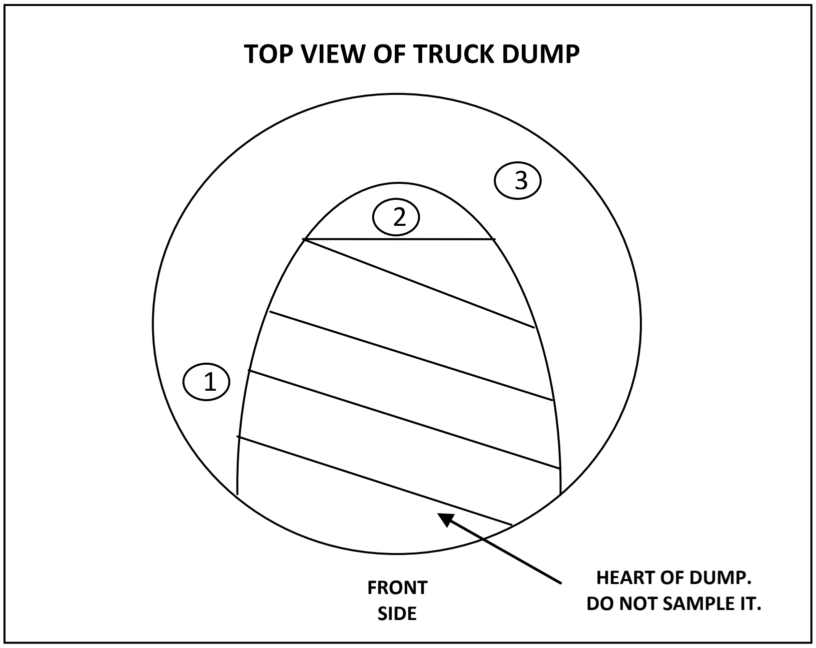


Figure 1: Top view of a single truck dump. Circled numbers indicate proper sampling points to combine for a composite sample.

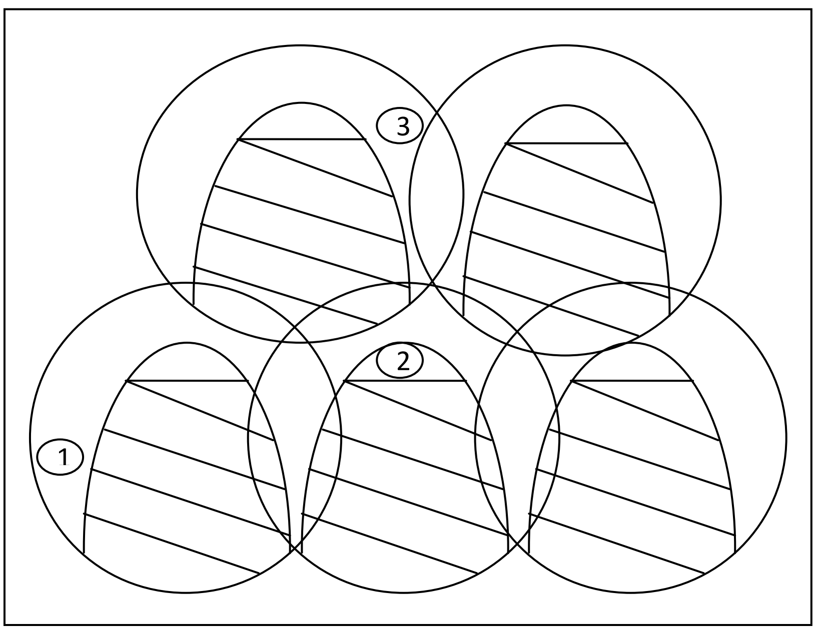


Figure 2: One set of possible sampling points on a stockpile consisting of multiple truck dumps. Sample at three points on the stockpile to represent the sampling points shown on Figure 1.

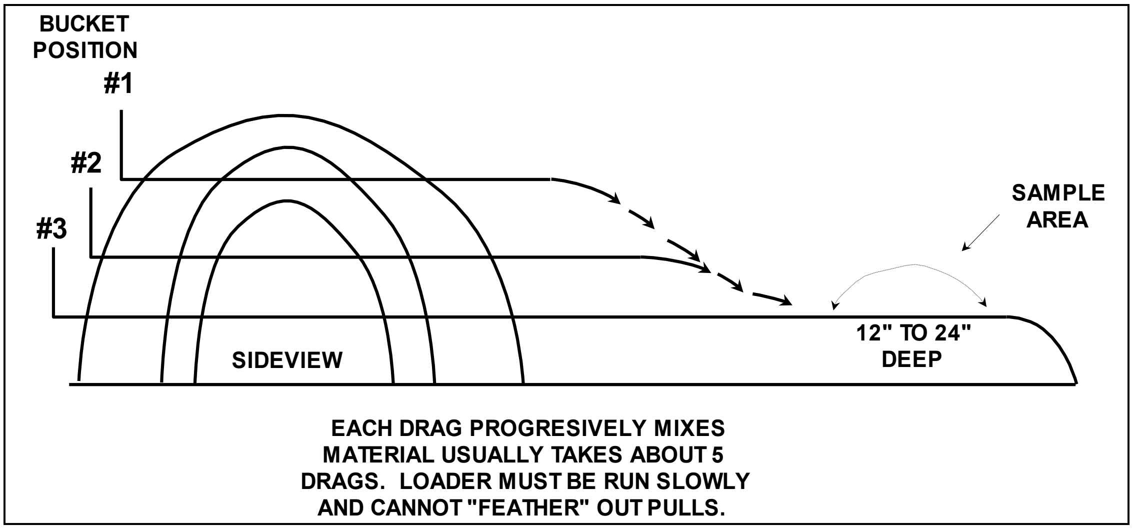


Figure 3: Side view of proper preparation of graded aggregate base for back drag sample.

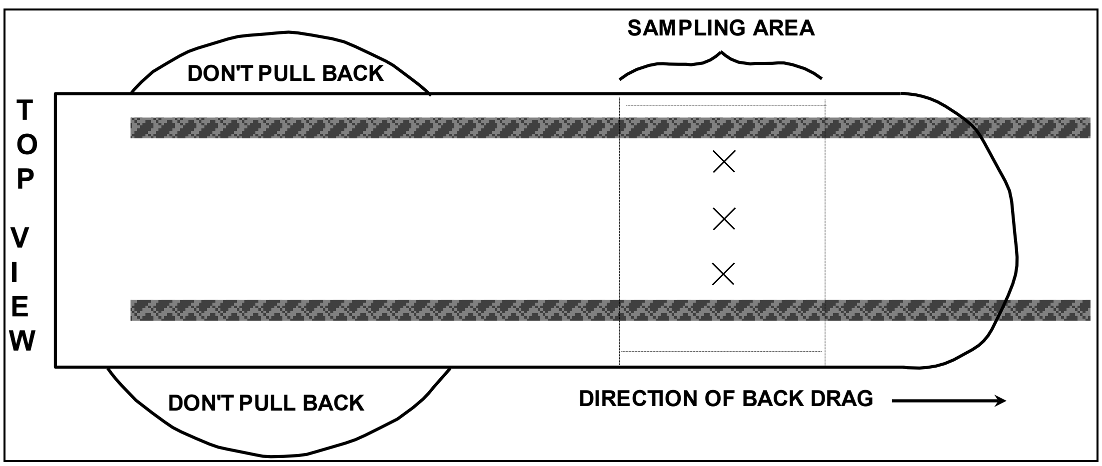


Figure 4: Sampling points for graded aggregate base back drag sample.

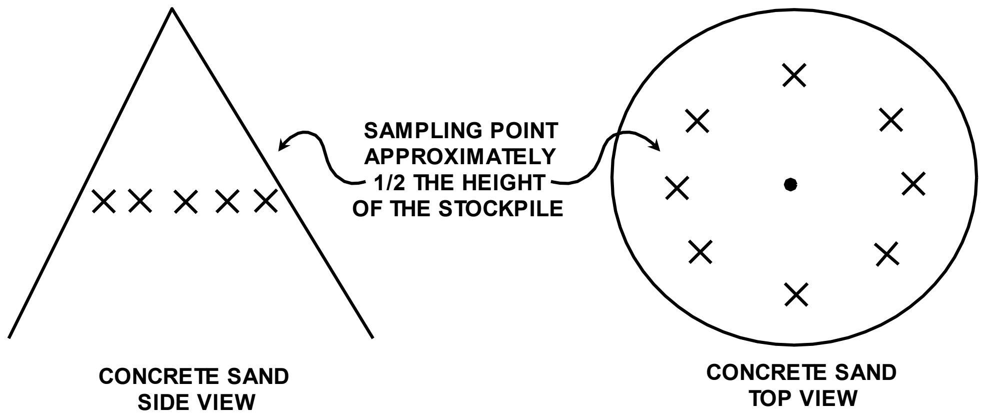


Figure 5: Sampling points around a cone of concrete sand.

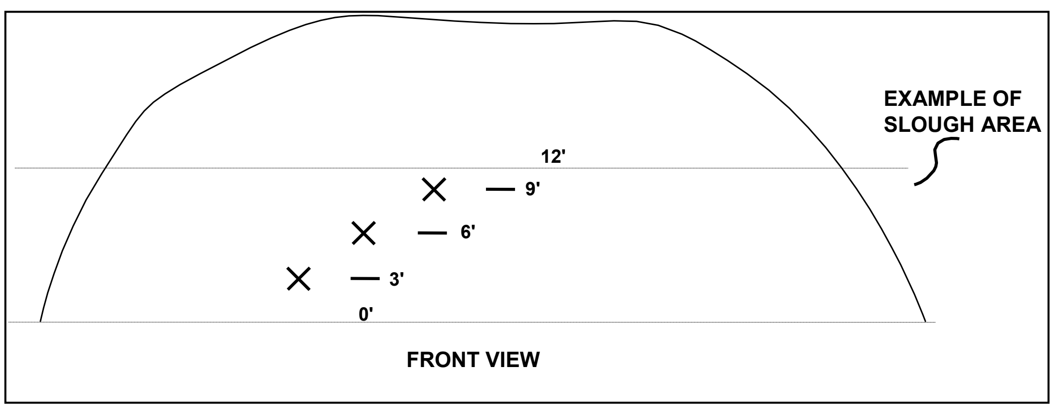


Figure 6: X's indicate sampling points in the slough area of a stockpile loading face.indicate sampling points in the slough area of a stockpile loading face.

GSP 10

General Description

Use this procedure to sample bituminous materials.

Suppliers of bituminous materials to be used on highway projects are required to comply with the Standard Operating Procedure for Monitoring the Quality of Bituminous Material (SOP 4), and shall be an approved supplier listed on the Qualified Products List (QPL-7).

The Office of Materials and Testing maintains the list of approved sources of bituminous materials, stating the full name of each organization, the types and grades of their approved products, and the locations of their refineries or terminals.

1. Obtain General Information
   a. Confirm that the bituminous material is from an approved supplier listed on QPL-7.
   b. Identify samples by date, source, source code number, grade, tank or distributor number, and type of sample (Log Code).

NOTE: If you see questionable material, regardless of its source, test it first. Do not use the material until you receive satisfactory test results from the Office of Materials and Testing.

2. Obtain Bituminous Samples
   - Performance Graded Asphalt Binder – Obtain 2 samples in 1 qt (or 1 L) cans at the terminal, refinery or project distributor.
     - Performance Graded Asphalt Binder (Assurance Testing at Asphalt Plant) – Obtain 2 samples in 1 pint (0.5 L) cans
   - Cutback Asphalt – Obtain 2 samples in 1 qt (or 1 L) cans at the manufacturer's facility or project distributor.
   - Emulsified Asphalt – Obtain 2 samples in plastic 1 gallon (4 L) containers with plastic or plastic lined lids at the manufacturer's facility or project distributor. Electrical tape should be applied around the lid of the plastic gallon containers.

   Visually check for contamination prior to sampling whenever possible.

   a. Bituminous materials may be sampled from these locations:
      - The sampling valve on tankers, distributors, or storage tanks
      - The railcar, tank or tanker (in absence of a sampling valve)
      - NEVER SAMPLE BITUMINOUS MATERIAL FROM THE DISTRIBUTOR SPRAYBAR OR SPRAY NOZZLE!

   NOTE: Report missing sampling valves at the terminal or refinery to the Bituminous Control Engineer. Missing or nonfunctioning sampling valves at the asphalt plant or on a distributor should be reported to the Bituminous Technical Services Manager.

   b. Observe these and other safety precautions when handling bituminous materials:

1) Wear gloves, face shield or safety glasses, and a long-sleeve shirt or other protective clothing while sampling material and sealing the containers.
2) Do not smoke while sampling.
3) Do not hold the container in your hand while sampling and sealing. Use tongs or some other device to hold the container.
4) Stand above and away from the material being sampled and on the windward side. Never stand in front of the sampling valve.
5) Take the sample slowly to prevent splashing.
6) Let at least one gallon (four liters) of material run from the valve prior to obtaining the sample at the terminal, refinery or point of manufacture. When sampling at the asphalt plant, obtain samples from the AC storage tank sample valve after allowing approximately two (2) quarts to run off. When sampling from distributor sample valve let 2 quarts run off for AC and 1 gallon for emulsion prior to obtaining sample.This helps purge the sample line.

NOTE: Beware of a sudden pressure surge from a partially clogged valve.

7) Let the flow stabilize. Fill the container close to the top to minimize air space.
8) Take two samples every time, regardless of the location from which you are sampling.
9) Submit both properly identified samples for testing. (If the first sample fails, the second sample will be tested as a retained sample.)

c. Follow these precautions during sampling to avoid contamination:

1) Ensure sample containers are clean and dry.
   a) Do not wash or rinse the containers before use.
   b) Ensure the top and container fit tightly together.
   c) Obtain emulsion samples in 1 gallon plastic containers. Never place emulsion samples into metal containers, or use unlined metal lids.
2) Ensure no contaminants enter the samples from a different type or grade of bituminous material or cleaning agent. Never wipe the outside of the sample container with a solvent-saturated cloth.

NOTE: Only a drop or two of any kind of fuel will contaminate the asphalt.

3) Examine the hauler's Bill of Lading to determine the type of material hauled on the previous load. Sample with caution when the previous load was a different type of material.
4) Examine the Bill or Bills of Lading to determine the supplier's name and the grade of materials sampled. If the last few shipments were from different suppliers (or grades), note the date, supplier name, and grade of the most recent three or four shipments on the sample card.
5) Always sample the material or observe it being sampled.
6) Take samples to the Laboratory as soon as possible.

d. To take a sample from the sampling valve:

1) Circulate the bituminous material to obtain thorough mixing.
2) Open the valve until a steady small flow stabilizes. Allow bituminous material to flow though the sampling valuve as detailed in sub-section 2.b.6 prior to obtaining the sample.

3) If needed, use a small funnel to direct the flow into the container and fill it.
4) Tightly seal the sample.
5) Wipe off spilled material from the outside of the container with a clean, dry cloth.

e. To take a sample from a railcar, or storage tank or tanker without a sample valve:

1) Vigorously stir the material with a clean paddle or stick to disperse any contaminants on the surface when mechanical agitation is not available.
2) Attach a clean can, bucket, or other suitable container to a stick, plank, or other type of handle.
3) Rapidly submerge the container into the bituminous material until the container is full.
4) Immediately transfer the material to the sample container and seal it.

f. Identify each control sample on Form 170 or other form if appropriate.

g. Submit the sample to the Office of Materials and Testing's Central Laboratory or Branch Laboratory designated by the Bituminous Control Section.

h. Test results will be reported on the following forms:

- Form 504M—Performance Graded Asphalt Binder
- Form 503M—Cutback Asphalt
- Form 325M—Emulsified Asphalt

GSP 15

Back to Table of Contents

A. General Description

Use this procedure to sample hot mix asphalt concrete mixtures from full trucks, roadways, or, occasionally, partially loaded trucks. You may also use this sampling procedure for sand asphalt base or surface courses.

NOTE: When sampling hot mix asphalt concrete mixtures, ensure that the samples accurately represent the materials being produced.

1. Sampling

To take sample from trucks:

a. Prepare a sampling area in the truck by shoveling off the cone of the material until you create a flat area at least 60 percent of the width of the truck and at least 6 in (150 mm) deep.
   1) Take samples with a square-nosed shovel.
   2) If the truck contains more than one cone, take samples from different cones. For example, take the first sample from the first cone, the second sample from the second cone, etc.
b. Take a sample from the full width of the flattened area so that the sample will weigh 25 to 30 lbs (11.34 to 13.6 kg) (about 3 or 4 shovels-full of material). Take the sample from a uniform depth at approximately a minimum depth of 3 times the nominal particle size for the type mix being sampled, striking off a vertical face for each shovel of material obtained for testing.
c. Place all the material into a bucket lined with a sample bag. Taking care to place the 3 or 4 shovels full of material in the bucket lined with a sample bag one on top of the other.
d. If you need to take second or third samples, use the same procedures to take them from the areas immediately adjacent to the original sampling area.

To take samples from the roadway:

e. Divide the roadway spreader width into 3 sections.
f. Wait until approximately 1/2 of the load has been dumped from the truck.
g. Use a square-nosed shovel to take a 25 to 30 lb (11.34 to 13.6kg) sample from each section.
1) Remove material for the total depth of the pavement course.
2) Place all the material in a sample bag or bucket lined with a sample bag.

2. Quartering (See description below)

a. **Transport the sample to the quartering table.** In one swift motion, invert the bucket and/or bag on the center of the table. Remove the bag and/or bucket straight up in a manner to leave the composite sample in a symmetrical, cone-shaped pile in the center of the table.
b. **Sampling stands with the quartering table attached** requires the sample taken to be placed in a container/bucket lined with a cloth bag and placed onto the quartering table, ***do not take the sample from the haul vehicle and place it directly onto the quartering table with the shovel.***
c. **Quarter with a quartering device.** With a vertical motion, insert the device straight down into the pile with very slight twisting movement on the vertical axis of the quartering device until the device is firmly resting on the table with no large particles under the device.
d. **First Quarter:** Remove opposite quarters from the table and retain in a suitable container.
e. **Second Quarter:** Quarter again to split the remaining undisturbed quarters.
f. All material removed from the first and second “reducing quarters” should be retained as referee sample material as prescribed in GSP-21.
g. **Third Quarter:** Quarter the remaining undisturbed quarters. Two opposing sections of the pile are combined to serve as the test specimen, while the remaining opposite quarters are labeled and retained as a Comparison Sample in accordance with GSP-21.

NOTE: Care should be taken each time the sample is "quartered" to ensure that each fraction of the sample is relatively the same size as its counterpart. (Final Results: Sample size should be within the minimum and maximum sample weight of the mix being produced.) The sample should not be mixed once it is placed on the table. If any discrepancies in sampling are noted, notify the TMOS for instruction.

h. Ensure that the mix weight meet the minimum and maximum sample weight requirement:

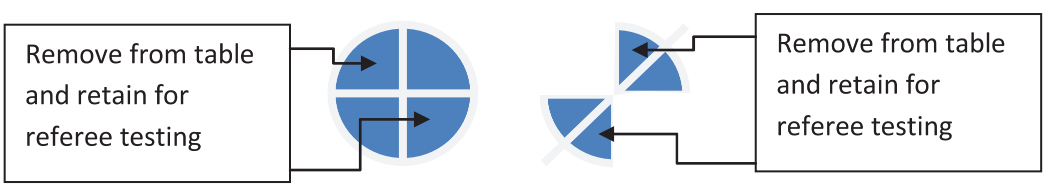
Table A

Superpave Mix	Min. Sample Weight lbs (g)	Max. Sample Weight lbs (g)
25 mm Superpave	5.5 (2500)	7.7 (3500)
19 mm Superpave	4.4 (2000)	6.6 (3000)
12.5 mm Superpave	3.3 (1500)	5.5 (2500)
9.5 mm Superpave	2.6 (1200)	4.9 (2200)
4.75 mm Mix	2.2 (1000)	4.4 (2000)
9.5 mm OGFC	2.2 (1000)	4.4 (2000)
12.5 mm OGFC	2.6 (1200)	4.9 (2200)
12.5 mm PEM	2.6 (1200)	4.9 (2200)
19 mm SMA	4.4 (2000)	6.6 (3000)
12.5 mm SMA	3.3 (1500)	5.5 (2500)
9.5 mm SMA	2.6 (1200)	4.9 (2200)

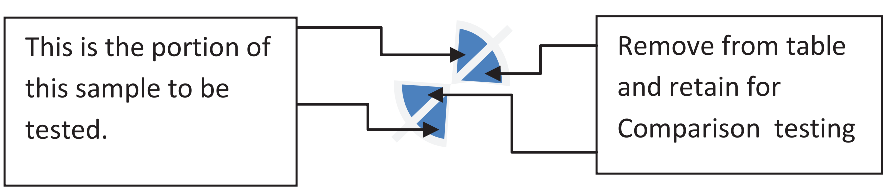
__Quartering method__

First Quarter

Second Quarter



Final Quarter



If you cut a core on in-place material for your sample of asphaltic concrete mixtures, ensure the cores meet the minimum and maximum size requirements In Table A, GDT 125 and GDT 83.

Take all samples of Asphaltic Concrete “OGFC or PEM” mixtures from trucks at the plant as soon after loading as possible, using the following procedure:

a. Take samples with a preheated scoop (place the scoop in the hot mixture to preheat).

b. Prepare a sampling area in the truck by shoveling off the cone of material until you create a flat area at least 60 percent of the width of the truck and at least 6 in (150 mm) deep.

c. Scoop a sample by starting at one side of the prepared area and moving horizontally across the area until you get a sample between 2.2 and 4.4 lbs (1000 - 2000g) for 9.5mm OGFC, 2.6 and 4.9 lbs (1200 - 2200g) for 12.5mm OGFC or PEM.

NOTE: Do not quarter OGFC or PEM samples.

d. Place the Asphaltic Concrete “OGFC or PEM” sample in a hot melt box (hot or cooled) or in a cloth or plastic bag once material has cooled.

e. Send the sample to the Office of Materials and Research for analysis.

Revised: October 3, 2019

GSP 21

A. General Description

This procedure governs the sampling procedures for contractor acceptance testing of hot mix asphaltic concrete.

The sampling testing, and inspection duties described herein are to be performed by a Georgia Department of Transportation Certified Contractor QCT.

1 Notification

It is the responsibility of the asphaltic concrete mix producer, when they are also the contractor, to notify the Office of Materials and Testing their intent to produce mixture for the Georgia Department of Transportation. Quality Control Testing Technicians shall inform the District Testing Management Laboratory in which the material is being produced, by email, each day of GDOT funded production within 2 hours after shipping the first load of mix. Please include the Plant ID number, Project number, County and mix type(s). In the event the producer is not the contractor, the producer shall submit the Plant ID number, the mix type(s) and the Project number and County provided by the contractor within 2 hours after shipping the first load of mix. Emails for each District Testing Management Laboratory is as follows:

District Laboratory	Email Address
1	OMATD1Lab@dot.ga.gov
2	OMATD2Lab@dot.ga.gov
3	OMATD3Lab@dot.ga.gov
4	OMATD4Lab@dot.ga.gov
5	OMATD5Lab@dot.ga.gov
6	OMATD6Lab@dot.ga.gov
7	OMATFPLab@dot.ga.gov

In the rare event where internet connection is lost, the asphaltic concrete mix producer shall notify the District TMOS by telephone within the 2 hour deadline and follow up with the required email notification once internet connection is reestablished. Telephone notification is not acceptable under any other circumstances.

2. Sampling

a. Randomly select samples from within Sublots of 500 tons (or 500 Mg) per mix type. Use the same procedure in situations where more than one mix is produced or mix is produced for different projects within the same working day.

b. An Acceptance Lot consists of the amount of each type of asphaltic concrete mixture produced and placed in one construction day or at least 500 tons (or 500 Mg). If less than 500 tons (or 500 Mg) is produced per mixture type, it may be incorporated into the next day's production for Lot determination. In this case, use the same mix-sampling schedule as if the mix had been produced all in one operation. For higher production projects with extended paving shifts, Lots may be closed at 2,000 tons at the contractors' request. Prior to mix production, the Contractor may request to separate and maintain Lots of the same mix type when producing and placing mix in separate operations such as one Lot for mainline and another for shoulder mix under guardrail. Lots will not be separated after the production and placement of mix; this request must be submitted prior to mix production. The State Materials Engineer may waive this requirement under extenuating circumstances.

c. A Lot containing less than 500 tons may be closed when a pay reduction is imminent due to Quality Acceptance Sample test results when approved by the District Testing Management Operations Supervisor and the Area Bituminous Technical Services Specialist.

d. Sample the mix from the truck or roadway and quarter it according to GSP 15. The appropriate sample size required is prescribed in GDT 83 or GDT 125. When roadway cores are to be obtained or required for mix acceptance samples, take these cores according to GDT 73. The coring operation will be supervised by a GDOT representative.

a. If the size of both the opposite quarters obtained fails to meet specified size requirements, the next available truck should be sampled, with care taken to obtain a sample that meets the minimum size required for both opposite quarters. It should be documented in the plant diary as to why the random load was not sampled. During the quartering process of Hot Mix samples, the opposite quarters from the acceptance test specimen shall be labeled by the QCT and retained in accordance with Section 400.3.06.A and this GSP. In addition, label the remaining material removed from the total sample and retain for possible Referee testing by the Department. All samples are to be made accessible any time the asphaltic concrete producer is producing material for the Department. In the event the asphaltic concrete producer is not producing material and the plant and laboratory facilities are closed, the Department may request and shall be provided access to these samples at a coordinated time within 48 hours. The samples shall be retained for an additional five (5) days upon request for access to the samples. A worksheet or paper with the SiteManager sample number should be placed with the sample. If SiteManager is not accessible at the time the sample(s) is taken, contact the District TMOS for guidance on how to proceed in documenting the required sample(s).

References: GSP 15 (Sampling Procedures For Asphalt Concrete Mixtures)
GDT 73 (Method of Random Selection And Acceptance Testing of Asphaltic Concrete).
DOT 163 (Asphaltic Concrete Plant Sampling Report).
Sampling Report and Random Number Selection Examples.
Subsection 400.3.06

Note 1: All asphaltic concrete hot mix samples obtained by QCT's for Comparison and Referee testing shall be placed in a hot melt box (hot or cooled), or samples may be placed in a cloth or plastic bag after material has cooled. These sampling methods will help to eliminate the loss of liquid Asphalt Cement. (Do not use metal cans or place hot material in cloth or plastic bags when sampling asphaltic concrete mixes.)

Note 2: OGFC and PEM Acceptance Samples are obtained using preheated scoops in accordance with GSP 15. An additional sample shall be obtained and retained as the Opposite Quarter. For PEM, OGFC and thin lift courses < 110 lbs/yd^2, the retained opposite quarter shall be used for reevaluation when a reevaluation is requested by the Contractor.

Note 3: It will be the responsibility of the QCT Manager or QCT Technician to inform the Testing Management Operations Supervisor and Technical Service Specialist 24 hours prior to starting production if plant operations have been discontinued for more than seven calendar days.

3. Mixture Temperature

a. Take the mix temperature when extractions are obtained and also at other times as necessary to maintain uniform and specification temperatures. If problems exist, take one per load until problem has been corrected. Take the temperature on OGFC and PEM mixes at a frequency of at least one per hour.

b. The QCT shall take the temperature of the mixture and record the results on the load ticket each time a sample is taken. The respective load tickets shall also be signed by the QCT for each load from which a sample or temperature check is taken.

c. Perform asphalt thermometer calibration at least once per week or at increased intervals as necessary to assure accuracy. Document calibrations in the plant diary.

Temperature Tolerance = ± 20 °F (± 11 °C) of the Job Mix Formula (JMF).

Reference: Subsection 400.2.01.A

4. Stripping Tests

Stripping tests will only be required on Open Graded Friction Course (OGFC) and Porous European Mix (PEM) for every sample obtained.

Reference: GDT 56 (Test Method for Heat Stable Anti-Strip Additive)

5. Extractions

a. Determine the liquid asphalt content either by the extraction or ignition method. Sieve the remaining aggregate to determine gradation.

b. Properly label the extracted aggregate, ensure that it is stored in an approved container and secured in a protected and enclosed environment and retained in accordance with Section 400.3.06.A and this GSP. All samples are to be made accessible any time the asphaltic concrete producer is producing material for the Department. In the event the asphaltic concrete producer is not producing material and the plant and laboratory facilities are closed, the Department may request and shall be provided access to these samples at a coordinated time within 48 hours. The samples shall be retained for an additional five (5) days upon request for access to the samples. If samples meet a 1.00 pay factor and are not procured by the Department within three state funded production days, they may be discarded. If there is less than a 1.00 pay factor, the sample must be saved for seven state funded production days before being discarded.

b. Perform these procedures at the prescribed frequency in accordance with GDT 83 or GDT 125, GDT 38 and Subsection 400.3.06 of the Contract. Complete acceptance test results on the same day samples are obtained and entered into SiteManager. In the event the DOT data collection system is unavailable or error messages are given, email a printout of the results to the appropriate District Mailbox given in Section 1 within one working day. If SiteManager is not accessible at the time the sample(s) is taken, contact the District TMOS for guidance on how to proceed in documenting the required sample(s).

Note 4: Any test out of Section 828 must be reported to TMOS and Bituminous TSS immediately and properly documented.

Note 5: When determining the AC content by ignition (GDT 125) the long burn ticket shall be saved in the asphalt plant's filing system by project basis.

Note 6: Perform Lift Test in accordance with Ignition Oven's Manufacturer's recommendations or at a minimum frequency of once a month (30 days) and maintain test results for a minimum of 12 months.

References: GDT 38 (Method of Test for Mechanical Analysis of Extracted Aggregate)
GDT 83 (Method of Test for Extraction of Bitumen from Paving Mixtures using the Vacuum Extractor)
GDT 125 (Method of Test for Determining AC Content by Ignition)
Subsection 400.3.06.A.3.b.3
OMR-TM-140 (Extraction Analysis Worksheet)
DOT 159-5 (Asphaltic Concrete Lot Report)
Extraction Worksheet Example
Extraction Analysis Sieve Sizes for Each Mix
Asphalt Extraction Handout

6. Lot Tonnage

Enter all information requested on the Daily Production Status Sheet on a daily basis. Give the completed sheet to the TMOS no later than two working days after the end of the respective month.

Reference: Daily Production Status Sheet.

7. Haul Vehicle Inspection

Inspect haul vehicles prior to loading for proper tarps, strapping, insulation, and holes for taking temperature. Inspect vehicle beds for evidence of diesel fuel, or un-approved releasing agent, loose, foreign material and asphalt build-up. When any of these items are found to be in noncompliance with the specifications, make corrections before haul vehicle is allowed to transport material.

References: Subsection 400.2.01.A.

8. Lime Checks

a. Make lime checks daily, during mixture production regardless of tonnage, according to lime check procedures posted at each plant for type of system. Record the calculations and test results of these in the Plant Diary. Place the percent lime on DOT 159-5.

   Tolerance: Daily plus or minus 10% of JMF requirement.

   Semi-weekly (Volumetric System)- plus or minus 10% of weighed volume of lime compared to target weight of lime.

   Semi-weekly (Weigh Pod System)- plus or minus 2% of weights.

b. Check weight systems by utilizing test weights at least twice per week (7 calendar days) or at increased intervals as needed to maintain accurate calibration. Record the results of these checks and the calculations in the plant diary.

c. Check volumetric systems by weight and record in diary at least twice per week.

d. Check lime interlock systems according to the posted procedure or once per month to insure plant operations will interrupt mixture production if hydrated lime introduction fails. Record the actual time it takes for systems to interrupt mixture production in the plant diary.

References: Subsection 400.3.02.6.c

9. Rap Requirements

c. For asphaltic concrete mix designs incorporating ≤ 35 % RAP which were approved with Hamburg Wheel Tracking Device (HWD) testing, Abson Recovery testing is not required. For asphaltic concrete mix designs not approved with HWD testing, Abson Recovery testing is required for all asphaltic concrete mixtures that contain ≥ 20% RAP. Take an Abson Recovery sample at the beginning of construction for each affected mix type. Thereafter, use a sampling frequency of one sample per seven (7) lots for verification testing by DSR for viscosity of recovered AC. The Department may take Abson Recovery Samples on asphaltic concrete mixtures for quality assurance purposes.

d. Samples may be taken at the same time extraction samples are taken from trucks. Take samples with a clean scoop, trowel, or spoon and deposit into a minimum 5 pound/maximum 10 pound (minimum 2.3 kg/maximum 4.6 kg) hot melt box. Properly close the box. Enter the sample in SiteManager and properly identify the samples and submit them along with the accompanying completed report to the appropriate DOT Lab. If SiteManager is not accessible at the time the sample(s) is taken, contact the District TMOS for guidance on how to proceed in documenting the required sample(s).

References: Section 402

10. A.C. Samples

a. Take liquid asphalt samples and submit them to the Central or Branch Lab for testing.

b. Obtain samples from the AC storage tank sample valve after allowing approximately two (2) quarts to run off. Obtain samples in two (2) 1-pint (.5 liter), tin cans. If liquid overruns can, discard and obtain another sample.

c. Frequency

- **Start-up Samples** = When plant has been down for more than seven (7) calendar days, obtain results prior to plant operation beginning.
- **Quality Assurance AC Samples Interstate projects** = Two (2) per week (seven calendar days).
- **Quality Assurance AC Samples Non-Interstate projects** = One (1) per week (seven calendar days).

References: GSP 10 **(Sampling Procedure for Bituminous Material)**

Note 7: Obtain Quality Assurance AC samples with a GDOT Representative present. All samples shall be entered into SiteManager before being dropped off at the Central or Branch labs and must be accompanied by the SiteManager sample ID number. If SiteManager is not available at the time the sample(s) is taken, contact the District TMOS for guidance on how to proceed in documenting the required sample(s).

Notes 8: All contractors will be required to submit start-up samples to the Central or Branch Labs 24 hours prior to starting production. When production is scheduled to begin on a weekend, state Holiday or the day after a state holiday, submit samples 3 to 4 days prior to start of production. Producers will not be allowed to start until test results are complete and meet the specified Requirements for asphalt cement.

The start-up requirement can be waived by the State Bituminous Construction Engineer In extenuating circumstances on all grades of asphalt cement except PG 76-22, if asphaltic concrete mix has been produced for private work during this time and it can be verified with asphalt cement bill of ladings (3 minimum) that the asphalt cement has been replenished with fresh material meeting the Performance Grade requirements for a state project.

If any failing asphalt cement sample is obtained, ensure that a representative of the Department is present when the follow-up sample is obtained.

11. Other Sampling Requirements

a. Provide all sample containers, extractants, forms, diaries and other supplies. These items are subject to the approval of the Engineer.

b. The following are materials that the Contractor's QCT will be required to sample and submit to the appropriate DOT laboratory, as directed. Samples should be submitted no later than seven (7) days from sample date should Department Technicians not assist with delivery:

1) Sampling mix for HWD testing.
2) Sampling mix for field verification of mix design.
3) Sampling of miscellaneous materials used in the mix.

12. Warm Mix Asphaltic Concrete (WMAC) Projects Only

a. Sampling and fabrication requirements for WMAC for field verification of mix designs:

In addition to all standard sampling , testing and inspection requirements established in Section 410, Section 400, Section 402, Section 828 and other sections within this document, the additional following requirements are established:

1) Fabricate samples for testing in accordance with GDT 66 , during the first day of WMAC production and then once every 5 days or 5 Lots thereafter unless otherwise instructed by the Office of Materials and Testing as required in accordance with Section 828 guidelines when stripping is visually indicated. These samples are to be fabricated during mixture production and not from reheated material. The fabricated samples are to be submitted to the District laboratory for testing along with completed sample cards.
2) Within the first three (3) lots of production, submit Fifteen (15) filled ten pound (4.6 kg), minimum, hot melt boxes of mix ***(with each box having at a minimum, the mix ID and sample number of the test recorded with a marker on the box)*** to the Branch Laboratory for HWD, T-209 and when required, GDT 66 Testing from the same portion of mix as taken for asphalt cement content and gradation accompanied with the SiteManager sample id for this sample
3) Obtain aggregate stockpile samples for all aggregate types used in the production of the WMAC and determine moisture content.
4) The Department may obtain cores samples on warm asphaltic concrete mixtures from the roadway for quality assurance purposes.

b. Documentation Requirements for WMAC Projects

1) Record aggregate moisture contents obtained for all sampled aggregate stockpiles in the plant diary
2) Record, under Remarks on the 159-5, that WMAC is being produced.

13. Interstate Projects Only*

a. Sampling and fabrication of HMA specimens for field verification of mix designs for mixtures placed on interstate projects' mainline including leveling and patching meeting the specified lot frequency: Field verification of new mix designs will be required on interstate projects regardless of area of placement. The contractor will be required to fabricate and submit one set (two specimens) of mix design volumetric pills for mainline placement only.

1) Submit Fifteen (15) filled ten pound (4.6 kg), minimum, hot melt boxes of mix ***(with each box having at a minimum, the mix ID and sample number of the test recorded with a marker on the box)*** to the Branch Laboratory for HWD, T-209 and when required, GDT 66 Testing from the same portion of mix as taken for asphalt cement content and gradation accompanied with the SiteManager sample id for this sample. Provide one set of samples for each mix type per Lot within the first two lots of production and one set per seven (7) lots, thereafter. The Office of Materials and Testing may reduce the field verification frequency, at the discretion of the State Bituminous Construction Engineer, based on prior field verification results.
2) Fabricate and submit one set (two specimens) of mix design volumetric pills for Gap-graded and Dense-graded mixtures with each field mix design verification. Prepare the specimens using the gyratory compactor at the N Design Level Specified for the mixtures. Compact the mixtures at the Job Mix Formula temperature.
3. Conduct testing for AASHTO T-209 to determine the maximum specific gravity of the mixture by testing one sample for each specimen taken for gyratory compactor described above. Determine the mix density and percent air voids of each gyratory compactor specimen described above by using the average result of the two AASHTO T-209 samples as the theoretical maximum specific gravity.
4) Submit the opposite quarter of the acceptance sample used for asphalt cement content and gradation for Ignition Oven Calibration verification.

b. When mix problems constitute a Job Mix Formula adjustment, obtain approval for the changes from the Technical Services Specialist. Upon approval, fabricate one set (two specimens) for gyration at N design and two samples of mix for AASSHTO T-209, and submit an additional Fifteen (15) filled ten pound (4.6 kg) minimum hot melt boxes (or other approved container) of mix to the Branch Laboratory for other required testing with the set of gyrated samples. Submit these samples to the Branch Laboratory.

> **Note 9: Supply a gyratory compactor, including a calibration kit, electronic balance with a weighing capacity of 12,000 grams, asphalt ignition oven and all T-209 test equipment in the field laboratory as specified in Section 152 of the contract on all Interstate projects mainline paving only.**

14. Non-Interstate Projects Only (No Gyratory Compactor Required)

a. Sampling and fabrication of HMA specimens for field verification of mix designs:

1) Sampling and fabrication of HMA specimens for field verification will only be required when a new Mix design is submitted or a Job Mix Formula change is requested.
2) Within the first three (3) days of production or after a JMF change, submit material to the lab for verification of mix design.
3) Submit Fifteen (15) filled ten pound (4.6 kg), minimum, hot melt boxes of mix ***(with each box having at a minimum, the mix ID and sample number of the test recorded with a marker on the box)*** to the Branch Laboratory for fabrication of one set (two specimens) for gyration at N design, six specimens for HWD, one complete set of pills (six specimens) for GDT-66, as required in accordance with Section 828 guidelines when stripping is visually indicated and two samples for AASHTO T-209.
4) Submit the opposite quarter of the acceptance sample used for asphalt cement content and gradation accompanied with the SiteManager ID for this sample for Ignition Oven Calibration verification.

> **Note 10: For all plant produced mix design verifications obtain the mix from the same load as the acceptance sample. Record the sample tests results, mix ID number and JMF requirements on the back of the sample card. Samples must be within tolerance established in Section 828.**

15. Plant Inspection Duties

Perform the inspection duties listed below at the designated frequency, document on the OMR-TM-143 form, and submit to the respective TMOS.

a) Visually observe cold feed bins and mechanical condition of each.
b) Visually inspect stockpiles for proper construction, segregation, and contamination.
c) Visually observe dryer, dust collection system, and bag house.
d) Visually observe asphalt storage system (unloading of tanker).
e) Visually inspect mixer on batch type plants and discharge gate on all type plants.
f) Visually inspect mix for segregation.
g) Visually inspect haul vehicles for proper covers, beds, and approved releasing agents.
h) Visually inspect lime systems.
i) Check A.C. and aggregate scales for accuracy and enter results in plant diary.

Reference: OMR-TM-143 (Asphalt Plant Check List)

16. Plant Diary

a. The plant diary is a legal document. Ensure that it remains at each plant and is properly filled out, daily. All entries are to be neat and legible.

b. Use preprinted Plant Diaries and include, as a minimum, the following information, to be entered on a daily basis.

   Entries shall include, but are not limited to:

   1) Project number or numbers
   2) Date and weather conditions
   3) Contractor's Representative (specify Q.C.)
   4) Type of mix
   5) Tons
   6) Lot number
   7) Mix I.D. number (from JMF)
   8) CPW checks (Furnished by DOT personnel)
   9) AC sample, Releasing Agent and Lime Samples including any samples taken for Lab testing
   10) Thermometer calibration
   11) Daily and Semi-weekly lime check calculations
   12) Moisture content of aggregate stockpiles (when producing WMAC)
   13) Any instructions given or received
   14) Any DOT visitors
   15) Any activities pertaining to State work.
   16) Signature and title

17. Computer

Note 11: In the event the Contractor’s computer system is inoperable, operations may be allowed to continue for a maximum of three working days by providing hand written test reports to the TMOS on a daily basis.

a. Enter all test data into SiteManager daily with the SiteManager sample id for all samples placed in the plant diary and made accessible to GDOT representatives. At each plant provide an internet service provider connection and an e-mail address for exchanging electronic correspondence with GDOT.

b. In accordance with SOP 27, provide an individual PC or laptop computer at each plant. Ensure that this computer remains at the plant at all times.

c. Ensure that each plant has a computer and accessories meeting the following requirements and as specified in Section 152 of the contract.

   1) Minimum Requirements:

      - At a minimum, each plant shall have hardware, software, and network connection that allows for installation and operation of AASHTOWARE Project SiteManager using Citrix Receiver and email capabilities.
      - Printer: Windows-compatible laser or ink jet printer

18. Control of Asphaltic Concrete Mixtures

a. Designate a Level II QCT Manager to be responsible for the daily quality control operations within his/her organization and held accountable for the action of all assigned QCTs as specified in contract. The Quality Control Manager will be responsible of ensuring that Quality Control Technicians do not simultaneously perform QCT and Plant Operator Duties.

b. The designated Level II - QCT manager will be responsible to control the Asphaltic Concrete mixtures produced for GDOT Projects. The mixture control tolerances from an approved Job Mix Formula are written in Section 828 and mixture acceptance tolerances are as written in Section 400, Section 410 and Section 415 of the governing GDOT Specifications for the respective Project.

References: GSP 21 (Sampling Procedures for Contractors)
GDTs (Sampling and Testing Manual or Study Guide)
Section 828 (Hot Mix Asphaltic Concrete Mixtures)
Section 400 (Hot Mix Asphaltic Concrete Construction)

Appendix D - Testing Procedures

GDT 38

A. Scope

For a complete list of GDTs, please see the Table of Contents

Use this test method to determine the particle size distribution of fine and coarse aggregates extracted from bituminous mixtures.

B. Apparatus

The apparatus consists of the following:

1. Balance: The balance or scale shall be capable of weighing the sample without additional splitting or distribution and have a resolution of 0.1 gram.
2. Mechanical Sieve Shaker: The Mechanical sieving device shall create a lateral, vertical, and jarring motion to keep the sample particles moving continuously over the surface of the sieve.
3. Sieves: Use woven-wire cloth sieves that conform to the "Standard Specification for Sieves for Testing Purposes," AASHTO M 92. Mount sieves with square openings on substantial frames constructed to prevent material loss during sifting. Select sieve sizes to furnish the information required by the Standard Specifications for the material to be tested.
4. Oven or Stove: An oven or stove of suitable size capable of maintaining a standardized temperature for the purpose of drying the aggregate, excluding Ignition Oven type furnaces.

C. Sample Size and Preparation

Use the entire sample of aggregate from which the bituminous material has been extracted (see GDT 83 or GDT 125).

NOTE: If utilizing GDT-125 for determining asphalt content, the extracted aggregate containing at least the aggregate passing the #8, (2.36mm) sieve and finer material must be subjected to washing over a No. 200 sieve in accordance with AASHTO T-11.

D. Procedures

1. Dry the aggregate utilizing a vented oven or stove with a vented hood to a constant weight and allowed to cool to room temperature.

2. Weigh the sample.

3. Nest the sieves in order of decreasing size of opening from top to bottom and place the sample in the top sieve. The sample shall be classified by particle sizes utilizing the required sieves outlined in the specifications for the material type being tested. Care should be taken to insure that sieve diameter is adequate. Limit the quantity of material on a given sieve by adding additional sieves as necessary so as all particles have the opportunity to reach the sieve openings a number of times during the sieving operation.
   a. Do not turn or manipulate fragments in the sample through the sieve by hand.

4. Agitate the sieves by hand or mechanical shaker for about 10 minutes or until less than 1 percent by weight of the total sample passes any sieve during 1 minute.

Note: When using a mechanical sieve shaker, periodically test the sieve's shakers accuracy against the results of sifting by hand. Make necessary adjustments in sifting time and/or repairs as required by manufacturer. This shall be included as part of the equipment review process for annual plant inspection.

> Note: When sieving by hand hold individual sieves in a slightly inclined position in one hand. Strike the side of the sieve sharply and with an upward motion against the heel of the other hand at a rate of about 150 times per minute, turning the sieve about one-sixth of a revolution at intervals of about 25 strokes.

5. Record the accumulative weight of the material retained on each sieve.

E. Calculations

Calculate the percent passing each sieve as follows:

$$P = 100 - \frac{R}{T} \times 100$$

where:

P = Accumulative percent passing sieve by weight of total aggregate

R = Accumulative weight of mineral aggregate retained on sieve

T = Total weight of extracted mineral aggregate

F. Report

Report the results of the sieve analysis as accumulated percentages passing each sieve. Report percentages to the nearest 0.1 percent on the(TM-140, Site Manager -appropriate Form(s).

GDT 39

A. Scope

For a complete list of GDTs see the Table of Contents.

Use this test method to determine bulk specific gravity of specimens of compacted bituminous mixtures. These procedures are described:

Uncoated Specimens, Dense Graded Mixtures Only

Paraffin Coated Specimens

AASHTO T 331 is an approved alternative method to Paraffin Coating method.

B. Apparatus

The apparatus consists of the following:

1. **Balance:** Use a balance having a capacity of 10 lb (4.5 kg) or more and sensitive to 0.0002 lbs (0.1 g) or less.
2. **Apparatus:** The suspension apparatus shall be constructed to enable the unit (wire basket or container) and the specimen to be immersed in water suspended by wire from the center of a weighing device to a depth sufficient to cover it and the test specimen during weighing.
3. **Water bath or Container:** for immersing specimens in water while suspended under a weighing device. The water bath or container shall be equipped with an overflow outlet to maintaining a constant water level.

C. Sample Size and Preparation

1. Make test specimens from either laboratory-molded bituminous mixtures or cut or cored compacted pavements. Do not distort, bend, or crack specimens during and after removal from pavement or mold.
2. Store specimens in a safe, cool place.
3. Ensure specimens are free from foreign materials such as seal coat, tack coat, foundation material, soil, or paper. Separate specimens from other pavement layers by sawing.

D. Procedures

1. Uncoated Specimens

Note: When roadway cores are saturated with water, conduct the following steps in this order: 4, 5, 1, 2, 3, and 6.

1. Dry the specimen to a constant weight. Constant weight is attained when further drying at 110 °, ± 9 °F (43.5 °, ± 5 °C) will not alter the weight 0.0002 lbs (0.1 g).
2. Cool the specimen to room temperature.
3. **Weigh the uncoated specimen**.
   a) Determine the dry weight of the specimen to the nearest 0.0002 lbs (0.1 g).
   b) Designate this weight as “A”.
4. **Weigh the specimen in water.**
   a) Place the specimen on an immersed ~~in~~ suspension device, in water, at room temperature for 1 to 4 minutes or until a constant weight is obtained.
   b) Leave the specimen in the water and weigh to the nearest 0.0002 lbs (0.1 g).
   c) Designate this weight as “C”.
5. **Weigh the surface-dry specimen.**
   a) Remove the specimen from the water.

b) Dry the surface by blotting with a damp cloth (*damp is when no water can be wrung out*).

c) Weigh the specimen to determine the surface-dry weight.

d) Designate this weight as “B”.

6. **Calculate the bulk specific gravity of the uncoated test specimen as follows:**

$$\text{Bulk Specific Gravity} = \frac{A}{B-C} \text{ where}$$

A = weight of dry sample in air in grams

B = weight of surface-dry sample in air in grams

C = weight of sample in water in grams

7. **Calculate the percent of water absorbed by the specimen (on a volume basis) as follows:**

$$\text{Percent of Water Absorbed by Volume} = \left[\frac{(B-A)}{(B-C)}\right] * 100$$

If the percent of water absorbed by the specimen as calculated exceeds 2.0 percent, use the Paraffin Coating Method to determine Bulk Specific Gravity. AASHTO T 331 is the recommended alternative to the Paraffin Coating Method for specimens with water absorbed results that exceeds 2.0 percent of water by volume.

2. Paraffin Coating

1. Dry the specimen to a constant weight. Constant weight is attained when further drying at 110°, ± 9° F (43.5 °, ± 5 °C) will not alter the weight 0.0002 (0.1 g).
2. Cool the specimen to room temperature.
3. Weigh the uncoated specimen.
   a) Determine the dry weight of the specimen to the nearest0.0002 (0.l g).
   b) Designate this weight as “A”.
4. Weigh the coated specimen.
   a) Preheat the paraffin to 130 ° to 150 °F (54 ° to 66 °C).
   b) Coat the test specimen on all surfaces with paraffin thick enough to seal all surface voids. Apply the coat in one of two ways: either use a paint brush to apply the hot paraffin or dip the specimen in the heated paraffin and brush more on to seal all pin-point holes.
   c) Determine the dry weight of the test specimen at room temperature. Weigh to the nearest 0.0002 lbs (0.1 g).
   d) Designate this weight as “D”.

Note: If you want to use the specimen for further tests that require removing the paraffin coating, dust the specimen with talc before applying the paraffin.

5. Weigh the coated specimen in water.
   a) Place the paraffin-coated specimen in the wire basket.
   b) Immerse the basket in water at room temperature.
   c) Weigh to the nearest 0.0002 (0.l g).
   d) Designate this weight as “C”.

6. Calculate the bulk specific gravity of the test specimen as follows:

$$\text{Bulk Specific Gravity } = \frac{A}{\left[(D - C) - \left[\frac{(D - A)}{0.90}\right]\right]}$$

A = Weight in grams of the specimen before paraffin coating in air
D = Weight in grams of the paraffin-coated specimen in air
C = Weight in grams of the paraffin-coated specimen in water
0.90 = Bulk specific gravity of the paraffin

E. Calculations

Determine the density of a specimen taken from compacted mixture as follows:

Roadway Core Density = Bulk Specific Gravity of Specimen * Specific Gravity of Water (62.4)

Determine the in-place air voids of a specimen taken from compacted mixture as follows:

{(100) – [(Density of Specimen ÷ Theoretical density) * (100)]}

NOTE: Target Specific Gravity is the Actual Specific Gravity as shown on the job mix formula or the Specific Gravity obtained on the project control strip.

F. Report

1. Calculate the specific gravity to the nearest 0.001.
2. Report density to the nearest 0.1 on form OMR-TM-150 and 159-5
3. Report voids to the nearest 0.1 on Form OMR-TM-150 and 159-5.

GDT 66

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to compare the Diametral Tensile Strength of bituminous mixtures on dry and wet specimens.

Internal water pressures in the mixtures are produced by vacuum saturation followed by a freeze and a warm-water soaking cycle. By comparing the properties of dry specimens with accelerated, water-conditioned specimens, you get the percentage of retained strength.

Use this method, along with GDT 56, to determine acceptability of liquid anti-stripping agents.

B. Apparatus

The apparatus outlined in AASHTO T 245 or T 312 is needed along with the following:

1. Vacuum Pump: Use a pump that can produce a pressure drop of 26 in (660.4 mm) of mercury (a gauge vacuum of 26 in (660.4 mm) Hg) for use in water-saturating the test specimen (WV-E-02).
2. Vacuum Chamber: Use Nalgene or equivalent vacuum jars, at least 6 in (152.4 mm) diameter and 8 in (203.2 mm) high, with smooth-fired edges. The chamber also includes:
   - A flat rubber gasket
   - A stiff, round plate greater than 6 in (152.4 mm) diameter, with a vacuum hose receptacle, having holes bored through the plate thickness
   - A vacuum hose attached between the receptacle fitting and vacuum pump
   - A 6 in (152.4 mm) diameter screen-type or highly porous specimen spacer approximately 0.25 in (6 mm) high
3. Freezer: Use a freezer that can maintain a temperature of –0.4 ° ± 3.6 °F (–18 ° ± 2 °C) and is big enough to contain the Marshall specimens to be frozen.
4. Warm Water Bath: Use the same as in AASHTO T 245.
5. Refrigerator or Cool Water Bath: Use equipment that cools specimens to a constant temperature of 55 °, ± 3.6 °F (12.8 °, ± 2 °C). If you use a bath, it must be made of stainless steel or non-corrosive metal. Use clean tap water in the bath. Periodically empty, clean, and refill the bath with fresh water.
6. Compression Testing Machine: Use one that conforms to ASTM D 1074, and can control deformation at a rate of 0.065 in/minute (1.651 mm/minute).
7. Loading Apparatus: Use a loading apparatus equipped with loading strips as shown in ASTM D 4123. The strips are attached to the loading apparatus to be parallel and centered on the vertical diametral plane.
8. Measuring Device: Use one graduated so that the height of the specimens can be determined to the nearest 0.05 in (1.27 mm).
9. Plastic Bag: Use a bag measuring 5 x 3 x 15 in (127 x 76.2 x 381 mm) (WB-01).

C. Sample Size and Preparation

1. Treating the Mixture with Additives
   a. Liquid Anti-Stripping Additive. When liquid anti-stripping additive is used in the mixture:
      1) Place a covered container of asphalt cement into an oven and heat it to 325 °F (162.8 °C).
      2) Weigh the appropriate amount of additive into the container of asphalt cement.
      3) Immediately lower a mechanical stirrer to within 1 in (25.4 mm) of the bottom of the container.
      4) Mix the contents for 2 minutes.
   b. To evaluate a liquid anti-stripping additive for the Qualified Product List:
      1) Place a covered container of asphalt cement into an oven and heat it to 325 °F (162.8 °C).

2) Maintain the temperature for 96 hours (as outlined in GDT 56) before preparing the specimens.

c. For routine design work:
   1) Discard the treated asphalt cement if you do not use it on the same day or if you have to reheat it.
d. Hydrated lime:
   1) When using hydrated lime in the mixture, dry-mix the lime into the hot aggregate immediately before adding and mixing the asphalt cement into the mixture.
   2) When the evaluation of new sources is for inclusion into QPL-41, the percentage of retained strength for the 3 cycles, as required in sub-section g, must meet the requirements of Section 828 of the Standard Specifications.
e. Prepare all specimens in accordance to AASHTO T 245 or T 312 except for the following modifications:
   1) Fabricate 6 specimens at optimum asphalt content. Adjust the number of gyrations or hammer blows in order to fabricate specimens with air voids that fall within a range of 6.0 ± 1.0 percent for Stone Matrix Asphalt Mixes (SMA), and a range of 7.0 ± 1.0 percent for all other mixes. Determine the air voids of the specimens according to AASHTO T 269.
   3) Determine the bulk density of the specimens according to AASHTO T 166. AASHTO T 331 can be used as an alternative to AASHTO T 275 for specimens with water absorbed that exceeds 2.0 percent of water by volume.
   4) Separate the specimens into two groups so that both groups have as nearly as possible the same average mix bulk density.
   5) Make sure the average air voids for the two groups are within the established limits.
   6) Use one group for accelerated conditioning and the other for "control" specimens.
f. To predict moisture-induced damage to an asphaltic concrete mix:
   1) Prepare specimens for the specific mix in question with an approved asphalt cement and an approved liquid additive (where applicable) or an approved hydrated lime (where applicable).
   2) When using a liquid anti-stripping additive, treat the asphalt cement as outlined in Sample Size and Preparation, step 1.a at the rate required by the Standard Specifications.
   3) When using hydrated lime, add the lime to the hot aggregate as outlined in Sample Size and Preparation, step 1.d at the rate required by the Standard Specifications.
g. To evaluate liquid anti-stripping additive for approval:
   1) Prepare 12 batches using laboratory standard aggregate to the following mix gradation:

Sieve Size	Percent Passing
1/2" (12.5 mm)	100
3/8" (9.5 mm)	95-100
No. 4 (4.75 mm)	60-70
No. 8 (2.36 mm)	44-46
No. 50 (300 μm)	18-22
No. 200 (75 μm)	5.5-6.5
% AC	5.25-7.0

NOTE: The laboratory-standard aggregate has a known history of stripping problems, and the laboratory-standard asphalt is a PG-67-22 normally used in the laboratory for mix design purposes.

   2) Mix the specimens with asphalt cement prepared according to Sample Size and Preparation , step 1.b at the rate required by the Standard Specifications. (NOTE: Hydrated Lime is not used for this additive evaluation)

3) Fabricate the 12 specimens using the optimum asphalt content. Adjust the number of gyrations or hammer blows in order to fabricate specimens with air voids that fall within a range of 7.0 ± 1.0 percent. Determine the bulk density of the specimens according to AASHTO T 166. AASHTO T 331 can be used as an alternative to AASHTO T 275 for specimens with water absorbed that exceeds 2.0 percent of water by volume. Determine the air voids of the specimens according to AASHTO T 269.
4) Separate the specimens into four groups so that all groups have as nearly as possible the same average mix bulk density.
5) Three groups are subjected to accelerated conditioning for one, three, and six freeze-thaw cycles respectively. The fourth group is used for "control" specimens.

h. When using cores from the roadway to determine moisture-induced damage:
1) Take 6 cores from within a few feet of each other along the same longitudinal alignment.
2) Make sure the cores are at least 1 in (25.4 mm) thick for mechanical testing.
3) Blot all samples free of moisture and desiccate them for 24 hours before starting the test.
4) Separate the cores into two groups based on mix bulk density so that each group is about equal. Determine bulk density as outlined in AASHTO T 166.

Note: For cores cut from a roadway that has gone through a freeze-thaw cycle, take only three cores and omit the grouping based on mix bulk density.

5) You may break apart cores less than 1 in (25.4 mm) thick to visually examine them and give a stripping rating.

i. Measure and record the height of each of the specimens.

Note: For cores cut from a roadway that has gone through a freeze-thaw cycle, prepare the cores as accelerated conditioned specimens in step j. After step j, skip to step s.1 and immediately place the cores in 55 ° F (12.8 °C) water. Test the cores as accelerated conditioned specimens.

j. Take the specimens for accelerated conditioning and vacuum saturate them.
1) Place the specimen in the vacuum chamber.
2) Cover the specimen with at least 1 in (25.4 mm) of tap water.
3) Drop the pressure in the chamber by 26 in (560.4 mm) of mercury for 30 minutes.
4) While the pressure drops, frequently tap or gently shake the chamber to dislodge trapped bubbles.
5) Release the vacuum and let the specimens remain in the water undisturbed for another 30 minutes.
6) After 30 minutes, determine the percent saturation:

$$\%\ \text{Saturation} = \frac{100\ (D - A)}{(C - B)\ (E)}$$

where:

A = Air weight (dry)

B = Weight in water before vacuum

C = SSD weight before vacuum

D = SSD weight after vacuum

E = Percent of air voids in specimen

k. Place each vacuum-saturated specimen into a plastic bag with approximately 10 cm^3 of extra water.

l. Squeeze most of the air out of the bag and draw it snugly around the specimen. Secure the top of the bag.

m. Freeze the vacuum-saturated specimens for at least 15 hours.

n. Remove the specimens from the freezer and place immediately into a warm water bath. Maintain the bath temperature at 140 °, ± 3.6 °F (60 °, ± 2 °C).

o. Leave the specimens undisturbed for 30 minutes.

p. After 30 minutes, carefully cut a small opening in the plastic bags.

q. Leave the specimens and bags undisturbed for 24 hours.

r. Carefully remove the specimens from the warm water bath, taking care to avoid damage in handling.

s. Prepare both accelerated conditioned and control specimens for mechanical testing as follows:
   1) Accelerated Conditioned Specimens:
      a. Allow specimens just removed from the warm water bath to remain undisturbed for about 1 hour, or until the specimens reach ambient temperature.
      b. Place each specimen into a beaker, plastic bucket, or corrosion-proof container.
      c. Cover with about 1 in (25 mm) of 55 °F (12.8 °C) water.
      d. Place the specimens into a refrigerator at 55 °, ± 3.6 °F (12.8 °, ± 2 °C) for 3 hours. You may also use a corrosion-proof water bath controlled within this temperature range.
      e. Remove one specimen at a time, blot the surface dry, and perform the mechanical testing.
   2) Control Specimens:
      a. Place each control specimen into the refrigerator at 55 °, ± 3.6 °F (12.8 °, ± 2 °C) for 3 hours. You may also use a corrosion-proof water bath controlled within this temperature range provided the specimens are kept dry sealed in a plastic bag or other suitable container.
      b. Remove one specimen at a time and perform the mechanical testing.

D. Procedures

1. Immediately after removing each specimen from the refrigerator (or cool water bath), remove surface water by blotting and place the specimen into the loading apparatus.
2. Place the loading apparatus and the specimen under the breaking head of the testing machine.
3. Apply load at a rate of 0.065 in/minute (1.65 mm/minute).
4. Immediately release the load whenever you note a load drop or when the load has remained constant for 15 seconds.
5. Record the maximum load reached.
6. Place conditioned specimens back under the breaking head of the testing machine and apply a load until a vertical crack appears.
7. Pull the specimen apart and inspect for stripped particles.
8. Record the rate of stripping according to the following table:

Stripping Code	Degree of Stripping
0	None (No evidence of stripping)
1	Slight (Some stripping, primarily on coarse particles)
2	Moderate (Considerable stripping on coarse particles; moderate stripping on fine particles)
3	Severe (Severe stripping on fine and coarse particles)

E. Calculations

1. Calculate the diametral tensile strength of each specimen as follows:

   $$S = 2P \div (\pi t D)$$

   where:
   S = tensile strength, psi (kPa)
   P = maximum load, pounds (kN)
   t = specimen height immediately before tensile test, inches (meters)
   D = specimen diameter, inches (meters)
2. Calculate the percent retained stability as follows:

   $$RS = Sa \div Sc$$

   where:
   RS = percent retained strength

Sa = average tensile strength of accelerated conditioned subset, psi (kPa)

Sc = average tensile strength of control subset, psi (kPa)

F. Report

1. Report the average retained stability to the nearest 0.1 percent on Form 159-5.
2. Show the percent liquid additive or hydrated lime (as appropriate) used in the test specimens.

GDT 73

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use these test methods to randomly select and test for acceptance asphaltic concrete mixes and pavement construction. The characteristics to be tested are mixture composition and compaction.

B. Apparatus

For Method C, the apparatus consists of the following:

1. Computer—Use the computer specified in Section 152 of the Specifications.

C. Sample Size and Preparation

1. Lot Boundaries

   An Acceptance Lot normally consists of the amount of asphaltic concrete produced and placed in one construction day, or at least 500 tons (500 Mg).
2. Evaluate each Lot with the sampling procedures and the specified acceptance criteria for mixture composition and voids.
3. When evaluating these features, always use the same Lot boundaries. If the Job Mix Formula changes significantly, the Engineer may end one Lot and begin a new Lot.

D. Procedures

1. Selecting Loads to be Sampled
   a. Randomly sample the designated Lot based on the load number.
   b. Randomly sample the mix for the Lot from sublots consisting of approximately 500 tons (500 Mg).
   c. Sublots may be increased to 750 tons (750 Mg) if approved by both the District Testing Management Operations Supervisor and the Area Bituminous Technical Services Engineer. To be considered for use of expanded sublots, the contractor must have produced at least 2,000 tons (2,000 Mg) of a specific mix per day for three consecutive working days. Approval for increased sublot sizes may be rescinded upon agreement by both the District Testing Management Operations Supervisor and the Area Bituminous Technical Services Engineer any time the Contractor fails to produce at least 2,000 tons (2,000 Mg) of mix in any one day of production.
   d. Method A: Use random numbers chosen from Table 1.

      Method B: Draw numbered tokens from a container.

      Method C: Use the FDCS computer-generated numbers.

      See examples in Calculations, for using each of these methods.
2. Testing for Asphalt Cement Content and Gradation
   a. Use GDT 83 or GDT 125 to test the asphalt cement content.
      1) When the plant that produces the mix is operating and the mix is tested according to GDT 125, use the asphalt cement content calculated from the ticket .Calculate the content from the appropriate ticket that corresponds to the load from which the sample was taken. The ticket and gradation worksheet should be attached to the TM159-5 report and retained in the project files. In all cases, test the mixture gradation with GDT 38.
   b. Project personnel may submit to the Central Laboratory for approval any other method for random sampling when existing conditions make load sampling impractical.

Note: Test according to GDT 83 or GDT 125 and GDT 38. Accept according to Section 400 of the Standard Specifications.

3. Determining Core locations for Mixture Acceptance
   a. Determine core locations as follows:
      1) Divide the Lot into 5 sub-lots for lots containing greater than 500 tons (500 Mg) or 1 sub-lot per 100 tons (100 Mg) if 500 tons (500 Mg) or less (Example)

Lots ≥ 500 tons (500Mg) of mix should be divided into 5 sub-lots of equal distance.

Lots <500 tons (500Mg) of mix should be comprised of a sub-lot or sub-lots consisting of up to 100 tons (100 Mg) of mix each. There may be less than 5 sub-lots.

Note: Round up for any fraction tonnage to the next 100 tons (100 Mg). Example: 301 tons = 4 cores

GDT 73 Table 1

1		2		3		4		5		6		7	
.576	.730	.430	.754	.271	.870	.732	.721	.998	.239	.053	.899	.554	.627
.892	.948	.858	.025	.935	.114	.153	.508	.749	.291	.810	.159	.225	.163
.669	.726	.501	.402	.231	.505	.009	.420	.517	.858	.081	.277	.035	.039
.609	.482	.809	.140	.396	.025	.937	.310	.253	.761	.982	.468	.334	.921
.971	.824	.902	.470	.997	.392	.892	.957	.640	.463	.095	.801	.576	.417
8		**9**		**10**		**11**		**12**		**13**		**14**	
.427	.760	.470	.040	.904	.993	.509	.025	.794	.850	.917	.887	.751	.608
.549	.405	.285	.542	.231	.919	.371	.059	.164	.838	.289	.169	.569	.977
.860	.507	.081	.538	.986	.501	.165	.996	.356	.375	.654	.979	.815	.592
.690	.806	.879	.414	.106	.031	.477	.535	.137	.155	.767	.187	.579	.787
.251	.884	.522	.235	.398	.222	.788	.101	.434	.638	.021	.894	.324	.871
15		**16**		**17**		**18**		**19**		**20**		**21**	
.698	.683	.566	.815	.622	.548	.947	.169	.817	.472	.864	.466	.897	.877
.796	.996	.901	.342	.873	.964	.942	.985	.123	.086	.335	.212	.875	.969
.348	.743	.470	.682	.412	.064	.150	.962	.925	.355	.909	.019	.190	.696
.358	.595	.068	.242	.667	.356	.195	.313	.396	.460	.740	.247	.341	.688
.698	.539	.874	.420	.127	.284	.448	.215	.833	.652	.601	.326	.846	.355
22		**23**		**24**		**25**		**26**		**27**		**28**	
.209	.862	.428	.117	.100	.259	.425	.284	.882	.227	.552	.077	.454	.731
.109	.843	.759	.239	.890	.317	.428	.802	.464	.658	.629	.269	.069	.998
.757	.283	.666	.491	.523	.665	.919	.146	.123	.791	.503	.447	.659	.463
.587	.908	.865	.333	.928	.404	.892	.696	.116	.120	.721	.137	.263	.176
.831	.218	.945	.364	.673	.305	.195	.887	.836	.206	.914	.574	.870	.390
29		**30**		**31**		**32**		**33**		**34**		**35**	
.716	.265	.058	.075	.636	.195	.614	.486	.629	.663	.619	.007	.296	.456
.917	.217	.220	.659	.630	.673	.665	.666	.399	.592	.441	.649	.270	.612
.994	.307	.631	.422	.804	.112	.331	.606	.551	.928	.830	.841	.602	.183
.798	.879	.432	.391	.360	.193	.181	.399	.564	.772	.890	.062	.919	.875
.104	.755	.082	.939	.183	.651	.157	.150	.800	.875	.205	.446	.648	.685

2) Take one random core in each sublot insuring that cores meet minimum weight requirements in GDT 125.
3) Select successive numbers, depending on the number of sublots, from Table 1 for the longitudinal coordinate.
4) Select the same number of successive numbers for the transverse coordinate.
5) Determine the axis based on the beginning of a sublot and the left-hand edge of the pavement looking ahead.

b. Example for coring lots for Acceptance (using Method A).

You are given the following:

- The lot is 3,000 ft (914.4 m) long and the lane is 12 ft (3.65 m) wide and has 300 tons (300 Mg) of mix.

1) You are cutting three cores from the lot. By an unbiased method, use the First random number in Block 18 of Table 1 in the right column and the two successive numbers (0.947, 0.942, and 0.150) to determine longitudinal values.
2) Take the lane width minus 1 foot and place 1 pill per foot into a can to be drawn out for Transverse Coordinate (12 foot lane 1 through 11 in can-pills 3, 5, 9).

Note: It is the intention of this procedure to sample materials from the population in a random manner. The use of a Random Number Generator such as those found as a function on some Scientific Calculators and as found within the Field Data Collection System is allowed. If a Random Number Generator is used, determine the test location by substituting the randomly generated number for the random numbers from Table 1 in the examples of Method A

Location of Sample from Beginning of Each Sublot		
Sample No.	**Longitudinal Coordinate**	**Transverse Coordinate**
1	1000 ft. x 0.947 = 947 ft	3 ft
2	1000 ft. x 0.942 = 942 ft	5 ft
3	1000 ft. x 0.150 = 150 ft	9 ft

Note: In some individual cases due to safety reasons, material must be tested within a lane closure**. This will make equal sublots impossible; however, you must include the full length of each day's production in the Lot. There are also safety issues to be considered. In the event that a test site falls in a unsafe area (i.e. in blind curves or just over the crest of a hill) the test location should be move to just beyond the unsafe area but within the boundaries of the sublot being tested. In the event that either of these is the case, an explanation should be included in the remarks section of TM 150 test report.**

4. Determining locations with Nuclear Gauge

a. The length of the Lot is 5,000 ft (1,524 m). Use 1,000 ft (1,524 m) per sublot (5000 ft/5 = 1000

b. To determine stations, use an unbiased method. The first random number in block 18 in the right column and the four successive ones (.947, 0.942, 0.150, 0.195, and 0.448) determine the stations.

Station Within Each Sublot	
Sublot 1	1000 feet x 0.947= 947 feet from start of sublot
Sublot 2	1000 feet x 0.942= 942 feet from start of sublot
Sublot 3	1000 feet x 0.150= 150 feet from start of sublot
Sublot 4	1000 feet x.195 = 195 feet from start of sublot
Sublot 5	1000 feet x 0.448= 448 feet from start of sublot

Note: Do not test any section within 25 ft of a transverse joint. Do not test any turning lanes, turnouts, and driveways less than 200 ft in length or tapered sections less than 10 ft wide.

c. To determine transverse coordinates, divide the lane into three equal transverse zones.

d. Record on the work sheet one reading within each zone at the random selected site.

e. Determine the average and record it as a test.

f. If the width of lane is 12 feet you will use 4 feet per zone (12 ft/3 zones = 4 ft per zone

g. For this example, place 4 tokens, numbered 1 through 4, in a container.

h. By an unbiased method, you select three numbers from the pill can to determine the transverse locations of the test sites. The numbers are 2, 3, and 1.

i. Since the left edge of the lane looking ahead is the axis, take the readings at the following transverse locations:

Zone	Calculation	Location
1	Pill 2	2ft
2	Pill 3	3 ft
3	Pill 1	1 ft

Note: Avoid testing sites that fall on the edge of a paving lane. For example, use 1 ft (300 mm) for any sites falling 1 ft (300 mm) or less.

j. Take the 3 gauge readings for sublot #1 starting 947 ft- from the beginning of the sublot at 2 ft, 7 ft, and 9 ft from the left edge of the lane.

k. Use the average of the three readings as the test for that sublot.

l. Determine the test locations for the remaining sublots using the same process.

Note: Before reporting test results for payment, automatically retest non-conforming lots of asphaltic concrete density. Test at the same longitudinal location as the previous tests and at a randomly selected transverse site according to GDT 39. Base official values for non-conforming average Lot density on the core average from step 5 below.

5. Re-evaluating Non-Conforming Average Voids

   a. If you reevaluate beyond the automatic recheck, use randomly determined cores at new locations as described in Procedure 4. 1 and 2

   b. Determine the Transverse Coordinates by taking the lane width minus 1 ft and placing 1 pill per foot into a can. Draw a pill from the can and core at that transverse location on the mat.

E. Calculations

1. Method A

   a. Method A Calculations

   This example uses Table 1 to calculate the sublot tests. You are given the following:

   Expected plant production: 1,600 to 1,800 tons (1,600 to 1,800 Mg) (3 to 4 samples)

   Average load of haul vehicles: 20 tons (20 Mg)

   1) Therefore, use 25 loads [(500 tons (500 Mg)) / (20 tons (20 Mg)/load) = 25] for the first sublot.

   2) By an unbiased method, use the last random number in Block 18 of Table 1 in the right column and the four successive numbers (.215, .284, .802, .146 and .696).

   3) Calculate the loads to sample as follows:

Sample	Calculation	Load
1	25 loads x .215 = 5.4 or 5 +0	= 5th Load
2	25 loads x .284 = 7.1 or 7 + 25	= 32nd Load
3	25 loads x .802 = 20.1 or 20 + 50	= 70th Load
4	25 loads x .146 = 3.7 or 4 + 75	= 79th Load

   4). If the plant produced 92 loads for that day, take samples of the mix from loads 5, 32, 70, and 79 to represent that Lot.

2. Method B (Random Tokens)

   This example uses Method B to calculate the sublot tests. You are given the following:

   Plant production: 2,600 to 3,000 tons (2,600 to 3,000 Mg) (4 to 5 samples)

   Average load of haul vehicles: 22 tons (22 Mg)

   a. Therefore, use 34 loads (750 tons (750 Mg) / 22 tons (20 Mg)/load = 34) for the sublots.
   b. Place 34 tokens numbered 1 through 34 in a container.
   c. Draw a token from the container.
   d. Record the number and return it to the container.
   e. Calculate the sublots to be tested as follows:

Sample	Calculation	Load
1	Token #1 drawn = 1	= 1st Load
2	Token #16 drawn = 16 + 34	= 50th Load
3	Token #31 drawn = 31 + 68	= 99th Load
4	Token #16 drawn = 16 + 102	= 118th Load
5	Token #11 drawn = 11 + 136	= 147th Load

   f. If the plant produced 130 loads for that day, take samples of the mix from loads 1, 50, 99, 118, and 147 to represent that Lot

3. Method C (DOT Computer Program)

   This example uses Method C to calculate the sublot tests.

   a. Using the computer program developed by the Georgia DOT, enter the requested pertinent data about expected production and the haul load sizes. The program will randomly select the loads per sublot for the entire Lot.
   b. Retain this list for future reference.

Note: Method C is the preferred method when performing sampling at an asphalt plant. It should be utilized as the correct sampling procedure at all times unless specific permission is granted by both the District Testing Management Operations Supervisor and the Area Bituminous Technical Services Engineer

F. Re-Evaluation

1. Mixture Acceptance

   For all mix types other than PEM, OGFC, Mixture paid as patching and thin lift courses < 110 lbs/yd^2, the Department will take the same number of new tests on cores taken at the locations where the loads sampled were placed and will use only those cores results for acceptance. If the location of the sampled loads cannot be isolated and documented to the approval of the Engineer, the lot will not be re-evaluated and the original test results will be used for acceptance. For PEM, OGFC and thin lift courses < 110 lbs/yd^2, the retained opposite quarter shall be used for revaluation when a re-evaluation is requested by the Contractor.

2. Compaction Acceptance

   The Department will reevaluate the lot through additional testing by cutting the same number of cores originally obtained at randomly selected locations and averaging these results with the results from the original density tests.

Note: Reevaluation of Lots and acceptance will be based on Department evaluations. The Request for reevaluation shall be made within 5 working days of notification of the Lot results. The Department will be reimbursed for the cost of the re-evaluation. Traffic control will be the responsibility of the contractor. The TMOS, Assistant, or TSE must be present during re-evaluation(The cost can be found below in the RE-Evaluation Cost Table)

G. Report

Keep track of the loads sampled and locations sampled and report actual tests on the respective forms:

1. From GDT 83 or GDT 125 for Asphalt Cement Content.
2. From GDT 38 for Mixture Gradation.
3. From GDT 59 for Nuclear Gauge Compaction.
4. From GDT 39 for Core Compaction.

RE- Evaluation Cost Table

GDT	Hr/Rate	Mileage	Bit wear	Test
GDT-39	$55.00 per person	.70 mile	$12 per inch	$25 per core
GDT-125	$55.00 per person	.70 mile	$12 per inch	$150 per core

GDT 83

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to determine the bitumen content of hot paving mixtures by using the vacuum extractor. You may use the aggregate remaining after extraction for sieve analysis.

B. Apparatus

The apparatus consists of the following:

1. Vacuum Extractor—Use a vacuum extractor complete with filter ring.
2. Vacuum Source— Use a source with a minimum vacuum of 5 psi (34 kPa).
3. Filter Paper—Use filter paper, medium grade, fast filtering, of the diameter required to fit inside the ring, normally either 11 in (29 cm) or 13 in (33 cm).
4. Oven or Hot Plate—Use an oven or hot plate for drying capable of maintaining a temperature of approximately 230° F (110° C).
5. Trowel—Use a trowel and/or quartering device —not necessary when testing cores.
6. Mixing Bowls—Use a 4qt (3.8 L) mixing bowl
7. Plastic Beakers—Use two plastic beakers, 34 oz (1000 ml) capacity *(Optional for Field Lab Testing)*
8. Mixing Spoon
9. Plastic Wash Bottle—Use two 1pt (0.47 L), plastic wash bottles
10. Spatula
11. Glass Stirring Rod—Use for stirring (*GDOT Laboratory Only)*
12. Drying Pans—Use two 18 in or 16 in (450 mm or 400 mm) diameter drying pans for filter,
13. Laboratory Balance—Use an approved laboratory balance with a capacity of at least 7.9 lb (3600 g) and readable to (0.1 g).
14. Solvent—Use Terpene Hydrocarbon.

Note: solvent used for extraction purposes must be on the GDOT QPL list.

Note: The use of terpene hydrocarbon may require the use of a rinsing agent.

15. Filtering Aid—Use a diatomaceous silica filtering aid.
16. No. 16 (1.18 mm) Sieve— **(Optional)** Use a 12 in (300 mm) diameter No. 16 (1.18 mm) Sieve (WS-12 #16).
17. No. 200 (75µm) Sieve—Use a 12 in (300 mm) diameter No. 200 (75µm) Sieve.
18. Thermometer.

C. Sample Size and Preparation

1. If the mixture is not soft enough to separate with a trowel or quartering device, place the sample in an oven at about 290° F (143° C) long enough to separate it.
2. If you took the sample before compaction, quarter it to the desired test size is accordance with the size requirement in Table1 :

Table 1

Superpave Mix	Min. Sample Weight lbs (g)	Max. Sample Weight lbs (g)
25 mm Superpave	5.5 (2500)	7.0 (3500)
19 mm Superpave	4.4 (2000)	5.9 (3000)
12.5 mm Superpave	3.3 (1500)	4.6 (2500)
9.5 mm Superpave	2.6 (1200)	3.7 (2200)
4.75 mm Mix	2.2 (1000)	3.3 (2000)
9.5 mm OGFC	2.2 (1000)	3.3 (2000)
12.5 mm OGFC	2.6 (1200)	3.7 (2200)
12.5 mm PEM	2.6 (1200)	3.7 (2200)
19 mm SMA	4.4 (2000)	5.9 (3000)
12.5 mm SMA	3.3 (1500)	4.6 (2500)
9.5 mm SMA	2.2 (1200)	3.7 (2200)

3. Allow the sample to cool to approximately 140° F (60° C) before adding any solvent.

D. Procedures

1. Place the warm sample into a bowl.
2. Add solvent and stir thoroughly.
3. Weigh a dry filter paper and place on the perforated support plate, which is centered on the vacuum extractor. (Care should be taken to see that the filter and support plate is centered)
4. Place the funnel ring over the filter and tighten the wing nuts.
5. Weigh a predetermined amount of diatomaceous filtering aid into a beaker and add enough solvent to suspend the amount of filtering aid into a solution after thoroughly mixing. ***Adding solvent is optional for field labs (See not Below)***
6. For mixes with a high percentage of minus No. 200 (75 µm) material or for mixes made with local material, the amount of diatomaceous earth may be increased to improve the filtering process.
7. Stir until the filtering aid is completely in suspension.
8. Immediately pour the solution onto the filter and start the vacuum pump.
9. Leave the vacuum on until the pad formed by the filtering aid is surface dry and begins to crack slightly.

Note: You may apply the diatomaceous filtering aid dry if you distribute it evenly.

10. **(Optional)**: Place nested No. 16 (1.18 mm) and No. 200 (75 µm) mesh 12 in (300 mm) sieves onto the funnel ring.

Note: You can use only the No. 200 (75 µm) mesh 12 in (300 mm) sieve if you carefully pour (decant) the solution to prevent larger aggregate particles from damaging the sieve.

11. Gently decant the solvent and asphalt solution from the sample container onto the No. 16 (1.18 mm) sieve or No. 200 (75 µm) sieve, whichever is applicable, being careful not to disturb the filtering pad.
12. Start the vacuum pump and adjust the vacuum to at least 5 psi (34 kPa).
13. Continue vacuuming until all of the solvent has disappeared through the filter, if a hard crust appears after vacuuming, gently pull a spatula rounded blade edge or similar device across the filter to break the crust.

a. Continue washing and decanting the sample three to five times (depending on the sample size).

1) After vacuuming, pour approximately 17 oz (500 ml) of water over the aggregate in the mixing bowl and stir well with the mixing spoon. The water will turn milky-white.
2) After the asphalt extractant/asphalt solution has completely vacuumed from the diatomaceous filtering aid, decant the water from the mixing bowl through the sieve or sieves onto the filter pad.
3) Pour the water over the entire surface of the sieve.
4) Repeat the water washing from 3 to 5 times until the water is clear.

Note: The additional water removes the solvent from the aggregate. Four to six washes should be sufficient , but with very large samples more water washes may be required.

14. Use a wash bottle with water and thoroughly rinse all aggregate particles from the sample container and spoon onto the sieve(s).
15. Remove the 12 in (300 mm) sieve(s) containing the plus No. 200 (75 µm) material and put them aside to dry.
16. After vacuuming all the liquid through the filter, use a spatula to transfer the filtering aid away from the edges of the filter and funnel ring toward the center.
17. Use the wash bottle to rinse the side of the funnel ring.
18. Allow the vacuum to run approximately 3-5 additional minutes to aid in drying the filter.
19. Carefully remove the filter and place it into a drying pan without losing any material.
20. Move the aggregate retained on the sieve(s) to another drying pan.
21. Dry each of the pans of material to a constant weight and record the weights.
22. If you need the aggregate gradation, use GDT 38 and always use "T" for total weight of extracted aggregate.

E. Calculations

1. Calculate the percent bitumen in the sample.

   Weight of extracted aggregate:

   $W_0 = W_1 + (F_2 - (F_1 + DE))$ where

   W_1 = Weight of aggregate retained..

   F_1 = Original weight of the filter placed in the vacuum extractor

   F_2 = Final weight of the filter (includes the diatomaceous earth and minus No. 200 (75 µm) materials)

   DE = Original weight of diatomaceous earth

2. Percent bitumen =

   $\frac{W - W_0}{W}(100) +$ R where

   W = Original weight of the sample

   W_0 = Weight of extracted aggregate

   R = Retention factor

3. Report the percent bitumen to the nearest 0.01.
4. Calculate the Retention Factor **(Only if applicable)**

   Most types of aggregate will retain a small amount of bitumen after being tested by the vacuum extractor. Take this into consideration when calculating the final percent bitumen in the mixture.

Note: Perform this test procedure separately on at least two samples of aggregate representative of the material to be used in the mix.

a. Use a test specimen weighing at least 2.6 lb (1200 g).

b. Dry the aggregate specimen to a constant weight.
c. Place the specimen in a tared metal container and weigh.
d. Heat the aggregate and asphalt cement to the temperature specified in the Asphaltic Concrete Mixture Control Temperature Charts.
e. Add the asphalt cement to the aggregate mixture at the amount prescribed by the Job Mix Formula.
f. Calculate the exact percentage of bitumen added to the nearest 0.01 percent.
g. Mix the bitumen and aggregate by hand as fast as possible until the aggregate is thoroughly coated. The fast mix reduces temperature loss.
h. Cool the specimen to approximately 140° F (60° C).
i. Add solvent and proceed as in Procedures.

5. Calculate the percentage of bitumen extracted as in Calculations, step 1 and determine the retention factor as follows:

$P_2 = \frac{S - A}{S}(100)$ and $R = P_1 - P_2$ where

S =Total weight of mixture

A = Weight of extracted mineral aggregate

P_1 = Percent of bitumen added to mix

P_2 = Percent of bitumen extracted

R = Retention factor

F. Report

Report the percentage of bitumen extracted and the **retention factor**, **if applicable**, on Form 140 or similar document and retain for your records. QCT's will report test data on the 159 in the FDCS program and upload report to the database for verification.

Revised: August 26, 2011

GDT 107

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to determine asphalt plant ratings. The ratings help evaluate the effectiveness of a Contractor's quality control program.

The asphalt plant rating system was developed using the Mixture Control Tolerances established in Section 828 of Georgia's Standard Specifications. This system is designed to provide Industry and the Department with a management tool for measuring the success of the Producer Certification Program and to promote consistency of products.

B. Apparatus

None listed for this test.

C. Sample Size and Preparation

No sample preparation is needed.

D. Procedures

In order to produce the ratings, certain data must be calculated. The following procedures are applicable to producing data for the rating system:

A. Tolerance Band

A tolerance band derived from the tolerances established in Section 828 is used to calculate the rating for all types of asphaltic concrete mixes. The maximum deviation allowed in Section 828 from the Job Mix Formula represents a grade of 70.

Example:

9.5 mm Superpave Type 1

Tolerances established in Section 828

Rating Criteria		Deviation
4.75 mm Sieve	0 = 100	$\pm$ 5.6 = 70
2.36 mm Sieve	0 = 100	$\pm$ 4.6 = 70
75 um Sieve	0 = 100	$\pm$ 2.0 = 70
Asphalt Cement	0 = 100	$\pm$ 0.4 = 70

B. Rating Standards

Ratings	**Quality of Mixes**
90-100	Excellent
80-89	Good
70-79	Marginal
Below 70	Unacceptable

E. Calculations

A. Determination of Mix Score:

1. A score for each type of asphalt mixture produced by a plant is calculated as follows:

MIX SCORE = (0.6 x Average score for rated sieves) + (0.4 x score for AC content)

**Gradation accounts for 60% of Composite Score and AC accounts for 40%.

Note: If the combined score is < 70, report the combined score. If the combined rating is $\geq$ 70, but either gradation or AC portion of rating is < 70, show the combined rating as 69.9.

2. The rating criteria for each type mix in order to calculate the mix score are:

MIX	AC & SIEVES USED
25 mm Superpave, 19mm SMA	12.5 mm, 2.36 mm, 75 um, AC
19 mm Superpave 12.5 mm PEM 12.5 mm OGFC 12.5 mm SMA 12.5 mm Superpave Open Graded Interlayer (OGI)	9.5 mm, 2.36 mm, 75 um, AC
9.5 mm OGFC 9.5 mm SMA 9.5 mm Superpave Type 1, Type 2	4.75 mm, 2.36 mm, 75 um, AC
4.75 mm	2.36 mm, 75 um, AC
Paver Laid Surface Treatment	
Type A	4.75 mm, 2.36 mm, AC
Type B	4.75 mm, 2.36 mm, AC
Type C	9.5 mm, 2.36 mm, AC

3. A Specification Tolerance Factor (**STF**) is used to determine the score for each rated sieve. The **STF** is derived using the tolerances established in Section 828 of the specifications and assuming that the maximum allowed tolerance for each rated sieve equals a score of 70. The **STF**s for each mix type is listed below.

Superpave

12.5 mm Sieve	0 = 100	$\pm$ 6.0 = 70	6.0 ÷ 30 = 0.2000 (0.2000 = **STF**)
9.5 mm Sieve	0 = 100	$\pm$ 5.6 = 70	5.6 ÷ 30 = 0.1870 (0.1870 = **STF**)
4.75 mm Sieve	0 = 100	$\pm$ 5.6 = 70	5.6 ÷ 30 = 0.1870 (0.1870 = **STF**)
2.36 mm Sieve	0 = 100	$\pm$ 4.6 = 70	4.6 ÷ 30 = 0.1534 (0.1534 = **STF**)
75 um Sieve	0 = 100	$\pm$ 2.0 = 70	2.0 ÷ 30 = 0.0670 (0.0670 = **STF**)
Asphalt Cement	0 = 100	$\pm$ 0.4 = 70	0.4 ÷ 30 = 0.0134 (0.0134 = **STF)**

SMA, OGFC,PEM and OGI

12.5 mm Sieve	0 = 100	$\pm$ 6.1 = 70	6.1 ÷ 30 = 0.2034 (0.2034 = **STF**)
9.5 mm Sieve	0 = 100	$\pm$ 5.6 = 70	5.6 ÷ 30 = 0.1870 (0.1870 = **STF**)
4.75 mm Sieve	0 = 100	$\pm$ 5.7 = 70	5.7 ÷ 30 = 0.1900 (0.1900 = **STF**)
2.36 mm Sieve	0 = 100	$\pm$ 4.6 = 70	4.6 ÷ 30 = 0.1534 (0.1534 = **STF**)
75 um Sieve	0 = 100	$\pm$ 2.0 = 70	2.0 ÷ 30 = 0.0670 (0.0670 = **STF**)
Asphalt Cement	0 = 100	$\pm$ 0.4 = 70	0.4 ÷ 30 = 0.0134 (0.0134 = **STF)**

Paver Laid Surface Treatment

9.5 mm Sieve	0 = 100	$\pm$ 5.0 = 70	5.0 ÷ 30 = 0.1667 (0.1667= **STF**)

4.75 mm Sieve	0 = 100	$\pm$ 4.0 = 70	4.0 ÷ 30 = 0.1333 (0.1334 = **STF**)
2.36 mm Sieve	0 = 100	$\pm$ 4.0 = 70	4.0 ÷ 30 = 0.1333 (0.1334 = **STF**)
300 um Sieve	0 = 100	$\pm$ 3.0 = 70	3.0 ÷ 30 = 0.1000 (0.1000 = **STF**)
75 um Sieve	0 = 100	$\pm$ 2.0 = 70	2.0 ÷ 30 = 0.0670 (0.0670 = **STF**)
Asphalt Cement	0 = 100	$\pm$ 0.4 = 70	0.4 ÷ 30 = 0.0134 (0.0134 = **STF)**

B. Determination of Plant Score:

1 The plant score is determined from the mix scores and the percent of each type mix produced as a function of total production. Acceptance sample results shall be used in determining the monthly asphalt plant rating. Monthly plant ratings shall be based on a minimum of three extractions per mix. If less than three extractions are taken, the mix will not be rated. A monthly rating of less than 70 for any mix will result in an overall monthly plant rating of less than 70.

The score for each rated sieve and AC based on the average absolute deviation from the job mix formula is divided by the specification tolerance factor (**STF**) and then subtracted from 100. Find the score to the nearest one decimal place.

2. PLANT SCORE = The sum of (% of type mix of total production x mix score)

3. Listed below is an example of a plant score that has produced two different mixes, a 9.5 mm Type 1 Superpave and a 12.5 mm Superpave.

a. Example: Type 9.5 mm Superpave Type 1 Produced Tons =1000

Average Absolute Deviation from Job Mix Formula				
Sieves	**4.75 mm**	**2.36 mm**	**75 um**	**AC**
Test 1	0.6	1.3	0.8	0.08
Test 2	1.3	2.8	1.3	0.13
Test 3	3.0	3.4	0.8	0.17
Test 4	1.0	1.9	1.5	0.22
Test 5	3.1	3.5	1.4	0.09
Avg. Abs. Dev.	1.800	2.580	1.160	0.138

Grades	4.75 mm	100 – (1.800 ÷ 0.1870) = 90.37
	2.36 mm	100 – (2.580 ÷ 0.1534) = 83.18
	75 um	100 – (1.160 ÷ 0.0670) = 82.69
	AC	100 – (0.138 ÷ 0.0134) = 89.70

Mix Score for 9.5 mm Superpave Type 1

$$\left\{\frac{[(90.37 + 83.18 + 82.69) \times .60]}{3} + (89.70 \times .40)\right\} = 87.1$$

b. Example: 12.5 mm Superpave Produced Tons = 785

Average Absolute Deviation from Job Mix Formula				
Sieves	**9.5 mm**	**2.36 mm**	**75 um**	**AC**
Test 1	2.1	1.6	0.8	0.06
Test 2	1.1	1.3	0.3	0.11
Test 3	1.6	1.45	.55	0.085
Avg. Abs. Dev.	1.6	1.45	0.55	0.085

Grades	9.5 mm	100 – (1.60 ÷ 0.1870) = 91.44
	2.36 mm	100 – (1.45 ÷ 0.1534) = 90.55
	75 um	100 – (0.55 ÷ 0.0670) = 91.79
	AC	100 – (0.085 ÷ 0.0134) = 93.66

Mix Score for 12.5 mm Superpave

$$\frac{[(91.44 + 90.55 + 91.79) \times .60]}{3} + (93.66 \times .40)\} = 92.2$$

c. Weighted Average Rating for Day's Run

9.5 mm Superpave Type 1 ={ [1000/(1000 + 785)] x 100} = 56.02 % of day's production

12.5 mm Superpave = {[785/(1000 + 785)] x 100} = 43.98 % of day's production

Total day's production = 1785 Tons

Plant Score: (87.1 x 0.5602) + (92.2 x 0.4398) = 89.3

Note: Example is for one day's run; format would be the same for any chosen span of time.

C. Determination of Overall Plant Rating for Extended Time Periods

1. Overall Plant Rating for time periods longer than one month will be calculated based upon the average of the monthly plant ratings and adjusted for the tonnage produced per month to provide weighted plant ratings for the time period being rated.

a. Example Begin date 1/1/11 To 6/30/11

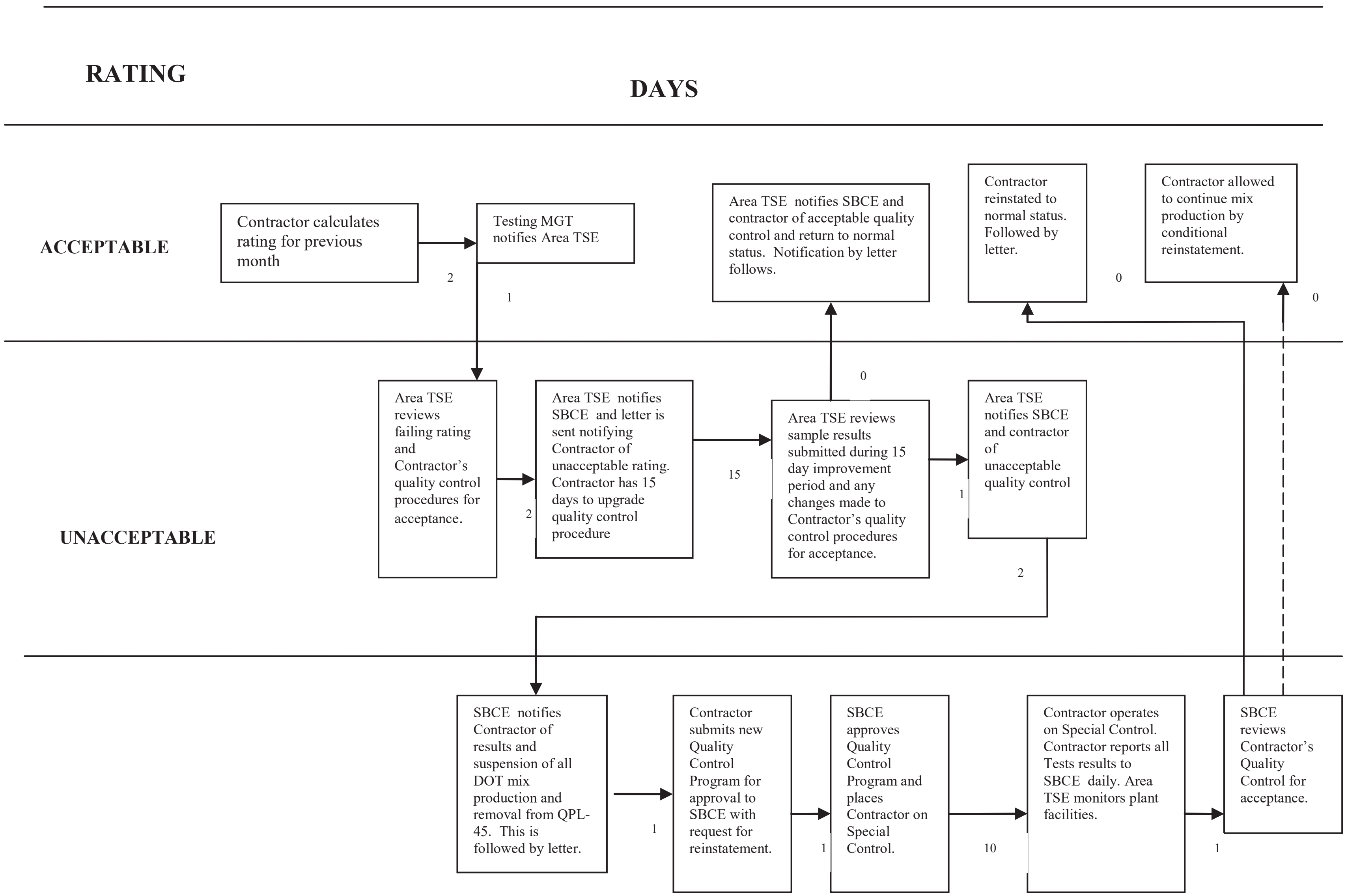
Date	Tonnage	% Tonnage	Plant Rating	Calculation	Weighted Rating
1/11	1785	21.8	89.3	(.218 x 89.3)	19.5
2/11	800	9.8	90.7	(.098 x 90.7)	8.9
3/11	1500	18.3	95.3	(.183 x 95.3)	17.4
4/11	500	6.2	86.7	(.062 x 86.7)	5.4
5/11	2000	24.4	91.7	(.244 x 91.7)	22.4
6/11	1600	19.5	94.0	(.195 x 94.0)	18.3
Totals	8185	100.0			91.9

Average Plant Rating for the time period 1/01/11 to 6/30/11 = 91.9

F. Report

1. Report test results monthly on a Quality Control Rating form; however, you may make more frequent checks to determine the effectiveness of a Contractor's quality control procedure.
2. Unless approved by the Office of Materials and Research, close all open Lots of Asphaltic Concrete on the last day of the month.
3. Make reports on the first working day after the end of each rating period. Notify the Area Bituminous Construction Engineer of the results in writing.
4. Yearly Plant Ratings will be reported annually by the Office of Materials and Research
5. Figure 107-1, below, describes the normal reporting procedure.
6. To be included in the List of Approved Hot Mix Asphaltic Concrete Plants (QPL 45), a Contractor must meet the requirements of SOP 27 which requires an acceptable rating. Figure 107-1

Figure 107-1


RATING
DAYS
ACCEPTABLE
Contractor calculates rating for previous month
2
Testing MGT notifies Area TSE
1
Area TSE notifies SBCE and contractor of acceptable quality control and return to normal status. Notification by letter follows.
Contractor reinstated to normal status. Followed by letter.
0
Contractor allowed to continue mix production by conditional reinstatement.
0
UNACCEPTABLE
Area TSE reviews failing rating and Contractor's quality control procedures for acceptance.
2
Area TSE notifies SBCE and letter is sent notifying Contractor of unacceptable rating. Contractor has 15 days to upgrade quality control procedure
15
0
Area TSE reviews sample results submitted during 15 day improvement period and any changes made to Contractor's quality control procedures for acceptance.
1
Area TSE notifies SBCE and contractor of unacceptable quality control
2
SBCE notifies Contractor of results and suspension of all DOT mix production and removal from QPL-45. This is followed by letter.
1
Contractor submits new Quality Control Program for approval to SBCE with request for reinstatement.
1
SBCE approves Quality Control Program and places Contractor on Special Control.
10
Contractor operates on Special Control. Contractor reports all Tests results to SBCE daily. Area TSE monitors plant facilities.
1
SBCE reviews Contractor's Quality Control for acceptance.

GDT 125 – DETERMINING ASPHALT CONTENT BY IGNITION

A. Scope

This test measures the asphalt cement content of asphaltic concrete mixtures, Reclaimed Asphalt Pavement (RAP), and Reclaimed Asphalt Shingles (RAS) by burning away the asphalt binder in a high-temperature furnace. The aggregate remaining may be used for sieve analysis using AASHTO T-30 or GDT 38. The method includes the procedure for determining the calibration factor and notes on calibrating mixtures containing hydrated lime and fiber additives.

For a complete list of GDTs, see the Table of Contents (GDT Table of Contents in The Source, on line).

B. Apparatus

1. Ignition furnace

   The test requires an ignition furnace designed for determining asphalt cement content. The furnace may heat the sample by convection or radiant heating. It must be equipped with an internal balance thermally isolated from the furnace chamber. The internal balance must be capable of weighing a 3500 gram sample in addition to the sample baskets, and it must be calibrated and certified as meeting the requirements of AASHTO T-308. Calibration and certification must be performed every twelve months using certified NIST-traceable weights or by an independent calibration service. Additional calibrations may be required when error is suspected. Maintain records of all calibrations and certifications, including those for certified NIST-traceable weights, if used.

   The furnace must incorporate an internal data collection system which automatically prints and displays ignition chamber temperature, weight loss, and per cent weight loss each minute during the test. The data system shall provide for the input of the Calibration Factor and shall issue a printed record of each test, listing the initial sample weight in grams, the Calibration Factor (%), calibrated asphalt content (%), elapsed time, and chamber temperature (°C). The furnace shall be equipped with an audible alarm and indicator light which signals when the weight loss does not exceed 0.1% of the sample weight for three consecutive minutes. The sample door must be equipped with an automatic lock to prevent its being opened during the ignition test. The furnace must heat the sample sufficiently to ignite and completely vaporize the liquid asphalt, and it must be equipped with an exhaust filtration system to vaporize or remove airborne particles. The furnace must be vented to the outside via an exhaust system capable of maintaining sufficient draft to prevent the escape of smoke and strong odors into the laboratory. The exhaust must not be vented near flammable materials.

2. Sample basket assembly

   A complete sample basket assembly designed for the furnace is required, consisting of two baskets with covers, a catch pan, and a retaining bracket, all made of a high-temperature alloy. The basket must enclose the sample completely with perforated sheet metal to allow air and combustion gases to flow through and around the sample with no measurable removal of dust particles. The baskets and catch pan must fit together in a stack, so that the catch pan will receive all particles that may fall from the baskets. In addition, a special lifting fork designed by the manufacturer for lifting the basket assembly must be provided.

3. Laboratory oven

   Provide a laboratory oven to loosen and dry samples. It must maintain a temperature of 260° F (125° C).

4. Laboratory balance

   Provide a laboratory balance with a capacity of at least 6,500 grams meeting the requirements of AASHTO M-231, Class G-2 (i.e., readability and sensitivity to 0.1 g and accuracy of 0.2 g or 0.1 percent). The balance must be calibrated and certified to meet these requirements every twelve months using certified NIST-traceable weights, if owned, or by an independent calibration service. Maintain records of all calibrations and certifications, including those for certified NIST-traceable weights, if used.

5. Safety equipment

   The operator must wear high-temperature protective apparel including forearm covers, apron, gloves, and safety glasses or face shield. Provide a heat resistant surface capable of withstanding 1200 °F (650 °C), and a protective cage to surround the sample baskets.

6. Miscellaneous equipment for gradation analysis

   Provide a metal pan larger than the sample baskets for transferring samples after ignition. Provide a plastic wash bottle, trowel, spoon, spatula, bowl, quartering device, 2-inch paint brush, and a wire sieve brush.

C. Procedure

1. Prerequisites.

a. Use the Calibration Factor (CF) established for the mixture to be tested. (Here *mixture* means a formulation of ingredients from specific sources according to an approved mix design.) *Use the mix designer's CF when available, or as provided in E.1 below*. See E.1 for the requirements for calibrating mixtures.
b. The technician-operator must be thoroughly familiar with the operating manual provided by the manufacturer of the furnace, especially with the safety information. A copy of the manual shall be available for reference.
c. Inspect the ignition furnace for cleanliness, safety, and correct alignment of the internal balance. The ceramic tubes which support the sample platform must be centered in the holes in the bottom of the chamber. Refer to the manufacturer's instructions for cleaning and maintenance. Clean the flue filter as recommended by the manufacturer or if the lift test reading is below the limit established by the manufacturer.
d. Ensure that the furnace is set to print out all data points; **do not use the abbreviated print-out.** Ensure that the paper tape supply is sufficient to complete the test.

2. Preparation of samples

Obtain samples according to GSP-15. Samples may consist of loose material or cores heated and broken down. Ensure that samples are dried to a constant weight, as necessary. Take normal precautions in handling to avoid segregating the mix. Refer to the table below to determine the correct sample weight for the type of mix to be tested. Samples of loose mix must be reduced by splitting or quartering to fall within the specified range. When sampling loose mix, ensure that the weight collected will obtain a weight within the specified range after it is split or quartered. Note that the quartered or split sample must not exceed the specified size. If a sample cannot be separated with a trowel or quartering device, heat it in a laboratory oven at not more than 260 °F (125 °C) until it becomes workable. Avoid heating longer than necessary. Heat and separate roadway core samples in the same manner. Obtain core samples in sufficient numbers for the tested layer to fall within the weight range specified in the table below.

Sample Weights for Ignition Tests, in grams

Mix Type	Minimum weight	Maximum weight
25 mm Superpave	2500	3500*
19 mm Superpave	2000	3000*
12.5 mm Superpave	1500	2500*
9.5mm Superpave	1200	2200*
4.75 mm Mix	1000	2000*
9.5 mm OGFC	1000	2000*
12.5 mm OGFC	1200	2200*
12.5 mm PEM	1200	2200*
19 mm SMA	2000	3000*
12.5 mm SMA	1500	2500*
9.5 mm SMA	1200	2200*

*Check for signs of incomplete burning when sample size approaches maximum weight.

NOTE: Steps 3 through 12 below describe how to operate a typical furnace. Ignition furnaces from different manufacturers vary in the arrangement and functions of manual controls, although the test method is essentially the same. The following instructions are written primarily for convection furnaces, which are the most common models. For models programmed to display menus and instructions, follow the programmed prompts. Refer to the manufacturer's handbook for instructions on the particular type and model to be used.

3. Temperature

If the furnace is of the convection type, pre-heat it to the "set point" temperature of 1000 °F (538°C). (When testing an aggregate which fractures in high heat, it may be necessary to select a lower set point or temperature profile according to the manufacturer's instructions. Refer to E.4 below for requirements for the Aggregate Gradation

Correction Factor.) To set, press “Temp” and enter the target temperature (“set point”) of 1000 °F (538 °C). Press “Enter” and note the temperature displayed before starting the test.

4. Settings

   Ensure that the "Test Stability Threshold" setting is set to 0.1g.

   If the device features more than one automatic cutoff mode ("burn mode"), select a mode which stops the test when the incremental weight loss falls below the cutoff limit for three minutes. Do not set burn time manually for routine tests.

5. Enter Calibration Factor (CF)

   For convection furnaces, enter the CF ("% Correction”), by pressing “% Correction”. The display will read “0.00”. Enter the Calibration Factor for the specific mix to be tested, as determined by the procedure in section E below, and press “Enter”. *To enter a negative calibration factor, press “% Correction” twice, then enter the numerals.* The Calibration Factor will be displayed with a negative sign in the window.

   Alternatively, the CF may be set to zero; this is recommended where multiple mix designs will be tested, to reduce the possibility of incorrect entries. Either value may be used for step D.2 below.

6. Weigh the basket assembly

   Weigh the empty sample baskets and catch pan on the laboratory balance with covers and retaining bracket in place and record the total weight of the assembly (tare weight) on the worksheet provided below. Note: Record all weights on the worksheet to 0.1 gram.

7. Load the sample

   Fit the lower sample basket onto the catch pan. Using a spatula or trowel, spread about half of the sample into the lower basket in an even layer, taking care to keep the material away from the sides. Fit the upper basket in place over the lower one. Spread the remainder of the sample into the upper basket in an even layer, and install the basket cover and guard.

8. Record combined and net weights

   Using the laboratory balance, measure and record the initial combined weight of the assembly and sample, to 0.1 gram. Subtract the empty weight of the assembly determined in step 6 above and record the initial net weight of the sample, **W.**

9. Enter initial sample weight in furnace

   a. Press “Weight” and key in the *net weight* **W** of the sample. (The furnace accepts only a four-digit whole number.) The “Percent Loss” window will briefly display the sample weight. Immediately press “Enter.”

   b. Press "Weight" again and **verify the sample weight**. The results printed on the ticket will be calculated from this initial sample weight and the loss measured by the internal balance.

   c. Tare the internal balance by pressing the zero key.

10. Install baskets

    Using the special lifting fork, place the sample basket assembly into the ignition chamber. Important: The assembly must be placed gently on the sample platform to avoid dislodging the ceramic tubes which support the platform. Ensure that the basket assembly does not contact the sides and that the door latch is secure. The convection furnace will display the total weight of the assembly in the window marked “Balance Indicator.” <u>As a check before proceeding, confirm that this weight does not differ from the total weight recorded in step 8 by more than 5.0 grams.</u> Failure of these weights to agree within 5.0 grams indicates a malfunction or an error in weighing, recording, or entering. In this event, re-weigh the sample on the external scale and, wearing the prescribed protective apparel, *confirm visually that the sample platform and ceramic tubes in the furnace are properly positioned and not bound by loose particles and that the assembly is not touching the walls of the chamber.*

11. Start test

    Press the “Start/Stop” button. This will lock the ignition chamber door, actuate the combustion blower, and start the test. The test will continue until the weight of the sample has stabilized, during which time the apparatus will record the progressive loss of weight from the sample and the changes in chamber temperature. (Note: It is normal for the temperature to decrease below the set temperature initially and to rise well above it as the sample fully ignites.)

12. End of Test

    When the weight of the sample has stabilized, this will be indicated by a light and audible signal. Press the “Start/Stop” button again to unlock the chamber and cause the printer to print the test results. Wearing the prescribed protective apparel, use the special lifting fork to gently move the assembly to a safe location for cooling. Place the protective cage over the basket assembly during cooling.

13. Record final weight of burned sample and basket assembly

When the sample and basket assembly have cooled to a safe temperature for handling, return them to the laboratory balance. Record the final combined weight on the worksheet where indicated.

14. Gradation.

    Empty all contents of the sample basket assembly into a flat pan, using a brush to dislodge any fines remaining on the baskets and catch pan. Re-weigh the sample. As a check, compare with weight obtained in step13 above, minus weight of basket assembly obtained in step 6. (Do not re-weigh the empty basket assembly.) Perform a gradation analysis according to AASHTO T-30 or GDT 38, as required. A washed gradation must be performed for every test; however, the 2.36 mm sieve and above may be omitted unless otherwise required. Record results on the worksheet below.

D. Calculation and report.

Use the worksheet below for recording and calculating all data. For acceptance and project record purposes, report results on Form DOT 159-5 and store the worksheet and the complete print-out with the project records. The steps indicated in the worksheet follow the instructions below. Note: Users may obtain the electronic version of the worksheet from the State Asphalt Design Engineer. Alternatively, a contractor may use a modified version of the worksheet which has been approved by the State Asphalt Design Engineer. The modified version shall include all information required in the original worksheet and may include additional information useful to the contractor.

1. Calculate the asphalt content of the sample as follows: Subtract the combined weight of sample and basket assembly after burning from the initial combined weight from step C.8. Record as "Loss, **W–W'**." Divide this by the initial net weight **W**, multiply by 100 per cent, and record as the Percent Loss. Subtract the approved CF for the mix design. Record this result on the worksheet as Calculated Asphalt Content.

   For acceptance testing: Use Calibrated Asphalt Content from printed ticket for the acceptance result. Follow Part D.2 below to compare "Calibrated Asphalt Content" from printed ticket with "Calculated Asphalt Content" from calculation above. (If no CF was entered in furnace, first apply the CF to the result on ticket.) Add completed worksheet form below and printed ticket to project records. *Worksheet must show both results.*
2. Compare Calculated Asphalt Content to result from printed ticket: In the spaces provided on the worksheet, re-enter Calculated Asphalt Content (from line 8) and the "Calibrated Asphalt Content" from the furnace's print-out. (If the CF entered in the furnace is zero, re-enter Percent Loss from line 7 step D.1.) If the difference between the two exceeds **0.15%**, a malfunction or weighing error may have occurred. Re-check the furnace and calculations and re-weigh the sample. If difference is not resolved, notify the State Asphalt Design Engineer, District TMOS and area Technical Service Engineer and record the date and time, project number, lot number, both results, and the name of the technician performing the test in the Plant Diary. The District TMOS and area Technical Service Engineer may be contacted to request assistance in resolving the discrepancy. These parties shall always be contacted for their concurrence prior to burning the opposite quarters.
3. Always attach the original printout to the worksheet.
4. Adjustment for un-calibrated mixtures containing lime: In some cases (e.g., for testing RAP) it is necessary to determine the asphalt content of a mixture for which no CF can be determined. It has been established through field studies that mixtures containing 1% hydrated lime required an average adjustment of -0.28%. Where permitted, use this value in place of the calibration factor for mixtures known to contain 1% lime.

E. Calibration procedure

1. Requirements

   An approved CF is required for each new mix design; it shall remain in effect for the design unless, upon verification, it is found to be inaccurate by the State Bituminous Construction Engineer. A new approved calibration is required when the mix design CF is found to be inaccurate or when the dosage rate of hydrated lime, cellulose fiber, or other combustible ingredient is changed. For mix designs approved prior to this requirement, an approved CF must be obtained for use in acceptance testing. Calibrations, verifications, and re-calibrations must be performed according to the procedure below, either by or under the supervision of a certified Superpave Mix Design Technician. Submit printouts and the calibration worksheet, bearing the name and certification number of the technician who performed or directly supervised the work, to the State Bituminous Construction Engineer for approval.

   A new calibration is not warranted for an adjustment in the Job Mix Formula except upon adjustment of the dosage rate of hydrated lime, cellulose fiber, or other combustible ingredient. However, verification of a CF may be requested if inaccuracy is suspected.
2. Preparation of samples

Prepare three samples at the gradation and asphalt content of the mix design, using the ingredients from the sources and stockpiles from which the mix will be produced. Ensure that aggregate ingredients have been dried to a constant weight. Batch size should exceed the minimum weight in the table of Section III by not less than 300g. Mix and discard one of the three samples as a “butter mix” to prepare the mixing vessel.

The following special requirements shall apply when calibrating mixtures containing Recycled Asphalt Pavement (RAP): Do not use the average asphalt content of the RAP stockpile for batching. Prior to batching, split a sufficient quantity of RAP using a sample splitter or quartering device, as described in AASHTO T-328. Determine the actual asphalt cement content of one portion by ignition or solvent extraction and use this value in the batching calculations. (Refer to D.4 above.) Avoid segregating the RAP in handling. If RAP constitutes more than 15 % of the mix, break it down in a screen shaker (e.g., Gilson shaker) and re-combine the sizes in the same manner as the virgin aggregate.

The coating of asphalt cement and fines on the tools and mixing vessel should not be allowed to accumulate from sample to sample. Perform the following check after mixing the samples: Average the two net weights (**W** on line 3 of the calibration worksheet) of the calibration samples, divide by their batch weight, and subtract the result from 1. Do not use the samples if the difference exceeds 0.005.

Note: Loss of sample weight in mixing may be excessive in mixes with high film thickness, such as open-graded mixes and SMA. If this loss cannot be controlled, the calibration samples may be batched at an asphalt content 0.5% below optimum.

3. Test and calculation

   Test the mixture specimens in the ignition furnace, following the test procedure above, steps C.3 through C.13. In Step C.5 enter a calibration value of zero. Using the Calibration Worksheet below, calculate the percent weight loss of each sample based on the initial and final weighings. Record results in the columns for samples A and B. If the two samples differ in percent loss by more than 0.15 %, prepare and test two additional samples. Calculate the percent loss for each of these samples and enter results in the columns for samples C and D. Omitting the highest and lowest percent loss, subtract the as-mixed asphalt content from the two remaining. Calculate and record the algebraic average of the two results as the CF for the mix design.

4. Aggregate Gradation Correction Factor.

   When testing materials with a history of excessive breakdown during heating, determine and apply the Aggregate Gradation Correction Factor according to Sections A.2.1 through A.2.9 of AASHTO T-308. The calibration worksheet and printed tickets should be submitted with the mix design to the State Bituminous Construction Engineer for approval.

F. Verification of CF

For quality control and acceptance testing, the accuracy of the CF must be verified at certain intervals for each mix design to be produced. Requirements for verifications are set forth in SOP 2.

WORKSHEET FOR GDT-125 - ASPHALT CONTENT BY IGNITION

Test date ________________________Technician preparing report:__________________________________

Mix identification no. & source of mixture ______________________________ Source code_________

Project no./contract id: _______________________________Comparison with (IA samples only) _________

A. CALCULATED ASPHALT CONTENT

Initial weight: (See C.9b) (1) basket assembly _________.__ g

(2) sample + basket assembly _________.__ g

(3) initial weight of sample, (2) – (1) _________.__ g (**W**)

Weight after burn: (4) sample + basket assembly _________.__ g

(5)final weight of sample, (4) – (1) _________.__ g (**W'**)

Weight Loss: (6) **W — W'** = _________.__ g

Percent Loss: (7) $\frac{(W - W')}{W}$ X 100% _________.___ %

Subtract calibration factor. — __.___%

(8) ASPHALT CONTENT ___.___%

B. CHECK RESULTS

Record "Calibrated Asphalt Content" from printed ticket. __________%

Subtract Asphalt Content (8) or Percent Loss (7) if furnace CF is set to zero.. __________%

Difference __________%

If difference exceeds 0.15%, check furnace, re-weigh sample, and review test for errors. If difference is not resolved, see step D.2 of procedure. **Attach print-out to this worksheet. *Use Calibrated Asphalt Content from printed ticket for Acceptance***

C. GRADATION BY GDT 38 AND AASHTO T-11:

Sieve size, in. (mm)	Wt. retained	Cumulative wt. retained, R	Percent passing P=100%[1-R/T]	Job Mix Formula	deviation
1½ (37.5)					
1 (25)					
¾ (19)					
½ (12.5)					
3/8 (9.5)					
#4 (4.75)					
#8 (2.36)					
#16 (1.18)					
#30 (0.600 mm)					
#50 (0.300 mm)					
#100(0.150 mm)					
#200(0.075 mm)					
Pan					

Check: Percent passing #200 versus weight from pan + amount removed by washing:

pan +loss by washing	g	----------	%

Notes: ____

WORKSHEET FOR GDT-125 – Determining Calibration Factor (CF)

For Mix design No. ________________________ Optimum AC __.__% Batch weight ___________.__ g

Attach batch sheet from mix design. List here the percentages of lime, cellulose fiber, rubber, and other special ingredients, as applicable: ____

____

	Sample A	**Sample B**	**Sample C***	**Sample D***
(1) Wt. of basket assembly				
(2) Initial wt. of basket assembly & sample				
(3) **W** = Initial net wt of sample, (2) – (1)				
(4) Wt. of sample & basket assembly after ignition				
W' = Wt of sample after ignition (4) – (1)				
Enter loss, **W – W'**, (2) – (4)				
P', Per cent loss: **P'**=**[[W – W']÷W] x 100%**				
Minus **P,** the % AC as mixed				
Difference **Δ = P' – P** (record negative sign if **P** is greater.)				

***** Samples C and D will be needed only if **P'** of A and **P'** of B differ more than 0.15%. If so, prepare and test Samples C and D. Ignore highest and lowest of the four Δ's.

<u>Calibration factor</u>. Average the two Δ's: _.__ % **This is the CF.** (Be sure to take the *algebraic* average. For example, the algebraic average of 0.06 and - 0.10 is - 0.02.) Round to two decimal places.

<u>Check: Compare CF to value from printed tickets</u>.

Average "Calibrated Asphalt Content" from the two printed tickets. __________%

Average the two Percent Losses from table above and subtract. – _________%

Difference __________%

If these values differ more than 0.15%, check furnace, re-weigh sample, and review test for errors. If difference is not resolved, repeat the calibration procedure. **Attach all print-outs to this worksheet.**

<u>Notes</u>

1. In mixtures containing lime, the CF for a lime mix is normally negative. Other ingredients, such as cellulose fibers and rubber, have an opposite but lesser effect.

2. The CF normally will fall between 0.10% (without lime) and – 0.38% (with lime). A CF which is outside this range or differs substantially from CF's for mixes with the same ingredient sources should be suspect. Check weights and calculations for error. If not corrected, the CF should be verified by repeating the calibration.

Date _________

Certified Mix Design Technician who performed or supervised the calibration ______________________________

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to determine the amount of drain-down in an uncompacted bituminous mixture when the sample is held in an oven at an elevated temperature. This test is particularly applicable to Modified Open-Graded Friction Course (OGFC) and Stone Matrix Asphalt (SMA) mixtures.

B. Apparatus

1. Oven capable of maintaining a temperature of 400 °F (204 ^{o}C). The oven should maintain the set temperature ± 3.5 °F (2 ^{o}C)during testing.
2. 9 inch (225 mm) paper plates capable of withstanding the test temperature of 350 ° ± 3.5 °F (177 °C ± 2 °C).
3. Standard basket meeting the dimensions shown in Figure A. Consturct the basket using standard 1/4 in (6.3mm) wire sieve cloth as specified in AASHTO M 92-91.
4. Spatulas, trowels, mixer, and bowls as needed.
5. 8.8 lb (4000 gram) balance accurate to 0.00022 lb (0.1 gram).

C. Sample Size and Preparation

1. Laboratory Prepared Samples
   a. Two samples are required for this test.
   b. Dry aggregate to a constant mass. Sieve it to appropriate size fractions as indicated in the job mix formula.
   c. Select a mixing temperature of the modified A.C. using density vs. Temperature procedure.
   d. Weigh into separate pans for each test sample the amount of each size aggregate fraction required to produce sample having a total mass of approximately 2.7 lbs (1200 grams). The aggregate fractions combined in a manner that the resulting aggregate blend has the same gradation as the Job Mix Formula. Place the samples in an oven and heat to a temperature not to exceed the mixing temperature of the modified A.C. by more than approximately 50 °F (28 °C).
   e. Heat the asphalt cement to mixing temperature as determined in “c” above.
   f. Place the heated aggregate in the mixing bowl. Add stabilizing fibers, hydrated lime, and/or other dry admixtures as specified to the dried aggregate. Thoroughly mix the dry components before the addition of the modified asphalt cement. Form a crater in the aggregate and add the required amount of asphalt cement as established in GDT 114. At this point, the temperature of the aggregate and asphalt cement shall be within the limits of the mixing temperature established in paragraph c of this Section. Using a spatula or mixer, mix the aggregate, admixtures, and asphalt cement quickly until the aggregate is thoroughly coated.
2. Plant Produced Samples
   a. Two samples shall be required from plant-produced mix.
   b. Sampling shall be in accordance with GSP 15 using the same technique stated for Asphaltic Concrete “D” mixtures with the following exceptions - samples shall have a total mass of 2.2-3.3 lbs (1000-1500 grams).

D. Procedures

1. Transfer the laboratory or plant-produced loose mixture to the tared test basket. Do not consolidate or otherwise disturb the sample. Determine the mass of the sample to the nearest tenth of a gram.
2. Record the mass of a paper plate to the nearest 0.00022 lb (0.1 gram). Place the basket on the paper plate and transfer the assembly into the oven set at 350 °F ± 3.5 °F (177 °C ± 2 °C) .
3. After the sample has been in the oven for 1 hour, remove the basket and paper plate. Record the mass of the paper plate plus the drained asphalt cement to the nearest 0.00022 lb (0.1 gram).

E. Calculations

Calculate the percentage of mixture that drained by subtracting the initial paper plate mass from the final paper plate mass and divide this by the initial sample mass. Multiply the result by 100 to obtain a percentage.

$$D = 100\,\frac{(P_f - P_i)}{M}$$

Where

P_i = Initial paper plate mass (grams)
P_f = Final paper plate mass (grams)
M = Mix mass (grams)
D = % Drain-down

F. Report

Report the average percentage drain-down to the nearest 0.01%