N E C E P T

Asphalt Construction Program

Bituminous Plant Technician Certification

Presented By

Northeast Center of Excellence for Pavement Technology

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N E C E P T

NECEPT WEB SITE

www.superpave.psu.edu

Training

- **PENNDOT Certification Program**
  - **Calendar of Courses**
  - **On Line Registration**
  - **Course Material**
  - **Exam Grades**

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Website
On-Line Registration

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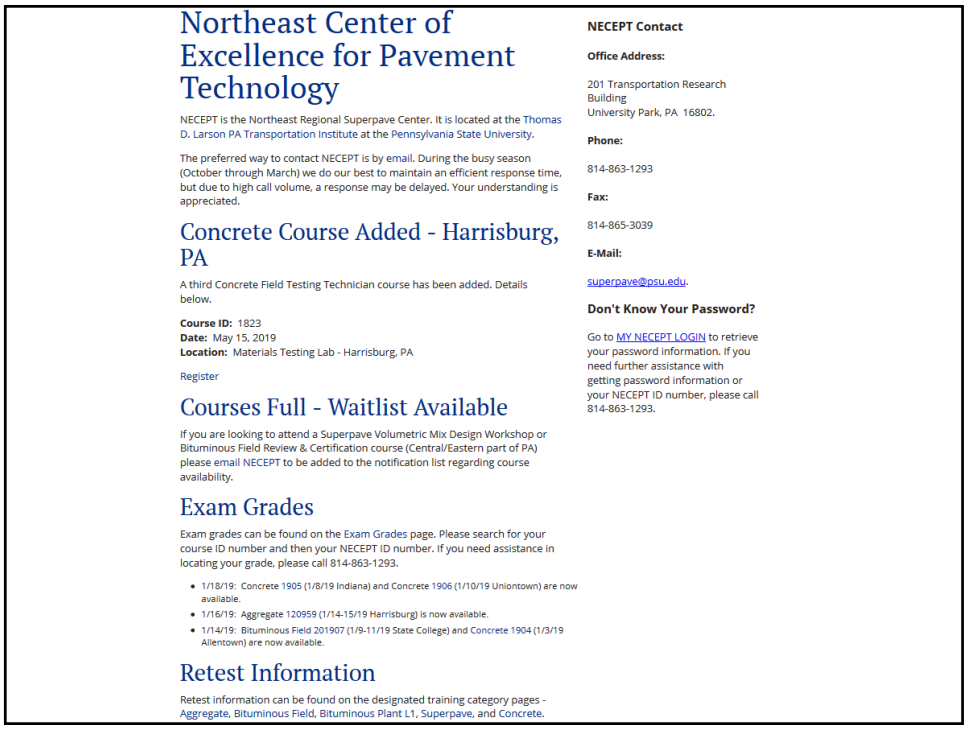

Northeast Center of Excellence for Pavement Technology

NECEPT is the Northeast Regional Superpave Center. It is located at the Thomas D. Larson PA Transportation Institute at the Pennsylvania State University.

The preferred way to contact NECEPT is by email. During the busy season (October through March) we do our best to maintain an efficient response time, but due to high call volume, a response may be delayed. Your understanding is appreciated.

Concrete Course Added - Harrisburg, PA

A third Concrete Field Testing Technician course has been added. Details below.

Course ID: 1823
Date: May 15, 2019
Location: Materials Testing Lab - Harrisburg, PA

Register

Courses Full - Waitlist Available

If you are looking to attend a Superpave Volumetric Mix Design Workshop or Bituminous Field Review & Certification course (Central/Eastern part of PA) please email NECEPT to be added to the notification list regarding course availability.

Exam Grades

Exam grades can be found on the Exam Grades page. Please search for your course ID number and then your NECEPT ID number. If you need assistance in locating your grade, please call 814-863-1293.

- 1/18/19: Concrete 1905 (1/8/19 Indiana) and Concrete 1906 (1/10/19 Uniontown) are now available.
- 1/16/19: Aggregate 120959 (1/14-15/19 Harrisburg) is now available.
- 1/14/19: Bituminous Field 201907 (1/9-11/19 State College) and Concrete 1904 (1/3/19 Allentown) are now available.

Retest Information

Retest information can be found on the designated training category pages - Aggregate, Bituminous Field, Bituminous Plant L1, Superpave, and Concrete.

NECEPT Contact

Office Address:

201 Transportation Research Building
University Park, PA 16802.

Phone:

814-863-1293

Fax:

814-865-3039

E-Mail:

superpave@psu.edu.

Don't Know Your Password?

Go to MY NECEPT LOGIN to retrieve your password information. If you need further assistance with getting password information or your NECEPT ID number, please call 814-863-1293.

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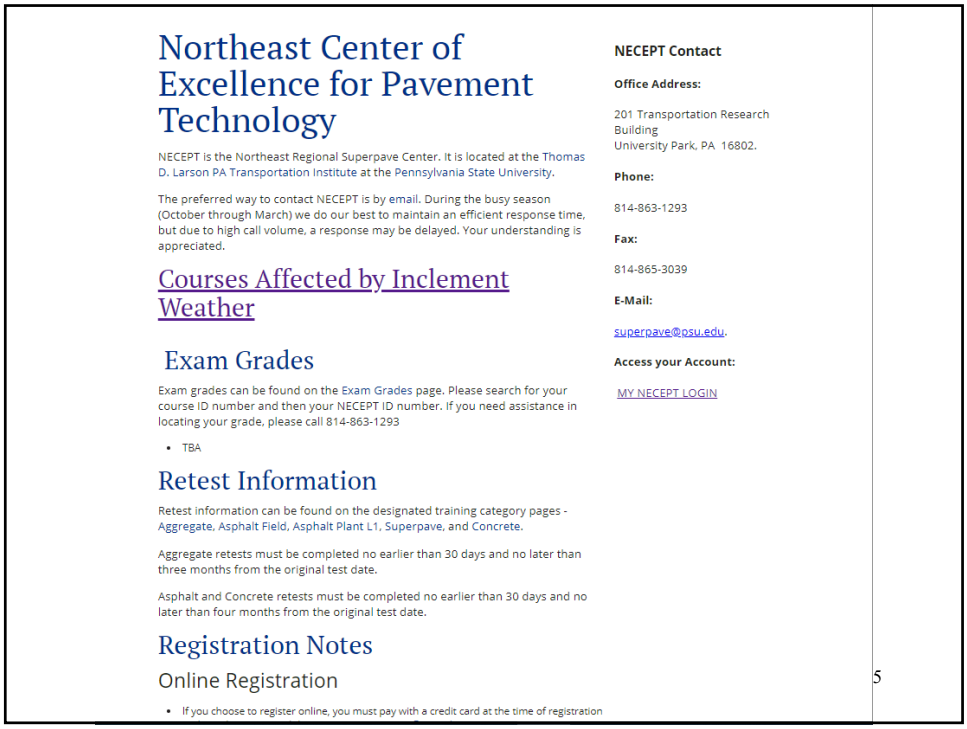

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Courses Affected by Inclement Weather

Exam Grades

Exam grades can be found on the Exam Grades page. Please search for your course ID number and then your NECEPT ID number. If you need assistance in locating your grade, please call 814-863-1293

- TBA

Retest Information

Retest information can be found on the designated training category pages - Aggregate, Asphalt Field, Asphalt Plant L1, Superpave, and Concrete.

Aggregate retests must be completed no earlier than 30 days and no later than three months from the original test date.

Asphalt and Concrete retests must be completed no earlier than 30 days and no later than four months from the original test date.

Registration Notes

Online Registration

- If you choose to register online, you must pay with a credit card at the time of registration

NECEPT Contact

Office Address:

201 Transportation Research Building
University Park, PA 16802.

Phone:

814-863-1293

Fax:

814-865-3039

E-Mail:

superpave@psu.edu.

Access your Account:

MY NECEPT LOGIN

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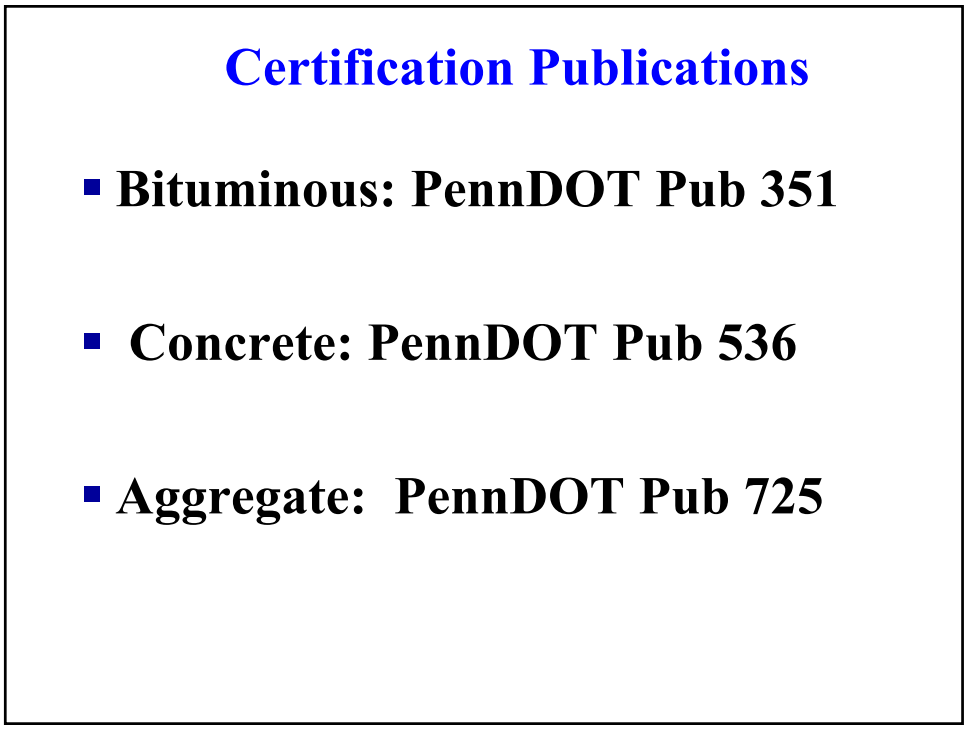

Certification Publications

- **Bituminous: PennDOT Pub 351**
- **Concrete: PennDOT Pub 536**
- **Aggregate: PennDOT Pub 725**

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Certification Categories

- Asphalt Field Technician
- Asphalt Plant Technician Level I
- Asphalt Plant Technician Level II
- Concrete Field Testing Technician
- Aggregate Technician
- PG Asphalt Binder Technician
  - (through NETTCP)

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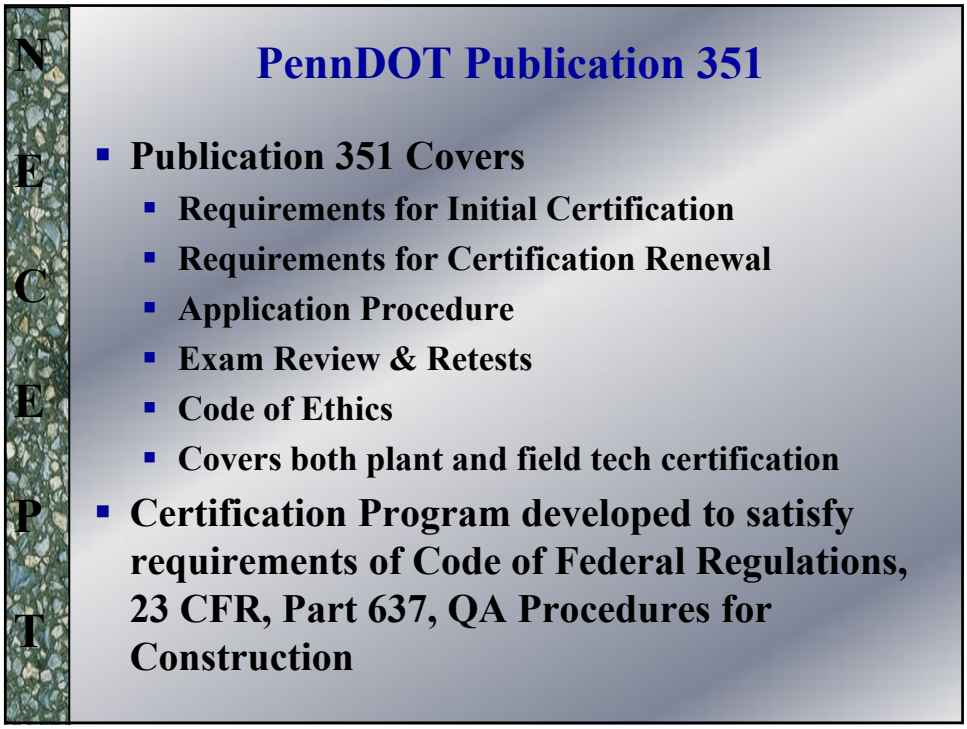
NECEPT
PennDOT Publication 351
Publication 351 Covers
Requirements for Initial Certification
Requirements for Certification Renewal
Application Procedure
Exam Review & Retests
Code of Ethics
Covers both plant and field tech certification
Certification Program developed to satisfy requirements of Code of Federal Regulations, 23 CFR, Part 637, QA Procedures for Construction

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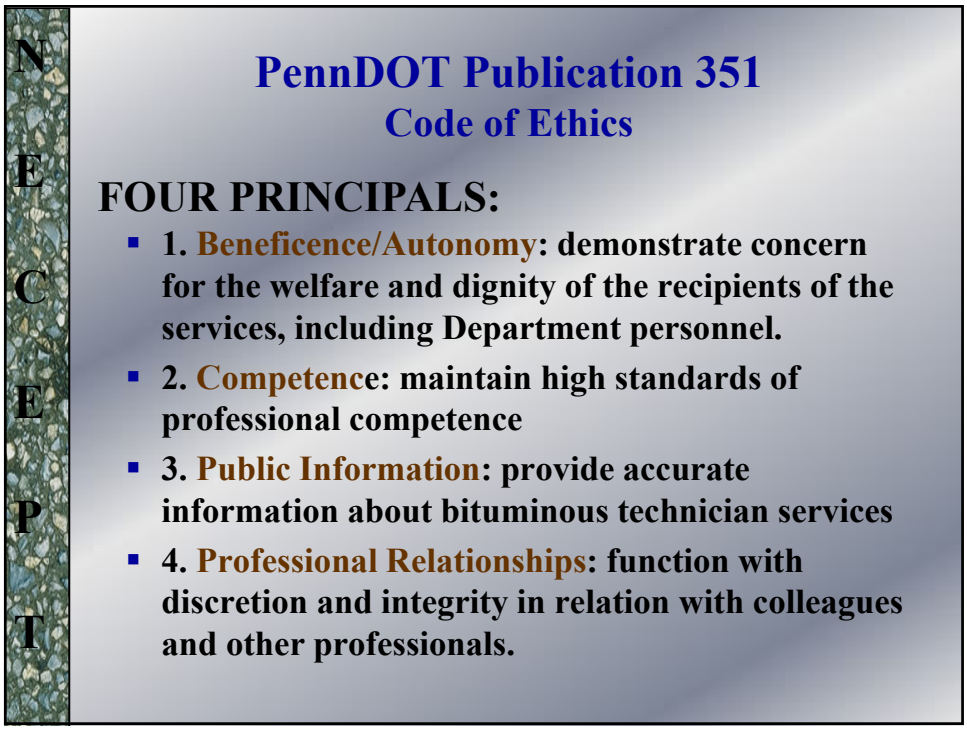
NECEPT
PennDOT Publication 351
Code of Ethics
FOUR PRINCIPALS:
1. Beneficence/Autonomy: demonstrate concern for the welfare and dignity of the recipients of the services, including Department personnel.
2. Competence: maintain high standards of professional competence
3. Public Information: provide accurate information about bituminous technician services
4. Professional Relationships: function with discretion and integrity in relation with colleagues and other professionals.

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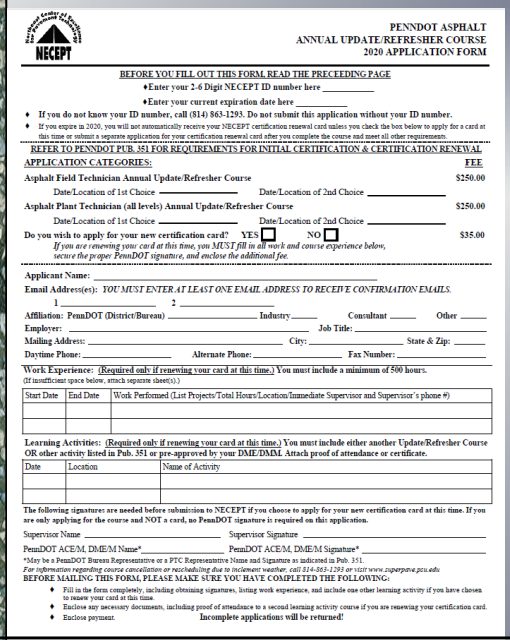
Certification Renewal



PENNDOT ASPHALT
ANNUAL UPDATE/REFRESHER COURSE
2020 APPLICATION FORM

BEFORE YOU FILL OUT THIS FORM, READ THE PRECEEDING PAGE
♦Enter your 2-6 Digit NECEPT ID number here _____
♦Enter your current expiration date here _____

♦ If you do not know your ID number, call (814) 863-1293. Do not submit this application without your ID number.
♦ If you expire in 2020, you will not automatically receive your NECEPT certification renewal card unless you check the box below to apply for a card at this time or submit a separate application for your certification renewal card after you complete the course and meet all other requirements.

REFER TO PENNDOT PUB. 351 FOR REQUIREMENTS FOR INITIAL CERTIFICATION & CERTIFICATION RENEWAL

APPLICATION CATEGORIES: FEE

Asphalt Field Technician Annual Update/Refresher Course $250.00
Date/Location of 1st Choice _____ Date/Location of 2nd Choice _____
Asphalt Plant Technician (all levels) Annual Update/Refresher Course $250.00
Date/Location of 1st Choice _____ Date/Location of 2nd Choice _____
Do you wish to apply for your new certification card? YES ☐ NO ☐ $35.00
If you are renewing your card at this time, you MUST fill in all work and course experience below, secure the proper PennDOT signature, and enclose the additional fee.

Applicant Name: _____
Email Address(es): *YOU MUST ENTER AT LEAST ONE EMAIL ADDRESS TO RECEIVE CONFIRMATION EMAILS.*
1 _____ 2 _____
Affiliation: PennDOT (District/Bureau) _____ Industry ____ Consultant ____ Other ____
Employer: _____ Job Title: _____
Mailing Address: _____ City: _____ State & Zip: _____
Daytime Phone: _____ Alternate Phone: _____ Fax Number: _____

Work Experience: (Required only if renewing your card at this time.) You must include a minimum of 500 hours.
(If insufficient space below, attach separate sheet(s).)

Start Date	End Date	Work Performed (List Projects/Total Hours/Location/Immediate Supervisor and Supervisor's phone #)

Learning Activities: (Required only if renewing your card at this time.) You must include either another Update/Refresher Course OR other activity listed in Pub. 351 or pre-approved by your DME/DMM. Attach proof of attendance or certificate.

Date	Location	Name of Activity

The following signatures are needed before submission to NECEPT if you choose to apply for your new certification card at this time. If you are only applying for the course and NOT a card, no PennDOT signature is required on this application.

Supervisor Name _____ Supervisor Signature _____
PennDOT ACE/M, DME/M Name* _____ PennDOT ACE/M, DME/M Signature* _____
*May be a PennDOT Bureau Representative or a PTC Representative Name and Signature as indicated in Pub. 351.
For information regarding course cancellation or rescheduling due to inclement weather, call 814-863-1293 or visit www.superpave.psu.edu
BEFORE MAILING THIS FORM, PLEASE MAKE SURE YOU HAVE COMPLETED THE FOLLOWING:
♦ Fill in the form completely, including obtaining signatures, listing work experience, and include one other learning activity if you have chosen to renew your card at this time.
♦ Enclose any necessary documents, including proof of attendance to a second learning activity course if you are renewing your certification card.
♦ Enclose payment. **Incomplete applications will be returned!**

Submit:

- **Certification Renewal Application**
- **With Processing Fee ($35.00)**

www.superpave.psu.edu

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Certification Renewal
Bituminous Level I Plant Technician
Pub 351: Section XI (Option A)

- **Level I certified for previous 5 years.**
- **500 documented hours experience in asphalt laboratory or plant since date of last certification.**
- **sign-off from supervisor or from a Level II Tech in company.**
- **sign-off from PennDOT DME/DMM.**
- **Within the previous 5 years, attended**
  - **Two NECEPT Plant Technician Update/Refresher Courses, or….**
  - **One NECEPT Update/Refresher Course and one acceptable asphalt-related conference, seminar, or workshop**

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Certification Renewal
Bituminous Level II Plant Technician

Pub 351: Section XII (Option A)

- **Level II certified for previous 5 years**
- **500 documented hours experience in asphalt lab or plant performing QC/QA testing or inspection since date of last certification**
- **sign-off from supervisor or from a Level II Tech in company.**
- **sign-off from PennDOT DME/DMM Within the previous 5 years, attended:**
  - **Two NECEPT Plant Technician Update/Refresher Courses, or….**
  - **One NECEPT Update/Refresher Course and one acceptable asphalt-related conference, seminar, or workshop**

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Accepted Asphalt-Related Annual Conferences, Seminars, and Workshops

- Annual APC Conferences
- Annual PAPA Conferences
- Mid-Atlantic States Quality Assurance Workshop
- Nationally Recognized Conferences or Courses
- PennDOT pre-approved Department or Industry sponsored training

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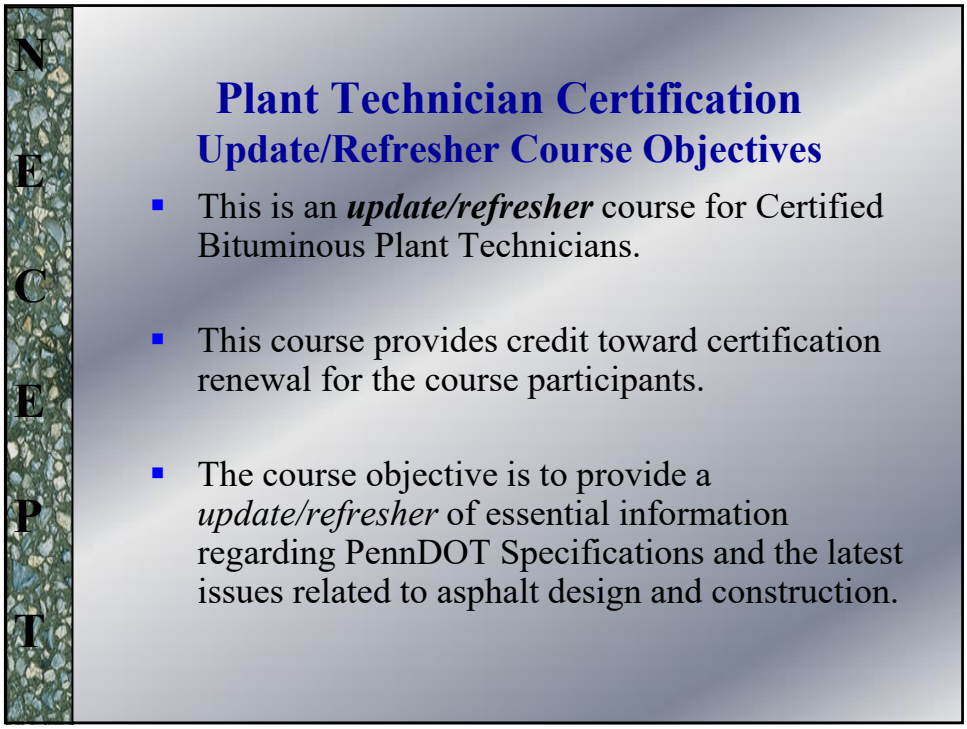
NECEPT
Plant Technician Certification
Update/Refresher Course Objectives
This is an update/refresher course for Certified Bituminous Plant Technicians.
This course provides credit toward certification renewal for the course participants.
The course objective is to provide a update/refresher of essential information regarding PennDOT Specifications and the latest issues related to asphalt design and construction.

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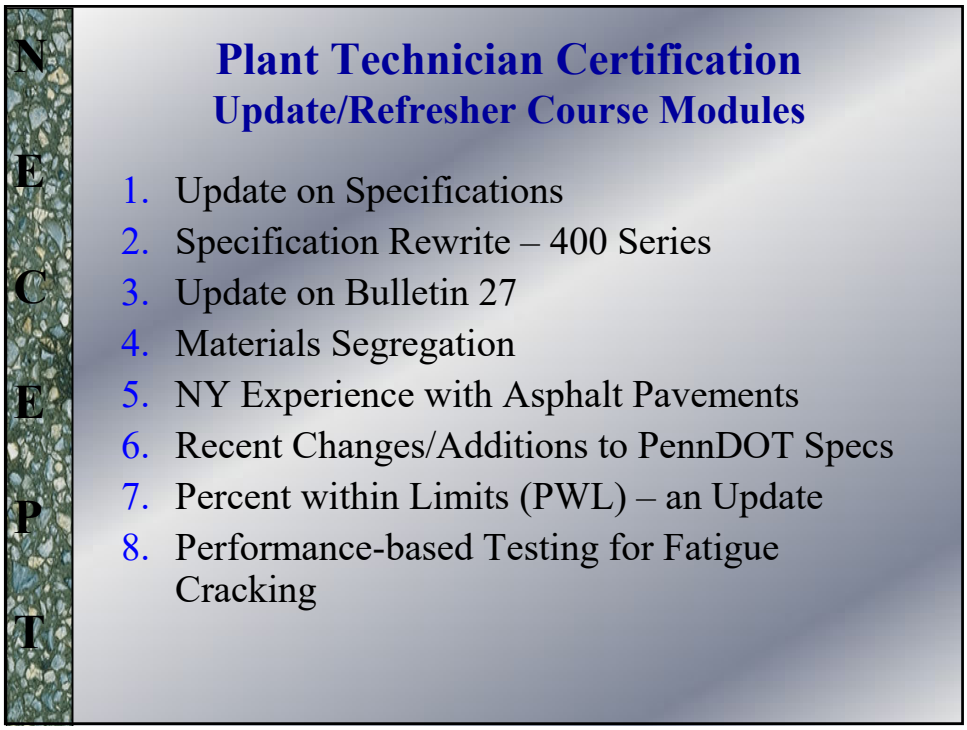
NECEPT
Plant Technician Certification
Update/Refresher Course Modules
1. Update on Specifications
2. Specification Rewrite – 400 Series
3. Update on Bulletin 27
4. Materials Segregation
5. NY Experience with Asphalt Pavements
6. Recent Changes/Additions to PennDOT Specs
7. Percent within Limits (PWL) – an Update
8. Performance-based Testing for Fatigue Cracking

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N E C E P T

Plant Certification Program

An Update on PennDOT Asphalt Specifications 2020

Northeast Center of Excellence for Pavement Technology
NECEPT

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Your Role with PennDOT Specifications

- You must be
  - familiar with specifications that cover your project.
  - be aware of the effective change dates and your project let date.

NECEPT

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Publication 408/ Pub 408

Year (Version)	Effective Dates
2000	April 3, 2000 to September 30, 2003
2003	October 1, 2003 to April 1, 2007
2007	April 2, 2007 to March 31, 2011
2011	April 1, 2011 to March 31, 2016
2016	April 1, 2016 to April 2, 2020
2020	April 10, 2020 to October 6, 2023

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Publication 408/ Pub 408

PennDOT's Rewriting for **2020** Edition

- Consolidate Information from SSP and SOL
- Merging **409 and 411** into one section **(413)**
- Merging **309 and 311** into one section **(313)**
- Initial Edition: **April 2020**

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PennDOT Specifications (Publication 408)

Pub 408/2020 – Initial Edition
(Effective April 10, 2020)

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Publication 408/2020

- PennDOT Pub 408/2020 contains Construction Specifications
- for PennDOT Projects Let after April 10, 2020
- PennDOT Website: http://www.dot.state.pa.us/public/PubsForms/Publications/Pub_408/408_2020/408_2020_IE/408_2020_IE.pdf

NECEPT

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PennDOT Specifications (Publication 408)

Version	Effective Date
Initial Edition	**April 10, 2020**
Change No. 1	October 2, 2020
Change No. 2	April 9, 2021
Change No. 3	October 8, 2021
Change No. 4	April 1, 2022
Change No. 5	October 7, 2022
Change No. 6	April 14, 2023
Change No. 7	October 6, 2023

2020

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Sections of Publication 408

Question:

How Many Sections Are There in Spec 408?

Answer:

Twelve

NECEPT

8

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Contents of Publication 408

- Sections 1 through 12
- Appendix A - Metric (SI) Information
- Appendix B – Standard Special Provisions
  - as set forth in the Bid Proposals
  - need further tailoring for use on specific projects
  - Includes seven indices
- Appendix C – Designated Special Provisions
  - Standard documents previously included in PennDOT Bid Proposals.
- Change Letters and Indices

NECEPT 9

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Sections Publication 408

- 100 - General Provisions
- 200 - Earthwork
- 300 - Base Courses
- 400 - Flexible Pavements
- 500 – Rigid Pavements
- 600 – Incidental Construction

NECEPT 10

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Sections
Publication 408

- 700 - Materials
- 800 – Roadside Development
- 900 – Traffic Accommodation & Control
- 1000 - Structures
- 1100 – Manufactured Materials
- 1200 – Intelligent Transportation System Devices

NECEPT 11

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Sections of
Publication 408

- 100 - General Provisions
  - Abbreviations and definitions
  - Bidding requirements and conditions
  - Award and contract execution
  - Scope and control of work
  - **Control of materials (Section 106)**
  - Measurement of quantities
  - Payment
  - Several others

NECEPT 12

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Sections of Publication 408

- 300 – Base Courses
  - SP HMA Base design/construction (**Section 309**)
  - SP WMA Base design/construction (**Section 311**)
  - Cold Mixes (**Sections 341 and 342**)
  - Asphalt Treated Permeable Base (**Section 360**)

NECEPT 13

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Sections of Publication 408

- 400 – Flexible Pavements
  - SP HMA design/construction (**Section 409**)
  - SP HMA design/construction fine graded (**Section 410**)
  - SP WMA design/construction (**Section 411**)
  - SMA (**Section 419**)

NECEPT 14

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Sections of Publication 408

- 700 – Materials
  - Bituminous materials (Section 702)
  - Aggregates (Section 703)

NECEPT 15

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Discussion of Specification Changes

NECEPT 16

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Publication 408/2011

Version	Effective Date
Initial Edition	**April 1, 2011**
Change No. 1	October 7, 2011
Change No. 2	April 6, 2012
Change No. 3	October 5, 2012
Change No. 4	April 5, 2013
Change No. 5	October 4, 2013
Change No. 6	April 4, 2014
Change No. 7	October 3, 2014
Change No. 8	April 3, 2015
Change No. 9	October 2, 2015

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Publication 408/2016

Version	Effective Date
Initial Edition	**April 1, 2016**
Change No. 1	October 7, 2016
Change No. 2	April 7, 2017
Change No. 3	October 6, 2017
Change No. 4	April 6, 2018
Change No. 5	October 5, 2018
Change No. 6	April 5, 2019
Change No. 7	October 4, 2019

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Relevant Sections Added in Pub 408 within the Last 5 Years:

Date	Section	Description
April 2015	496	60-Month Warranty Projects
October 2015	344	Full Depth Reclamation
October 2016	420	Pervious Bituminous Pavement System
October 2016	489	Ultra-Thin Bonded Wearing Course
April 2018	412	6.3-mm Thin Asphalt Overlay

NECEPT

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Sections of Publication 408 Containing Asphalt Specifications (2016, Chg. 7)

106	Controls of Material Statistics
309	Superpave Asphalt Mixture Design, HMA Base Course (Standard)
311	Superpave WMA Design/Construction for Base Course
316	Flexible Base Replacement
320	Aggregate Bituminous Base Course

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Sections of Publication Containing Asphalt Specifications (2016, Chg. 7)

322	Aggregate-Lime Pozzolan Base Course
341	Cold Recycled Bituminous Base Course (In-Pace)
342	Cold Recyled Bituminous Base Course (Central Plant)
344	Full Depth Reclamation
360	Asphalt Treated Permeable Base

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Sections of Publication Containing Asphalt Specifications (2016, Chg. 7)

404	Evaluation and Payment of Bituminous Pavement Ride Quality Incentive
405	Evaluation of Bit. Pavement Longitudinal Joint Density, Payment of Incentive/Disincentive
409	Superpave Asphalt Mixture Design HMA Wearing Course, Standard, RPS
410	SP. Mix Design, Stand. and RPS Construction of Plant-Mixed HMA Fine Graded Courses
411	Superpave WMA Design/Construction

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Sections of Publication Containing Asphalt Specifications (2016, Chg. 7)

412	6.3-mm thin asphalt overlays
419	SMA Design & RPS Construction of Wearing Course
420	Pervious Bituminous Pavement System
460	Bituminous Tack Coat
470	Bituminous Seal Coat
471	Bituminous Seal Coat using Precoated Aggregate
480	Bituminous Surface Treatment

NECEPT

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Sections of Publication Containing Asphalt Specifications (2016, Chg. 7)

481	Bituminous Surface Treatment using Precoated Aggregate
482	Slurry Seal
483	Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing)
489	Ultra-Thin Bonded Wearing Course
496	Asphalt Concrete Pavement, 60-month Warranty

NECEPT

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Changes in Specification 2011

Changes 8 and 9

April 2015 & October 2015

NECEPT 25

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Spec 408/2011- Section 496

Change No. 8 (April 2015)

- HIGHLIGHTS
  - **60-Month Warranty Specification** on Superpave, SMA
  - Warranty Bond (50% of the contract amount)
  - End-Result
  - Requires Warranty Performance Criteria
  - SP Design- by Level-2 Certified Technician
  - SP Design - Submit 7 days before use
  - Submit QC Plan & QC test results– for information only

NECEPT 26

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Spec 408/2011- Section 496

- CONSTRUCTION – Thickness Verification
  - Within 24 hours, drill one 4-inch core or larger for each 2,000 linear feet.
  - PTM 1 for Core Locations, PTM #1
  - Core Depth Determination: Use PTM 737
  - If thickness deficient more than 1/4 inch, and not possible to correct satisfactorily, then it is defective work.
  - If thickness deficient more than 1/8 inch for 3 consecutive cores, then deficient.

NECEPT 27

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Spec 408/2011- Section 496

- CONSTRUCTION – Quality Control/Assurance
  - Department reserves the right to request loose samples or cores at random locations- for information purpose only.
  - If directed, one loose sample behind the paver, boxed and delivered to inspector.
  - If directed, one 6-inch core for every 1000 tons of material. If core defective, a new core within 12 inches of the original location.

NECEPT 28

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Spec 408/2011- Section 496

- PERFORMANCE MEASUREMENT
  - Survey by Department or a designee
  - Annual survey analysis
  - Notify contractor 14 days before survey
  - Automated survey system
  - Follow Pub 336 for both automated and manual surveys
  - Flushing and pothole survey done manually
  - Results reported for each segment

NECEPT 29

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Spec 408/2011- Section 496

- PERFORMANCE CRITERIA
  - Provide survey results to contractor within 14 days
  - Compare with **Table A** of Spec 496 for action
  - If year 5 survey shows 30% of segment with two or more distresses of low severity, then remedial action by an approved surface treatment technique.

NECEPT 30

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Spec 408/2011- Section 496

- Performance Criteria of Table A of Spec 496,
  - Fatigue Cracking
  - Transvers Cracking
  - Raveling
  - Rutting
  - Flushing
  - Longitudinal Joint Deterioration
  - Edge Deterioration
- **For Each, there is Threshold Level and Remedial Action**

NECEPT 31

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Spec 408/2011- Section 496

- Performance Evaluation by the Contractor
  - Contractor may monitor or test warranted pavement courses using nondestructive methods at any time during the warranty period.
  - Notify District Executive at least 7 days in advance of such testing
  - Obtain written authorization from Department before such testing
  - No remedial work before written authorization from Department

NECEPT 32

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Spec 408/2011- Section 496

- REMEDIATION WORK
  - Remediation work must be satisfactory to Secretary, at contractor's cost
  - If remedial action needed, contractor notified within 5 days from the date of determination
  - No work by Department on the warranted pavement during the warranty period

NECEPT 33

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Spec 408/2011- Section 496

- REMEDIATION WORK
  - Contractor may propose a method of testing, measurement, or remedial action different from Table A. Then, must submit a plan of approach.
  - Department will review and approve or disapprove the plan.
  - Complete within 60 days

NECEPT 34

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Performance Criterion	Threshold Level	Remedial Action
Fatigue Cracking	All low, medium, high severity	R/R, as Section 496, Table A
Transverse/Miscellaneous Cracking	All low, medium severity	Crack seal as specified in Section 469
	All high severity	R/R, as Section 496, Table A
Raveling/Weathering	All medium or greater severity	R/R, as Section 496, Table A
Rutting	> ¼ inch	R/R, as Section 496, Table A
Flushing	All	R/R, as Section 496, Table A
Pothole, Loss of Bond, Delamination	All	R/R, as Section 496, Table A
Longitudinal/edge joint deterioration	All low severity	Crack seal as specified in Section 469
	All medium or greater severity	R/R distressed layer full lane on both sides transversely of distressed area and a minimum of 24 inches beyond the distressed area in all longitudinal directions

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Spec 408/2011- Section 496

- REMEDIAL EMERGENCY WORK
  - Contractor will be notified of any needed emergency repair work immediately.
  - Contractor will let Department know within 24 hours whether they will repair.
  - Must begin repair work with 48 hours from original notification by the Department
  - If Department does the repair, the cost will be the responsibility of the contractor.

NECEPT 36

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Spec 408/2011- Section 496

- DISPUTE
  - Contractor may dispute Department's performance results
  - Contractor may use a third party performance survey results as the base for dispute
  - Notify Department within 30 days from the date of Department's notification.
  - If not resolved within 14 days, then submit to the Conflict Resolution Team

NECEPT 37

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Spec 408/2011- Section 496

- CONFLICT RESOLUTION TEAM
  - Two Reps selected by the Contractor
  - Two Reps selected by the Department (District and BOPD)
  - One person mutually agreed (cost shared equally)
  - Team will meet within 30 days from the date of submission
  - Decision of majority will be final.

NECEPT 38

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Spec 408/2011- Section 496

- FACTORS BEYOND CONTROL
  - If Distresses because of Factors beyond Contractor's Control, then Contractor not responsible
  - The area of such distress calculated by the max. width times max. length times 1.5, but extending no more than 10 feet on either side of the distress area.
  - Department may repair these distresses at no cost to the contractor.

NECEPT 39

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Spec 408/2011- Section 496

- FACTORS BEYOND CONTROL
  - Base Condition causing fatigue cracks or other distresses
    - 6-inch cores
    - Measure thickness, void content, gradation, binder content
    - If within limits, contractor not responsible
  - Traffic Loading
    - If ESALs exceed 100% of the estimated 20-year design life ESALs
    - If ESAL's increase cause change in number of gyrations, then contractor not responsible
  - Department Routine Maintenance

NECEPT 40

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Spec 408/2011- Section 496

- FACTORS BEYOND CONTROL
  - Destructive Procedures by the Department
    - Distresses caused by coring, milling, etc.
  - Uncontrolled Forces of Nature
    - Floods, earthquakes, tornados, fires, landslides, sinkholes, …
  - Traffic Accidents
    - Fuel or chemical spills, vehicle fire, gouging or goring of pavement surface

NECEPT 41

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Spec 408/2011- Section 409
Change No. 9 (October 2015)

- Use of Material Transfer Vehicle is Required for RPS Bituminous Pavements.

- Added Language in Spec 409:

  "Utilize a Material Transfer Vehicle (MTV) as specified in Section 108.05(c)5 for RPS pavements unless otherwise approved by the Representative."

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Specification 2016

Initial Version and Changes 1 through 7

April 2016 – October 2019

NECEPT

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Spec 408/2016- Section 420

Pervious Bituminous Pavement System

Change No. 1 (October 2016)

- Use of Pervious Pavements on Department Projects.
- Allows water to <u>percolate and infiltrate</u> through the pavement and underlying layers.
- Minimizes runoff
- It is a System! Includes different layers, different materials, and drainage outlets

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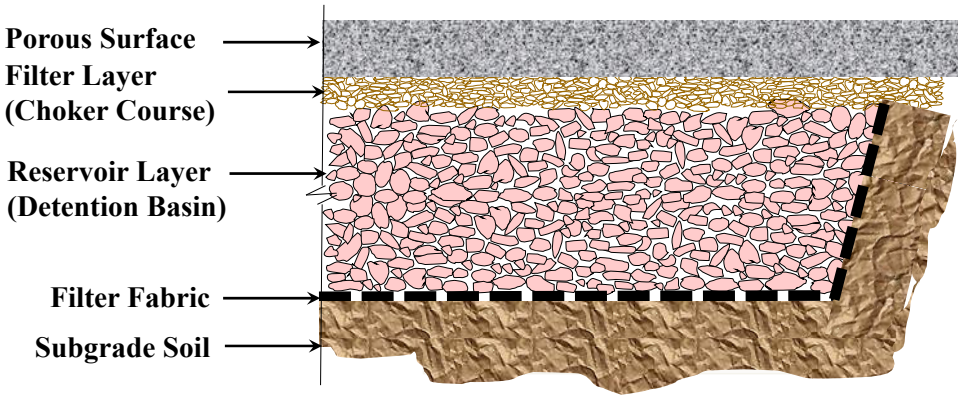
Spec 408/2016- Section 420
Pervious Bituminous Pavement System
Change No. 1 (October 2016)



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Spec 408/2016- Section 420
Pervious Bituminous Pavement System
Change No. 1 (October 2016)

- Materials
  - Type A Aggregate (for use in Asphalt Concrete)
  - AASHTO No. 3 for primary detention coarse aggregate, topped with AASHTO No. 57 as a choker and leveling coarse
  - Type A, Class 4, Geotextile
  - Edge Restraint to resist lateral roller forces

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Spec 408/2016- Section 420
Pervious Bituminous Pavement System
Change No. 1 (October 2016)

- Bituminous Materials
  - Pervious 9.5 mm wearing course, PG 70-22 or PG 76-22
  - Pervious 19.0 mm Binder course, PG 64-22
  - RAP limited to 10% of the mixture

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Spec 408/2016- Section 489
Ultra-Thin Bonded Wearing Course
Change No. 1 (October 2016)

- Ultra-thin bonded wearing course of HMA (UTWC) over polymer-modified emulsified asphalt membrane.
- Roll before temperature drops below 185ºF
- Minimum of 2 passes with a steel double-drum roller
- Minimum weight of roller: 8 tons
- Compact in static mode except at joints.
- Pneumatic-tire roller may be needed to prevent the "bridging" effect of the steel drum roller

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Spec 408/2016- Section 489
Ultra-Thin Bonded Wearing Course
Change No. 1 (October 2016)

Type	NMAS	Placement Rates (pounds per square yard)
A	6.3 mm (1/4 inch)	45 to 65
B	9.5 mm (3/8 inch)	55 to 80
C	12.5 mm (1/2 inch)	60 to 85

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Spec 408/2016- Section 411
Superpave WMA
Change No. 2 (April 2017)

Using Anti-Strip Additives with WMA

Incorporate a liquid anti-strip additive at the same dosage rate as the dosage rate for the HMA JMF.

If the WMA Technology includes an anti-strip additive additional liquid anti-strip additive is not required in mixtures where the moisture sensitivity analysis cannot be performed as specified in Section 411.2(e)1.

If the WMA Technology includes an anti-strip additive as part of its WMA Technology and moisture sensitivity analysis can be performed according to Section 411.2(e)1 add additional anti-strip additive or make other adjustments to the JMF and meet the specified moisture sensitivity requirements.

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Spec 408/2016- Section 409
Superpave Mixes
Change No. 3 (October 2017)

Nominal Max Agg. Size (mm)	Each Specimen	Multiple Specimens
Air Voids at N_{des} (V_a)	±2%	±1.5%
Min. VMA% for 4.75 mm mixes	16.0	-
Min. VMA% for 9.5 mm mixes	15.0	-
Min. VMA% for 12.5 mm mixes	14.0	-
Min. VMA% for 19.0 mm mixes	13.0	-
Min. VMA% for 25.0 mm mixes	12.0	-
Min. VMA% for 37.0 mm mixes	11.0	-

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Spec 408/2016- Section 419
WMA in SMA
Change No. 3 (October 2017)

WMA can be used with SMA

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Spec 408/2016- REMOVALS
Change No. 3 (October 2017)

422	Bituminous Wearing Courses FJ-1 ad FJ-1C (Removed)
430	Bituminous Wearing Course FB-2 (Removed)
431	Bituminous Binder Course FB-2 (Removed)
439	Bituminous Wearing Course FB-1 (Removed)
440	Bituminous Binder Course FB-1 (Removed)

Now in Pub 447: Approved Products for Lower Volume Local Roads

NECEPT

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Spec 408/2016- Section 460
Tack Coat
Change No. 3 (October 2017)

- New Tack with half of the water of AET (faster curing)
- Inclusion of non-tracking tack coat
- Revision of application rates based on surface texture

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Spec 408/2016- Section 483
Microsurfacing
Change No. 5 (October 2018)

Class of Bituminous Materials Changed

Used to be CSS-1hPM (E-8CPM)

Now it is CQS-1hPM

55

Spec 408/2016- Section 409
SP Mixes
Change No. 6 (April 2019)

Added

parking lot mixes to acceptance by certification

56

Spec 408/2016 - Section 409
Change No. 6 (April 2019)

Major Change to the section on

Weather and Seasonal Limitations

57

Spec 408/2016 - Section 409
Change No. 6 (April 2019)

Weather and Seasonal Limitations

Place between **April 1 to October 15** for

- all PG 76-22 wearing courses,
- >10 million ESALs wearing courses,
- 4.75 mm wearing courses,
- wearing courses placed less than 1.5 inches (compacted)

Place between **April 1 to October 31** for other mixes

58

Spec 408/2016 - Section 409
Change No. 6 (April 2019)
Paving in extended season

- Submit requests in writing at least 14 days prior to work
- Group 1: **April 1 to November 15**
- Group 2: **March 1 to December 15**
- Density acceptance will be by pavement cores,
- Utilize a Material Transfer Vehicle (MTV) on any day when the paving length will exceed 1,500 linear feet

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Spec 408/2016 - Section 409
Change No. 6 (April 2019)
Paving in extended season

Paving work completed during the fall portion of the Extended-Season will be subject to a spring evaluation and manual survey by the Department to be conducted by May 1.

Manual surveys will be conducted in accordance with Publication 336.

60

Spec 408/2016 - Section 409
Change No. 7 (October 2019)

Minimum Compacted Depth to Obtain Cores for Measuring and Accepting Density
(Increasing minimum depth for 12.5 mm mix)

Mixture	Minimum Depth
9.5 mm Wearing Course	1 ½ in.
12.5 mm Wearing Course	2 in.
19 mm Wearing Course	2 ½ in.
25 mm Wearing Course	3 in.

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Spec 408/2016 - Section 409
Change No. 7 (October 2019)

Change of Materials for Painting
Existing Vertical Surfaces in Contact with an Asphalt Mix):

Paint existing vertical surfaces … in contact with bituminous mixtures with a uniform coating of either emulsified asphalt, consisting of PennDOT Material Class TACK or NTT/CNTT, applied in two or more applications, or hot bituminous material of the class and type designated for the bituminous course.

NTT: Non-Tracking Tack Coat (Anionic) & CNTT: Non-tracking Tack Coat (Cationic)

Removed the following materials for painting vertical surface:
Class E-6 (AASHTO SS-1 or CSS-1), E-8 (AASHTO SS-1h or CSS-1h), Class AET applied in two or more applications, or of the class and type designated for the bituminous course.

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Highlights from Section 409

Do not place bituminous paving mixtures when surfaces are wet or when the air or surface temperature is **40°F** or lower.

63

Highlights from Section 409

Acceptance by certification is appropriate for **What mixtures**?

- Scratch courses
- Leveling courses less than 2 inch depth
- Mixtures used by Department maintenance forces
- Mixtures for local or municipal governments
- Mixtures placed in quantities not exceeding **500** tons in a continuous placement operation
- Mixtures used for parking lots
- All **4.75** mm asphalt mixture applications

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Highlights from Section 409

Which mix parameters must be used to certify mixtures based on QC tests

- Asphalt Content
- Percent Passing the **2.36 mm (No. 8)** sieve (excluding 4.75mm mix)
- Percent Passing the **0.075 mm (No. 200)** sieve

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Highlights from Section 409

Current Language in 409 on RAS

- 5% RAS
- Only manufactured waste
- Post-Consumer shingles not allowed
- Keep fiberglass felt and Paper/organic felt separate
- 100% passing 12.5 mm
- May blend with fine aggregate to avoid agglomeration

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Review of Tables in Section 409

NECEPT

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Section 409.2: MATERIALS

TABLE A

JMF – COMPOSITION TOLERANCE REQUIREMETNS

Gradation	Single Sample (n=1)	Multiple Sample (n≥3)
Passing 12.5 mm (1/2 inch) and Larger	± 8.0 %	± 6.0 %
Passing 9.5 mm (3/8 inch) to 150 µm (No 100) Sieves (Inclusive	± 6.0%	± 4.0 %
Passing 75 µm (No. 200) Sieve	± 3.0%	± 2.0%
Asphalt Content		
19.0 mm HMA mixtures and smaller	± 0.7%	± 0.4%
25.0 mm HMA mixtures and larger	± 0.8%	± 0.5%

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Section 409.2: MATERIALS

TABLE A (Cont'd)

JMF – TEMPERATURE OF MIXTURE, ºF

Class of Material	Type of Material	Minimum	Maximum
PG 58-28	Asphalt Cement	260	310
PG 64-22	Asphalt Cement	265	320
PG 76-22	Asphalt Cement	285	330
All other PG Binders	Asphalt Cement	As specified in Bulletin 25 (Specifications for Bit. Materials)	

NECEPT

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Section 409.2:Materials

TABLE B

JMF - VOLUMETRIC TOLERANCE REQUIREMENTS

Nominal Max Agg. Size (mm)	Each Specimen	Multiple Specimens
Air Voids at N_{des} (V_a)	±2%	±1.5%
Min. VMA% for 4.75 mm mixes	16.0	-
Min. VMA% for 9.5 mm mixes	15.0	-
Min. VMA% for 12.5 mm mixes	14.0	-
Min. VMA% for 19.0 mm mixes	13.0	-
Min. VMA% for 25.0 mm mixes	12.0	-
Min. VMA% for 37.0 mm mixes	11.0	-

NECEPT

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Section 409.2(f).1: Materials

TABLE C
MIXTURE ACCEPTANCE

Acceptance Level	Acceptance Method
Certification Acceptance	Producer Certification of Mixture Section 409.2 (f) 2
Lot Acceptance	Mixture Acceptance Sample Testing Section 409.3(h) 2

NECEPT

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Section 409.3: Construction

- **TABLE D.** - Re-adjustment of Lot Size and Associated Number of Sublots
- **TABLE E.** - Density Limits for Partially Completed Lots
- **TABLE F.** - Density Acceptable Levels & Criteria
- **TABLE G.** - Minimum Mixture Compacted Depths

NECEPT

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Section 409.4: Measurement & Payment

- TABLE H - Mixture Acceptance by Certification
  - Asphalt Content

NMAS	Criteria	Value		PF, %
All sizes	Printed Tickets	Al least 90% is ± 0.2 of JMF		100
		Less than 90% is ± 0.2 of JMF		85
19 mm and smaller	QC Sample Testing	Single, n=1	n≥ 2	----------
		±0.7%	±0.5%	100
		±0.8% to 1.0%	±0.6%	85
		> ±1.0%	≥ ±0.7%	RR or 50%
25 mm and larger	QC Sample Testing	±0.8%	±0.6%	100
		±0.9% to 1.2%	±0.7%	85
		> ±1.2%	≥ ±0.8%	RR or 50%

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Section 409.4: Measurement & Payment

- TABLE H - Mixture Acceptance by Certification
  - Gradation

NMAS	Criteria	Value		PF, %
		n=1	n≥ 2	
All sizes	QC Sample Testing for % Passing #200 Sieve	±3.0%	±2.1%	100
		±3.1% to ±4.0%	±2.2% to ±2.7%	85
		> ±4.0%	≥ ±2.8%	RR or 50%
All sizes	QC Sample Testing for % Passing #8 Sieve	±6%	±4%	100
		±7% to ±8%	±5%	85
		> ±8%	≥ ±6%	RR or 50%

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Section 409.4: Measurement & Payment

- **Mixture Acceptance by Lots**

  TABLE I

  – **Asphalt Content**
    - **Single and Multiple Samples as per Table A** **PF = 100**
    - **If any Single out or Lot Average out for Multiple Samples then Table K**

  – **Gradation (No. 200)**
    - **Single and Multiple Samples as per Table A** **PF = 100**
    - **If any Single out or Lot Average out for Multiple Samples then Table K**

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Section 409.4: Measurement & Payment

- **Mixture Acceptance by Lots**

  TABLE I

  – **Density**

  – Non- Movement or Optimum Rolling Pattern PF = 100

  – RPS Wearing and Binder Courses
    - See Table I

  – Standard Wearing and Binder Courses
    - See Table I

  – 25 mm and 37.5 mm Base Courses
    - See Table I

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Section 409.4: Measurement & Payment

- **TABLE J**
  - **Upper & Lower Limits for Calculating PWL**
- **TABLE K**
  - Payment Factor Based on PWL

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2020 NECEPT Field-Plant Update/Refresher Courses

January-April, 2020

Rich Polenik
District 10 Material Manager
(724) 355-4628
rpolenik@pa.gov

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Publication 408 Series 400 Rewrite

What's Changing?

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Today's Discussion

- Background
- Approach
- Section Review/Clearance Transmittals
- Final Implementation

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Background

August 2018

- Department Construction Process/Quality Team met to discuss the update/rewrite of Publication 408 Construction Specifications
- Focus on reducing/eliminating special provisions and incorporating needed updates
- Construction Specifications normally updated on a 4 year cycle (Publication 408 last updated April 1, 2016)

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Approach

September 2018

- Team leaders and members were selected for each specification section team comprised of PennDOT, Turnpike, Industry and FHWA representatives.
- A kick-off meeting was held at the Lab in Harrisburg to discuss the direction of the rewrite effort.
- Target February 2019 to have most clearance transmittal changes in place for spring 2020 roll out new Publication 408.

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400 Series Team

Team Lead:

Rich Polenik-PennDOT District 10 Materials

Team Members:

PennDOT-Neal Fannin, Lydia Peddicord, Adam Ostinowski, Steve Koser, Tim Ramirez, Garth Bridenbaugh, Brian Shannon, Nhan Phan, Josh Freeman

Industry-Charlie Goodhart, Gary Hoffman, Jeff Frantz, Tom Abbey, Mike Worden, Ed Morrison, Scott Grannas

Turnpike-Terry Dreher

FHWA-Jennifer Albert

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400 Series Group Effort

Prioritize sections for review

- The team determined high and low priority sections to review based on number of special provisions, District surveys and Industry concerns.

Special Provisions

- 60 District and standard specials were reviewed for all 400 series sections.
- Of the 60, 9 have been incorporated throughout various sections, 37 have been deleted and 14 have been kept for continued use.

Section Changes

- Based on the groups review, 12 of the 25 sections are going through the clearance transmittal process for change.

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Sections Not Submitted For CT Process

The following sections include minor terminology changes without the CT process:

410-Plant Mixed Fine Grade
412-Plant mixed 6.3mm
420-Pervious Asphalt System
461-Asphalt Prime Coat
470-Asphalt Seal Coat
471-Seal Coat Precoated
472-Asphalt Fog Seal
473-Seal Coat w/RAP
480-Surface Treatment
481-Surface Treatment w/Precoated Aggregate
482-Slurry Seal
483-Micro-Surfacing
490-Removal of Surface Course
492-Profile Milling
496-Asphalt Pavement 60-Month Warranty

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Section Changes **405**, 450, 460, 467 and 469

Clearance Transmittal Changes: H-18-042
Due 1/7/19

Section 405 Longitudinal Joint Incentive/Disincentive

- Increase joint density from 90.0% to 91.0% and increase pay incentive/disincentive $5000/$10,000 to $7500/$12,500 respectively.
- Removed corrective action of over banding.
- Changes based on analyzing joint density data and adjusting to current construction results.

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Section Changes 405, **450**, **460**, 467 and 469

Section 450 Manual Asphalt Patching

- Decreased minimum patch size from 4 SF to 1 SF. Minimizes removal of sound pavement adjacent to patch areas.
- Eliminate tack as a separate pay item. Included in unit price of patching now.
- Simplify payment of item.

Section 460 Asphalt Tack Coat

- Terminology change "bituminous" to "emulsified asphalt" or "asphalt" when appropriate

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Section Changes 405, 450, 460, **467** and **469**

Section 467 Heavy Duty Membranes

- Allows use of heavy duty membranes on a milled surface.
- Requires a manufacturers technical representative or certified installer.
- Changes based on District use and good performance results.

Section 469 Asphalt Joint and Crack Sealing

- Simplified the description of the item of work. Removed language requiring prepackaged material and created general statement for applicable material.
- Include gallon as unit of measure for sealer and ton for SP4.75 mm asphalt mixture.

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Section Changes **466** and 489

Clearance Transmittal Changes H-19-003
Due 2/13/19

Section 466 Asphalt Paving Fabric (NEW)

- New section to include Asphalt Paving Fabric specifications for use.
- Reinforced interlayer type products may be considered in this section in future changes.

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Section Changes 466 and **489**

Section 489 Ultra Thin Bonded Wearing Course

- Changed Emulsified Asphalt reference UTWCEM to UTFCEM to align with Bulletin 25 terminology.
- Edited text within tables B, D and E to define minimum crush faces for aggregate, specimen void content and sieve reference corrections.
- Added placement requirements to address material delivery to avoid stoppages and minimizing transverse joints.
- Adjusted placement dates according to PG binder used.

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Section Changes **313**, 404, 413 and 419

Clearance Transmittal Changes H-19-051
Due 8/6/19

Section 313 Asphalt Standard Base Course (New)

- This new section deletes former sections 309 and 311.
- HMA and WMA references are replaced with the term "asphalt".
- Minor text changes to clarify specification.

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Section Changes 313, **404**, 413 and 419

Section 404 Evaluation of Asphalt Pavement Ride Quality and Payment of Incentive

- HMA and WMA references are replaced with the term "asphalt".
- Defines and requires two construction operations to be performed to qualify for payment incentive.
- Minor text change to clarify specification regarding excluded areas (tapered pavement).

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Section Changes 313, 404, **413** and 419

Section 413-Superpave Mixture Design, Standard and RPS Construction of Plant-Mixed Asphalt Courses With Percent Within Limits and LTS Testing (PWL-LTS) (NEW)

- Combine former Sections 409 HMA with 411 WMA into one section (413) and require all asphalt paving be Warm Mix.
- Included Percent within Limits (PWL-LTS) payment method for all Section 413 items.
- Change performance grade binder reference to the current national designation. (PG 58S-28, PG 64S-22, PG64E-22).

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Section Changes 313, 404, **413** and 419

- Require over banding of all longitudinal wearing surface joints (taken from section 405 corrective action).
- Include Gmm verification special provision into the specification for Federally funded and NHS projects.
- Required to provide an access point on a hauling unit to conduct temperature checks of the mixture.
- Change text references from "bituminous" to "asphalt binder", "asphalt cement" or "emulsified asphalt" for the liquid and "asphalt mixture" for completed mix.

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Section Changes 313, 404, **413** and 419

- Use a 12 foot straightedge for surface tolerance checks.
- Incorporation of the Safety Edge Special Provision into the specification.
- Included Multiple Creep Recovery (MSCR) Testing AASHTO M 332 for Asphalt Binder determination.

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Section Changes 313, 404, 413 and **419**

Section 419-Stone Matrix Asphalt Mixture Design, RPS Construction of Plant-Mixed Wearing Courses

- Using Warm Mix as a standard.
- Incorporation of the Safety Edge Special Provision into the specification.
- Provide a range of Combined Aggregate Bulk Specific Gravities in Table C.
- Specify use of "wax-lined" boxes when obtaining mixture composition samples.
- Change performance grade binder reference to the current national designation.

  i.e. PG76-22 = PG64E-22
- Demonstration placement no longer incidental-PDA provided for payment.

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Section 491

Section 491-Milling of Asphalt Pavement Surface

- Text change was made to remove working days and replace with calendar days when calculating Work Zone Liquated Damages.

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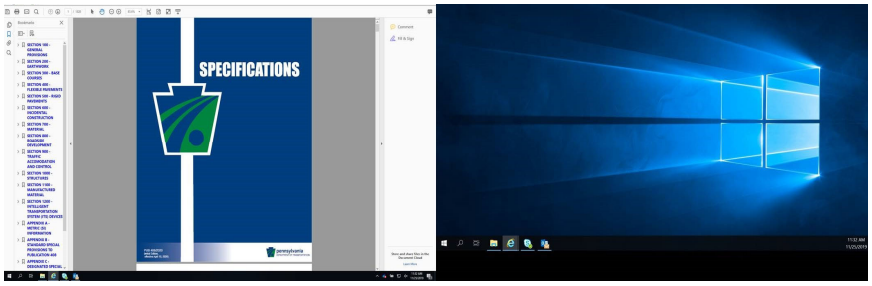
Final Implementation

Publication 408/2020

- Document is totally digital
- Effective dates April 10, 2020 to October 6, 2023
- Expect first projects let using the new specification to be late spring/early summer 2020
- Change #1 scheduled to be issued October 2020



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Questions/Comments???

Rich Polenik
PennDOT District 10 Materials Unit
(724)-355-4628
rpolenik@pa.gov

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Update on PennDOT Bulletin 27

2020 PennDOT/NECEPT
Bituminous Plant Technician
Annual Update/Refresher Course

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Update on PennDOT Bulletin 27 Outline

- Bulletin 27, 2003 Edition, Changes
- AASHTO Standards, Significant Changes

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Update on PennDOT Bulletin 27 Outline

- **Bulletin 27, 2003 Edition, Changes**
- AASHTO Standards, Significant Changes

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Bulletin 27, 2003 Edition, Changes

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J
- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, all of Appendix J, and all of new Appendix K.
- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portions of Chapters 2A and 2B.
- Pub 408/2016, Change 3 (Effective 10/6/2017)
  - Active, for small portion of Chapter 2A.

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Accessing PennDOT Strike-Off Letters (SOLs)

- ECMS - https://www.ecms.penndot.gov/ECMS/

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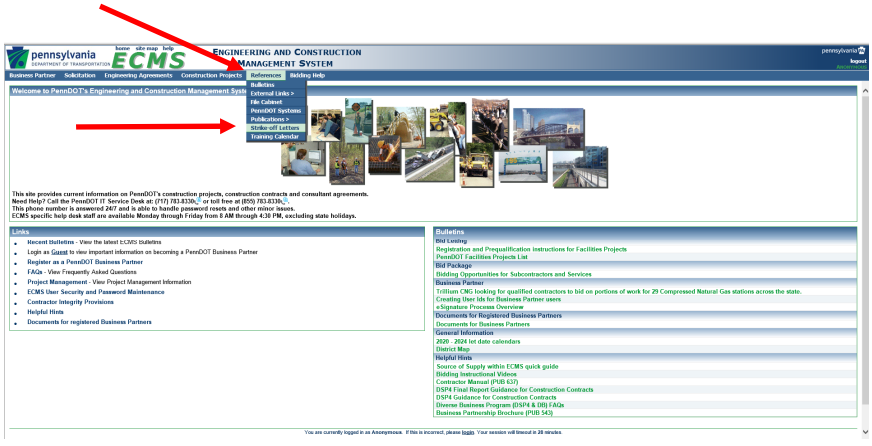
Accessing PennDOT SOLs



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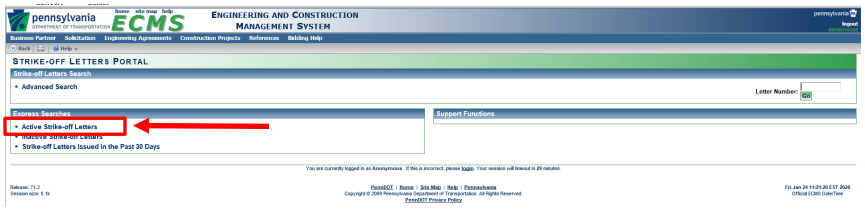
Accessing PennDOT SOLs



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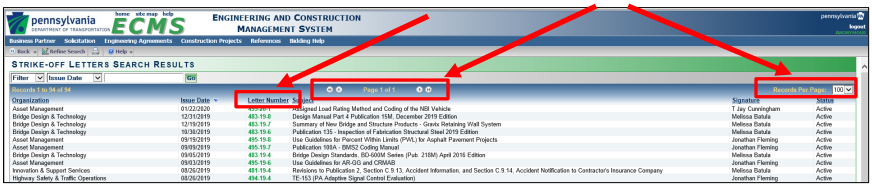
Accessing PennDOT SOLs



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Bulletin 27, 2003 Edition, Changes

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J
- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, all of Appendix J, and all of new Appendix K.
- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portions of Chapters 2A and 2B.
- Pub 408/2016, Change 3 (Effective 10/6/2017)
  - Active, for small portion of Chapter 2A.

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – issued on 04/13/2016

- General:
  - Changes to reduce the number of annual JMFs submitted for review and approval
  - Bulletin 27, Appendix J – Revisions
  - Bulletin 27, Appendix K – New
    - Standardized JMF Naming (Numbering) System
  - Bulletin 27, Chapter 2A – Revisions
  - Bulletin 27, Chapter 2B – Revisions

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Appendix J Revisions

- Submit JMFs meeting following conditions:
  - Existing JMFs produced and placed for a PennDOT or Municipal Project (Liquid Fuels Funds) during previous construction year
    - QC results must be in eCAMMS ESB
  - New JMFs that producer identifies will be used on an awarded PennDOT or Municipal Project (Liquid Fuels Funds)
  - In select cases, new JMFs the DME/DMM elects to review after receiving request in writing from Producer

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Appendix J Revisions

- Archive all other existing JMFs
  - Submit archived JMFs on an as-needed basis where the JMF will be used on newly awarded PennDOT or Municipal Project (Liquid Fuel Funds)
  - Submit archived JMFs at least 3 weeks before start of mixture production

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Appendix J Revisions

- Prior to Any JMF submittals and when the submitted aggregate Gsb values are not within the Table J-1 tolerances of the LTS Bulletin 14 aggregate Gsb values
  - Follow-up testing is required
    - Any testing determined by the DME/DMM
      - Aggregate Gsb and absorption testing
      - Asphalt mixture testing
      - Other

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Appendix J Revisions

- Existing Mix Design – Submittal Process
  - Revised From:
    "0 to ≤ 4 Production Quality Control Volumetric Analysis Test Results from the Previous Calendar Year"
  - To:
    "Archived or 1 to ≤ 4 Production Quality Control Volumetric Analysis Test Results from the Previously Approved JMF"

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Appendix K (New)

- Asphalt Concrete Gyratory Mix Design Naming System
  - Intended for JMF/Mix Design Number field in eCAMMS
  - Up to 10 characters
  - e.g., W95221G1

W = Type WMA
95 = Size 9.5 mm
2 = ESALS 0.3 to <3 (75 Ndes)
2 = Asphalt Binder PG 64-22
1 = RAP/RAS Tier 1
G = SRL-G
1 = Version

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Appendix K (New)

- Asphalt Concrete Non-Gyratory Mix Design Naming System
  - Intended for JMF/Mix Design Number field in eCAMMS
  - Up to 10 characters
  - e.g., NOVAA3H1 *

NOVAA = Class NOVAA (Ultra-Thin Bonded Wearing Course, Type A)
3 = Asphalt Material PG 76-22
H = SRL-H
1 = Version 1

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Chapter 2A Revisions

- Bulletin 27, Chapter 2A, Modifications to AASHTO R 35, Section 13. Report
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - No other changes

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 – Chapter 2B Revisions

- Bulletin 27, Chapter 2B, Modifications to AASHTO R 46, Section 4. Summary of the Practice
  - Subsection 4.6 Review of the Job Mix Formula (JMF)
  - Assign a JMF number by using the naming convention shown in Appendix K – Table 1
  - No other changes

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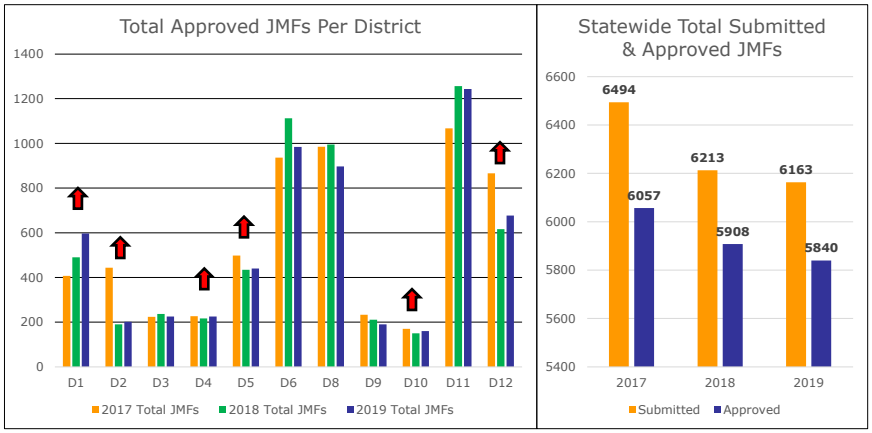
Bulletin 27, 2003 Edition, Changes SOL# 481-16-04 (4/13/16)– JMF Reduction



Approved = JMF Status = Approved, Approved Material Review, & Approved Material Revision
Submitted = JMF Status = All Approved, District Review, Resubmitted, Returned, Submitted, & Under Review.

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Bulletin 27, 2003 Edition, Changes

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J
- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, all of Appendix J, and all of new Appendix K.
- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portions of Chapters 2A and 2B.
- Pub 408/2016, Change 3 (Effective 10/6/2017)
  - Active, for small portion of Chapter 2A.

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – issued on 10/28/2016

- General:
  - All JMFs (HMA and WMA) approved after December 30, 2016 required to contain a minimum amount of anti-strip (AS) additive
  - Existing AS requirements associated with WMA JMFs have been deleted from Pub. 408, Section 311 and Section 411
    - i.e., WMA Categorized as Mechanical Foaming requiring minimum 0.25 percent AS
  - JMFs containing both coarse and fine aggregate types that are highly moisture susceptible
    - required to be evaluated for moisture susceptibility or contain a higher dosage of AS

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 4.4 (Page 2A-7)
  - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
    - i.e., 2 hours or 6 hours at 140, 145, or 153°C (285, 293, or 308°F)

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 4.4 (Page 2A-7)
  - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
    - i.e., 2 hours or 6 hours at 140, 145, or 153°C (285, 293, or 308°F)
  - **DO NOT DO!**

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO T 283 Mixture Conditioning
  - AASHTO T 283, Section 6.4 (LMLC) - After mixing:
    - Mixture cooled at room temperature for 2 ± 0.5 h
    - Mixture placed in a 60 ± 3°C (140 ± 5°F) oven for 16 ± 1 h for curing
    - Place the mixture in an oven for 2 h ± 10 min at the compaction temperature ±3°C (5°F) prior to compaction
  - AASHTO T 283, Section 7.4 (FMLC):
    - No loose-mix curing as described in Section 6.4 shall be performed on the field-mixed samples
    - Next, place the mixture in an oven *for 2 h ± 10 min at the* compaction temperature ±3°C (5°F) prior to compaction

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 4.4 (Page 2A-7)
  - All mixtures shall include either:
    - compatible, heat stable, amine-based liquid anti-strip (AS),
    - hydrated lime, or
    - another alternate compatible AS additive
  - Include AS additive at minimum dosage on manufacturer's tech data sheet (typ. 0.25% by mass AC)
  - Mixtures containing <u>both</u> CA and FA classified as a type of sandstone, siltstone, slag, quartz, shale, or gravel
    - Include AS, hydrated lime, alternate AS at dosage one level higher than minimum dosage rate (typ. 0.50% by mass AC)

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 4.4 (Page 2A-7)
  - Mixtures containing <u>both</u> CA and FA classified as a type of sandstone, siltstone, slag, quartz, shale, or gravel
    - Producer may elect to conduct AASHTO T 283 testing at minimum dosage rate (e.g., 0.25%) and at dosage one level higher (e.g., 0.50%)
    - If <u>all</u> true, set AS, hydrated lime, or alternate AS dosage rate at the higher dosage rate:
      - TSR of higher dosage mixture is higher than TSR of minimum dosage mixture
      - Conditioned and unconditioned tensile strengths of all AASHTO T 283 tests are above the minimum strengths in Bulletin 27, modifications to AASHTO R 35, Section 11.3

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 11.3 (Added Page 16)
  - Moisture susceptibility must be re-evaluated, at a minimum, once every 5 years (when JMF material sources, proportions, & targets remain same)
  - Moisture susceptibility must be re-evaluated when material sources change or, material proportions or JMF targets significantly change, as determined by the DME/DMM

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 11.3 (Added Page 16)
  - For virgin mixtures or mixtures falling under Appendix H, Tier 1 design
    - Compute required minimum AS or alternate AS dosage rate based on virgin asphalt binder content
      - Note: Versions of Pub. 408 prior to 408/2016, Change 2 in Section 411.2(h) specify to add minimum AS dosage based on total bituminous content
  - For mixtures falling under Appendix H, Tier 2 design
    - Compute required minimum AS or alternate AS dosage rate based on the total asphalt in the mixture

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 11.3 (Added Page 16)
  - All WMA versions of same parent HMA JMF must have separate moisture susceptibility evaluations
  - If HMA JMF requires anti-strip (AS), the WMA version of that JMF, produced by WMA Technology categorized as foaming or foaming process, must contain the minimum dosage of AS required in the HMA JMF.

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 11.3 (Added Page 16)
  - If Producer elects to use an alternate AS (not typical amine-based AS), contact DME/DMM
    - If directed by DME/DMM, perform moisture testing using alternate AS at manufacturer's recommended minimum dosage rate
    - If directed by DME/DMM, provide other documentation of successful use of alternate AS

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 13, Report (Added Page 19)
  - Does not include reference to Appendix K [JMF/Mix Design Naming (Numbering) System]
  - Must use SOL 481-16-04
    - Assign a JMF number by using the naming convention shown in Appendix K – Table 1

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2A Revisions

- AASHTO R 35, Section 13, Report (Added Page 19)
  - Does not include reference to Appendix K [JMF/Mix Design Naming (Numbering) System]
  - Must use SOL 481-16-04
    - Assign a JMF number by using the naming convention shown in Appendix K – Table 1

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- Bulletin 27, Chapter 2B, Modifications to AASHTO R 46, Section 4. Summary of the Practice
  - Revisions (New) to Subsection 4.4 *Evaluating Moisture Susceptibility* (Page 2B-2)
    - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
      - i.e., 2 hours or 6 hours at 153°C (308°F)

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- Bulletin 27, Chapter 2B, Modifications to AASHTO R 46, Section 4. Summary of the Practice
  - Revisions (New) to Subsection 4.4 *Evaluating Moisture Susceptibility* (Page 2B-2)
    - 1st paragraph – AASHTO T 283 mixture conditioning according to Bulletin 27, Appendix I
      - i.e., 2 hours or 6 hours at 153°C (308°F)
    - **DO <u>NOT</u> DO!**

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- AASHTO T 283 Mixture Conditioning
  - AASHTO T 283, Section 6.4 (LMLC) - After mixing:
    - Mixture cooled at room temperature for 2 ± 0.5 h
    - Mixture placed in a 60 ± 3°C (140 ± 5°F) oven for 16 ± 1 h for curing
    - Place the mixture in an oven for 2 h ± 10 min at the compaction temperature ±3°C (5°F) prior to compaction
  - AASHTO T 283, Section 7.4 (FMLC):
    - No loose-mix curing as described in Section 6.4 shall be performed on the field-mixed samples
    - Next, place the mixture in an oven *for 2 h ± 10 min at the* compaction temperature ±3°C (5°F) prior to compaction

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- AASHTO R 46, Section 4.4 (Page 2B-2)
  - All mixtures shall include either:
    - compatible, heat stable, amine-based liquid anti-strip (AS),
    - hydrated lime, or
    - another alternate compatible AS additive
  - Include AS additive at minimum dosage on manufacturer's tech data sheet (typ. 0.25% by mass AC)
  - Mixtures containing both CA and FA classified as a type of sandstone, siltstone, slag, quartz, shale, or gravel
    - Include AS, hydrated lime, alternate AS at dosage one level higher than minimum dosage rate (typ. 0.50% by mass AC)

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- AASHTO R 46, Section 4.4 (Page 2B-2)
  - Mixtures containing both CA and FA classified as a type of sandstone, siltstone, slag, quartz, shale, or gravel
    - Producer may elect to conduct AASHTO T 283 testing at minimum dosage rate (e.g., 0.25%) and at dosage one level higher (e.g., 0.50%)
    - If all true, set AS, hydrated lime, or alternate AS dosage rate at the higher dosage rate:
      - TSR of higher dosage mixture is higher than TSR of minimum dosage mixture
      - Conditioned and unconditioned tensile strengths of all AASHTO T 283 tests are above the minimum strengths in Bulletin 27, modifications to AASHTO R 35, Section 11.3

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- Bulletin 27, Chapter 2B, Modifications to AASHTO R 46, Section 4. Summary of the Practice
  - Subsection 4.6 Review of the Job Mix Formula (JMF) (Page 2B-2)
  - Does not include reference to Appendix K (JMF/Mix Design Numbering/Naming System)
  - Must use SOL 481-16-04
    - Assign a JMF number by using the naming convention shown in Appendix K – Table 1

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- Bulletin 27, Chapter 2B, Modifications to AASHTO R 46, Section 4. Summary of the Practice
  - Subsection 4.6 Review of the Job Mix Formula (JMF) (Page 2B-2)
  - Does not include reference to Appendix K (JMF/Mix Design Numbering/Naming System)
  - Must use SOL 481-16-04
    - Assign a JMF number by using the naming convention shown in Appendix K – Table 1

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- Attached Chapter 2B (SMA)
  - AASHTO R 46, Section 11.3 (Page 2B-7)
    - Moisture susceptibility must be re-evaluated, at a minimum, once every 5 years (when JMF material sources, proportions, & targets remain same)
    - Moisture susceptibility must be re-evaluated when material sources change or, material proportions or JMF targets significantly change, as determined by the DME/DMM

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- AASHTO R 46, Section 11.3 (Page 2B-7)
  - Compute required minimum AS or alternate AS dosage rate based on total asphalt in the mixture

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- AASHTO R 46, Section 11.3 (Page 2B-7)
  - All WMA versions of same parent HMA JMF must have separate moisture susceptibility evaluations
  - If HMA JMF requires anti-strip (AS), the WMA version of that JMF, produced by WMA Technology categorized as foaming or foaming process, must contain the minimum dosage of AS required in the HMA JMF.

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Bulletin 27, 2003 Edition, Changes SOL# 481-16-06 – Chapter 2B Revisions

- AASHTO R 46, Section 11.3 (Page 2B-7)
  - If Producer elects to use an alternate AS (not typical amine-based AS), contact DME/DMM
    - If directed by DME/DMM, perform moisture testing using alternate AS at manufacturer's recommended minimum dosage rate
    - If directed by DME/DMM, provide other documentation of successful use of alternate AS

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Bulletin 27, 2003 Edition, Changes

- Change 5 - issued on 01/19/2011
  - Active, except for Chapters 2A, 2B, and Appendix J
- SOL# 481-16-04 – issued on 04/13/2016
  - Active, for small portions of Chapters 2A and 2B, all of Appendix J, and all of new Appendix K.
- SOL# 481-16-06 – issued on 10/28/2016
  - Active, for large portions of Chapters 2A and 2B.
- Pub 408/2016, Change 3 (Effective 10/6/2017)
  - Active, for small portion of Chapter 2A.

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Bulletin 27, 2003 Edition, Changes Pub 408/2016, Change 3 (Effective 10/6/17)

- General:
  - Addition of Superpave 4.75 mm NMAS mixture to replace all FJ-1 asphalt mixtures.
  - Bulletin 27, Chapter 2A Revision:
    - AASHTO M 323, Section 6, Revisions to Table 3 – Aggregate Gradation Control Points.
    - Add Min. and Max Percent Passing for 4.75 mm to Table.
    - Percent Passing Min. and Max. Control Points are same as AASHTO.
  - Revision will be incorporated into next Bulletin 27 Edition/Change.

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Update on PennDOT Bulletin 27 Outline

- Bulletin 27, 2003 Edition, Changes
- **AASHTO Standards, Significant Changes**

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2015 to 2019 Significant Updates to Published AASHTO Standards

- M 323-17: Adds reference to NCHRP Report 452
  - Section 3, Terminology. Added term and definition for *reclaimed asphalt pavement binder ratio (RAPBR)*
  - Section 5, Binder Requirements. Added RAP can also be specified by RAPBR. Added new Table 3 for Binder Selection Guidelines when using RAPBR (two tiers, <0.25 RAPBR = No Change in Virgin Binder Grade and ≥0.25 RAPBR = Virgin Binder Grade based on Binder Blending Analysis). Added new equation for calculating RAPBR
  - New Appendix X2., Procedures for Estimating the Properties of Blended RAP and Virgin Binders
  - Revisions to existing Appendix X2 (Revised to X3), Procedures for Evaluating RAP Stockpiles. Added requirement for reagent grade solvents for recovering RAP binder to be tested for additional properties. Added that RAP stockpile evaluation may provide information for establishing maximum RAPBR.

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- R 35-15:
  - Section 6.5 & 6.7 - Clarification on purposes,
  - Section 9.2 - slight revision to VMA formula,
  - Section 9.3.6 – slight revisions to Gse, Pbe formulas.

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- R 35-17: Evaluating Moisture Susceptibility revisions to correct mixture oven conditioning requirements associated with T 283 and to add reference to alternate test method, T 324 (Hamburg).
  - Section 2.1., *AASHTO Standards*. Added reference to T 324.
  - Section 4.4., *Evaluating Moisture Susceptibility*. Revised mixture conditioning reference from "Mixture Conditioning for Volumetric Mixture Design procedure in R 30, Section 7.1" to "T 283, Section 6".
  - Section 11.1., Evaluating Moisture Susceptibility. Revised mixture conditioning reference from "Mixture Conditioning for Volumetric Mixture Design procedure in R 30, Section 7.1" to "T 283, Section 6".
  - Section 11.2., Evaluating Moisture Susceptibility. Added text to ensure the asphalt mixture used to determine Gmm is cured, heated or dried according to T 283, Section 9.1 during the evaluation and grouping of specimens. After curing, heating, or drying according to T 283, Section 9.1, do not further condition the asphalt mixture according to T 209, Section 9.2 before placing the asphalt mixture in a flask, bowl or pycnometer to determine the Gmm.

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- R 35-17 (Continued): Evaluating Moisture Susceptibility revisions to correct mixture oven conditioning requirements associated with T 283.
  - Section 11.3., Evaluating Moisture Susceptibility. Added new Note 18 - The specifying agency may require Hamburg wheel-track testing according to T 324 for evaluating moisture susceptibility.
  - Appendix X2.8.4.1., Special Mixture Design Considerations and Practices for WMA. Revised mixture conditioning to reference AASHTO T 283, Section 6.
- R 47-19, Reducing Samples of Asphalt Mixtures to Testing Size:
  - Revised "Hot Mix Asphalt (HMA)" to "asphalt mixture" throughout standard.
  - Sections 8, 10, and 12, Procedures. Revised heating equipment and tools "not to exceed the maximum mixing temperature of the asphalt mixture"

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- R 79-19, Vacuum Drying Compacted Asphalt Specimens:
  - Section 3, Terminology. Remove definition for constant mass (not used).
  - Section 4, Apparatus. In Section 4.2, revised "handheld infrared temperature sensor" to "thermometric device".
  - Section 5, Procedure. Added new Subsections 5.9 to 5.11 to require two drying cycles.
- R 96-19, Installation, Operation, and Maintenance of Ignition Furnaces:
  - New Standard.
- R 97-19, Sampling Asphalt Mixtures
  - New Standard.

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- T 304-17:
  - Section 6.1 Apparatus. Cylinder Measure revised from drawn copper water tube (ASTM B88 Type M or B88M Type C) to a piece of metal with a seamless smooth wall. Most manufactured cylinder measures are brass (e.g., Gilson).
- T 312-15:
  - Section 4.1.3, SGC Ram Pressure 600±60 kPa (1st 5 Gyrations) 600±18 kPA (Remaining Gyrations)
- T 195-18:
  - Section 2, Referenced Documents. Replaced M 92 with ASTM E11 for specification requirements for cloth and wire sieves. Added reference to M 156, Requirements for Mixing Plants.
  - Section 4, Sampling. Added new Subsection 4.3 to include reference to M 156 and to operate plant at a steady state condition for a period of time long enough to complete the sampling. Revised Subsection 4.4 (formerly 4.3) to add new language concerning selecting the most appropriate sampling location and sampling procedures according to T 168, Sampling Bituminous Paving Mixtures.

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- T 30-19:
  - Section 7, Procedure. In Subsection 7.6, revised to remove the specific sieve loading requirements including Table 1 and move them to a new Annex A2. Section 7.6 would read be revised in part to read "Do not overload sieves, see Annex A2."
  - Section 8, Calculations. Revised from "Record the masses of each sieve…" to "Calculate percentages passing…".
  - Annex A1, Time Evaluation. New mandatory Annex on establishing minimum shaker time.

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- T 209-19:
  - Revised "Hot Mix Asphalt (HMA)" to "asphalt mixture" throughout standard.
  - Section 2, Referenced Documents. Added R 18 and R 30. Deleted ASTM D4311/D4311M, Determining Asphalt Volume Correction to Base Temp.
  - Section 4, Summary of Test Method. Deleted.
  - Section 6, Apparatus. "Vacuum bowl" to "Bowl". Added to flask "with a factory inscribed line". Added to pycnometer "with a volume defined by means of a machined lid or glass plate". Revised "Thermometric device" to "Thermometer". Revised water bath requirements due to moving Section 10 to an Annex.
  - Section 7, Sampling. Added subsections for "laboratory prepared" and "plant produced".
  - Section 9, Sample Preparation. Added subsections for "laboratory prepared samples" and "plant produced samples".
  - Section 10, Standardization of Flasks, Bowls and Pycnometer. Section moved to an Annex.
  - Section 13, Mass Determination. Formula simplification for mass determination in water

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- T 209-19:
  - Section 12, Procedure. Test Method B - Manual Agitation.
    - In Subsection 12.1, added the text "Striking the side of the container with a rubber mallet or a similar object is not considered sufficient agitation".

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2015 to 2019 Significant Updates to Published AASHTO Standards (Continued)

- T 324-19, Hamburg Wheel Track Testing:
  - Section 5, Apparatus.
    - Revision to Note 1 to reference NCHRP report or available devices to verify the sinusoidal wave form.
    - Subsection 5.2.1. Revised Linear Variable Differential Transducer (LVDT) to Linear Displacement Transducer (LDT).
    - Revision to Note 2 to add that location of deformation readings should be verified accounting for the curvature of the verification device.
    - Subsections 5.4 and 5.5. Added new text to "free circulating water on all sides of the mounting system"
  - Section 9, Calculations.
    - In Subsection 9.2 for calculation of average rut depth at the five middle deformation locations added the text "or other suitable method as specified by the agency".
  - Appendix X2, Calibration/Equipment Verification. Added new subsection X2.6 requiring maximum limit from a sinusoidal wave and offset values of displacement values.

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Proposed Significant Changes to AASHTO Standards for Publishing in 2020

- R 67-20, Sampling Asphalt Mixtures after Compaction (Obtaining Cores):
  - PennDOT does not reference this standard. PennDOT references PTM No. 729.
  - Section 2, Referenced Documents. New Section. Moved text in Appendix X2 referencing ASTM D3549, Test Method for Thickness or Height of Compacted Asphalt Mixture to new Section 2.1.
  - Section 4, Apparatus. In Section 4.1 (formerly 3.1) revised from "wet-core drilling machine" to "core-drilling machine".
  - Section 5, Procedure. In Section 5.6 (formerly 4.6), added language to brush off loose particles adhering to core and to remove any granular subbase material from bottom of core.
  - Section 6, Packaging and Transporting Samples. In Section 6.3 (formerly 5.3) added text at end "to prevent breaking or deforming"
  - Appendix X2 (Non-Mandatory). Revised completely to make it a procedure for removing cut aggregates from a core before further testing of the core.

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Proposed Significant Changes to AASHTO Standards for Publishing in 2020

- T 209-20:
  - Section 2, Referenced Documents. In Sections 2.1, and 6.1.1, added reference to R 67.
  - Section 12, Calculatiion.
    - In Section 12.2, revised to include an equation and example for calculating the weighted average maximum theoretical specific gravity of large-size samples tested in portions.
    - In Sections 12.2 and 12.2.1, removed references to "(*Gmm)*" as these subsections are for Theoretical Maximum Density.

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Proposed Significant Changes to AASHTO Standards for Publishing in 2020

- TP 124-20, I-FIT:
  - Changed title of standard to include "Illinois" for the "I" in I-FIT.
  - Revised from "FIT" to "I-FIT" throughout standard.
  - Section 2, Referenced Documents. In Section 2.1, added reference to R 30.
  - Section 4, Summary of Method. In Figure 1, revised notch width & tolerance from 1.5 ± 0.5 mm to ≤ 2.25 mm.
  - Section 9, Preparation of Test Specimens and Preliminary Determinations.
    - In Section 9.1.1, Note 4, revised to allow SGC specimens compacted to 115 ± 1 mm height if laboratory does not have capability to compact SGC specimens to recommended 160 ± 1 mm height.
    - In Section 9.3, revised notch width & tolerance from 1.5 ± 0.5 mm to ≤ 2.25 mm.
    - In Section 9.4, a new Note 6 was added to reference R 30 if testing to determine the effects of long-term aging.
  - In Section 14, Precision and Bias. Added precision estimates.

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Questions

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Percent Within Limits

Acceptance of Asphalt Pavements

Steven L. Koser, P.E.
Bureau of Maintenance and Operations

Adam M. Ostinowsky, E.I.T.
Urban Engineers, Inc.

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Quality

Continuation of the Goal of Increased Quality

- Target: Drive product consistency focused on job mix formula (JMF) (50% lot pay factor)
- Tighter adherence to field density spec. requirements (50% lot pay factor)

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What's different with PWL spec?

- **Incentive/Disincentive** structure (maximum 4% incentive)
- Primary Control Sieve (PCS) part of payment
- Modifies "goal posts" approach for 100% payment (good or no good)

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Payment Equation Changes

- **Section 409** specification (50% mix, 50% density)
  - 25% asphalt content
  - 25% #200 sieve
  - 50% field density
- **PWL** specification (50% mix, 50% density)
  - 30% asphalt content
  - 10% #200 sieve
  - 10% primary control sieve
  - 50% field density

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Current Status

Two (2) methods in use:

1. **PWL-LTS (Laboratory Testing Section)**
   - Acceptance at LTS
   - Gmm Verification included on Federally Funded and NHS Projects
   - Becomes **NEW Section 413**

2. **PWL-HOLA (Hands On Local Acceptance)**
   - Department Acceptance, Contractor Selected Lab
   - Department Option to Witness Only (**No Federal Funds and Not on NHS**)
   - Gmm Verification included on Federally Funded and NHS Projects.(Conducted at Local Lab)

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PWL-LTS

- **Very similar** to **Section 409 process**
- Allows a **contractor option** to **expedite sample delivery** to Harrisburg
  - Inspection staff secures samples
  - Secure samples given to contractor
  - Contractor delivers to LTS at their cost
  - LTS verifies security prior to testing
  - 2-3 Standard Work Day Goal at LTS

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Expedited Shipping (Contractor)

- For expedited shipping contractor must:
  - Indicate shipping entity (themselves or a third party)
  - Outline process in QC plan
  - Provide containers, cushioning and all packaging materials to Department
  - Third party shipping services must provide the ability to track delivery

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Expedited Shipping (Field Inspector)

- Field inspection responsibilities:
  - Secure containers with Department issued security tape (Supplied by the District)
  - Record the unique number from tape to TR-447
  - Place the TR 447 inside the shipping container
  - Return the secured containers to the contractor for shipping

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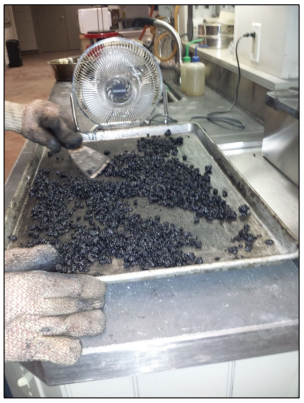
PWL-HOLA

- HMA/WMA Material **<u>samples collected</u>** as usual
- **<u>Acceptance testing</u>** performed at:
  - Assessed producers lab
  - or another mutually acceptable lab
- **<u>No LTS acceptance testing</u>** (except for dispute resolution situation)



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Local Acceptance QC Plan

- Separate LA QC Plan required to detail specifics
- 3 weeks before paving
- Must identify lab and equipment for testing
  - ✓ AASHTO re:source Assessment

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Sample Transportation and Security

- Tamper proof coolers with clasps
- Must be capable of relocking for storage
- Department supplied numbered security ties/security tape

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Acceptance Testing

- Testing to begin once lot is complete
- HOLA testing takes priority over other testing
- Department's Certified Technician **MUST** perform testing on **all Federally funded** project and project on the **NHS**

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Independent Assurance

- Required by FHWA 23 CFR 637
- First lot and randomly once for every ten thereafter
- Performed at the LTS
- Ensures sampling and testing is performed correctly
- Ensures testing equipment used is properly calibrated and operating correctly

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2019 Construction Season

District	Total Projects Advert.	Advertised LTS Projects	Advertised HOLA Projects	Projects with Acceptance Test Results
1-0	25	25	0	27
2-0	8	6	2	16
3-0	17	17	0	16
4-0	13	13	0	14
5-0	15	13	2	30
6-0	15	7	8	22
8-0	45	45	0	37
9-0	32	18	14	14
10-0	30	30	0	23
11-0	24	24	0	25
12-0	9	7	2	12
Total	**233**	**205**	**28**	**236**
		88%	12%	

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Summary of PWL Results
(As of December 31, 2019)

	Overall Lot Payment Averages				Mixture Pay Factor Averages		
	Lots	Average Lot Payment	Average Lot Payment (max. 1.04)	Average Lot Payment (max. 1.02)	Asphalt Content	#200 Sieve	Primary Control Sieve
Total	1290	1.01	1.02	1.00	100.45	100.34	100.35
PWT-HOLA	230	1.03	1.03	1.01	102.59	101.92	102.33
PWT-LTS	1060	1.01	1.01	1.00	99.98	99.99	99.92

Lot Comparison		
	PWL	%
Incentive Pay Lots	925	71.7%
100% Pay Lots	68	5.3%
Disincentive Pay Lots	288	22.3%
Defective Lots	9	0.7%
Total PWL Lots	1290	

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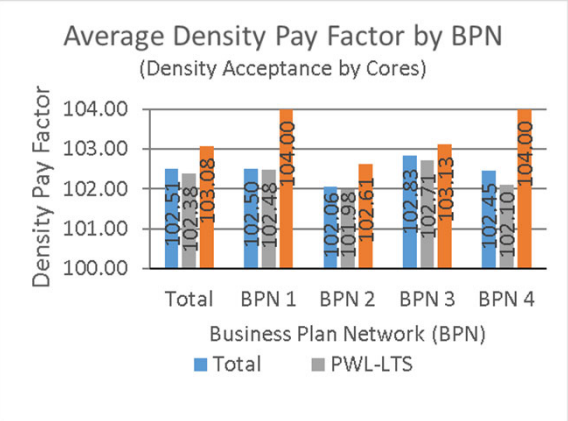
Average Density Pay Factor by BPN
(as of December 31, 2019)



BPN 1 – Interstates
BPN 2 – NHS
BPN 3 – State (ADT ≥ 2000)
BPN 4 – State (ADT < 2000)

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Key Points of PWL

- Does my project have PWL?
- Where can be PWL be applied?
- Terminated Lots (Contractor Elected)
- Sample Setup
- Incentives/Disincentives

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Does my project have PWL?

Applied to Project as a Standard Special Provision (SSP)

b04001 SUPERPAVE ASPHALT MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF ASPHALT PAVEMENTS WITH PERCENT WITHIN LIMITS AND LTS TESTING (PWL-LTS) **(Includes Gmm Verification)**

b04002 SUPERPAVE ASPHALT MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF ASPHALT PAVEMENTS WITH PERCENT WITHIN LIMITS AND LTS TESTING (PWL-LTS)

b04003 SUPERPAVE ASPHALT MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED ASPHALT PAVEMENT COURSES WITH DEPARTMENT LOCAL ACCEPTANCE, AND PAYMENT BY PERCENT WITHIN LIMITS (PWL-HOLA) **(Includes Gmm Verification)**

b04004 SUPERPAVE ASPHALT MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED ASPHALT PAVEMENT COURSES WITH DEPARTMENT LOCAL ACCEPTANCE, AND PAYMENT BY PERCENT WITHIN LIMITS (PWL-HOLA)

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Where can PWL be applied?

- If Governed by Pub. 408/2016 and earlier with a PWL SSP
  - ✓ Applicable to all asphalt paving items following material acceptance procedures of Sections 309, 311, 316, 409, 410, and 411
- If Governed by Pub. 408/2020
  - ✓ Applicable to all asphalt paving items following material acceptance procedures running through Section 413

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Contractor Terminated Lots

Allows contractor to limit risk when early QC results indicate an issue

- ❑ Must stop paving
- ❑ Notify Inspector in Charge in Writing
- ❑ 95% maximum pay

(Versions A, B, C and D 90% maximum pay)

- ❑ Must R&R if defective by test results

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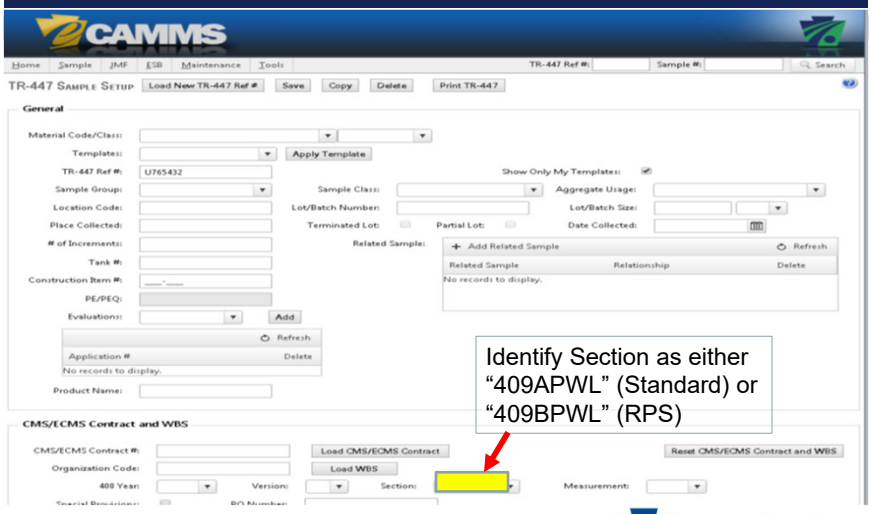
Sample Setup



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Incentives/Disincentives

INCENTIVES

- Contract Item for Incentives (PDA)
  - Item 9000-6174 SUPERPAVE PWT INCENTIVE
  - Started with Version C of SSPs
- Contract Adjustments entered into ECMS
  - "PWL Adjustment (LTS)" or "PWL Adjustment (HOLA)"
  - Attach eCAMMS Report
  - Versions A & B of SSPs

DISINCENTIVES

- Contract Adjustments entered into ECMS
  - "PWL Adjustment (LTS)" or "PWL Adjustment (HOLA)"
  - Attach eCAMMS Report
  - ALL Versions of SSPs

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Incentive Example

Lot Size = 2,500 tons

Contract Unit Price (CUP) = $130.00/ton

Lot Payment from eCAMMS = 1.03 Bonus Payment

Lot Payment for Contract Item = $325,000.00 (Qty x CUP)

Test Level - Bituminous Gradation Testing (AASHTO T		
Sieve Size	# of Increments	Avg. % Passing
#200	5	5.3
#100	5	8
#50	5	11
#30	5	16
#16	5	23
#8	5	37
#4	5	58
3/8"	5	98
1/2"	5	100
#200 Sieve Pay Factor	104.00	Bonus PF
PCS Sieve	#8 Sieve	
PCS Pay Factor	98.50	Reduced PF
OLPF	103.00	
Lot Payment	1.03	Bonus Payment

Incentive Calculation

Lot Payment with Incentive = Lot Payment from eCAMMS x Qty x CUP

Lot Payment with Incentive = 1.03 x 2,500 tons x $130.00
= $334,750.00

Lot Incentive = Lot Payment with Incentive – Lot Payment for Contract Item

Lot Incentive = $334,750.00 - $325,000.00

Lot Incentive = $9,750.00

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Disincentive Example

Lot Size = 2,500 tons

Contract Unit Price (CUP) = $130.00/ton

Lot Payment from eCAMMS = 0.83 Reduced Payment

Lot Payment for Contract Item = $325,000.00 (Qty x CUP)

Test Level - Bituminous Gradation Testing (AASHTO T		
Sieve Size	# of Increments	Avg. % Passing
#200	5	5.7
#100	5	9
#50	5	12
#30	5	17
#16	5	24
#8	5	38
#4	5	57
3/8"	5	95
1/2"	5	100
#200 Sieve Pay Factor	104.00	Bonus PF
PCS Sieve	#8 Sieve	
PCS Pay Factor	104.00	Bonus PF
OLPF	83.00	
Lot Payment	0.83	Reduced Payment

Penalty Calculation

Lot Payment with Disincentive = Lot Payment from eCAMMS x Qty x CUP

Lot Payment with Disincentive = 0.83 x 2,500 tons x $130.00
= $269,750.00

Lot Disincentive = Lot Payment with Disincentive – Lot Payment for Contract Item

Lot Disincentive = $269,750.00 - $325,000.00

Lot Disincentive = (-$55,250.00)

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2020 Construction Season

- PWL on **ALL** **Applicable** Paving Projects
- PWL-LTS becomes Section 413 of Pub. 408
  - Revised PWL-HOLA SSP

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Be a Part of the TEAM

- Please feel free to email your comments, questions and experiences.

Steve Koser
skoser@pa.gov

Adam Ostinowsky
c-aostinow@pa.gov

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Questions ?

Additional Resources

- PWL Field Users Guide
  (ECMS → References → File Cabinet → "PWL Field User Guide")
- Percent Within Tolerance (PWT) for Bituminous Pavement Acceptance Webinar
  (ECMS → References → Training Calendar → Course Search "PWT")

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Publication 408/2016

Below are links to the changes and list of effective dates. Select by clicking on the change.

Change	Effective Date
Initial Edition	April 1, 2016
Change No. 1	October 7, 2016
Change No. 2	April 7, 2017
Change No. 3	October 6, 2017
Change No. 4	April 6, 2018
Change No. 5	October 5, 2018
Change No. 6	April 5, 2019
Change No. 7	October 4, 2019

SECTION 106—CONTROL OF MATERIAL

106.01 GENERAL—Use material complying with the requirements of these specifications. At the pre-construction conference, submit a list of material to be sampled and tested by the Contractor and a list of material to be sampled and tested by the Department.

Comply with the provisions of the Pennsylvania Trade Practices Act, 71 P.S. Section 773.101, et seq., concerning the purchase of aluminum and steel products produced in a foreign country. On Federal-Aid projects, also comply with the provisions specified in Section 106.10.

Comply with the provisions of the Steel Products Procurement Act, 73 P.S. Section 1881, et seq. in the performance of the contract or any subcontract.

Following contract execution, furnish to the Department a complete statement of the project construction material's origin, composition, and manufacture.

For Fabricated Structural Steel materials, as identified in Section 1105.01(a) and inspected in accordance with Section 1105.01(e), and any other fabricated aluminum, precast or prestressed concrete products inspected during manufacturing, stamped and approved for shipment by the Department's Representative, furnish Form CS-4171 to the Inspector-in-Charge. Certified mill test reports for any steel included will be reviewed by the Department's Inspector and retained by the fabricator.

For all other steel products or products containing steel that will serve a permanent functional use in the project, provide the Inspector-in-Charge the following when the product is delivered to the project site:

- For any "identifiable" steel products, certification that Section 4 of the Steel Products Procurement Act, 73 P.S. Section 1884, has been complied with. Identifiable steel products are steel products which contain permanent markings which indicate the material was both melted and manufactured in the United States.
- For all other "unidentifiable" steel products, documentation such as invoices, bills of lading, and mill certification that positively identify that the steel was melted and manufactured in the United States.

The provisions of the Steel Products Procurement Act will not be waived unless the Secretary has determined, under authority granted in Section 4(b) of the act, that a certain steel product or products is not produced in the United States in sufficient quantities to meet contract requirements. Such a determination will be set forth in a proposal for the Department's review and response. Include with the proposal a comprehensive list of sources, including names and contact information, for verification. The Secretary does not have the authority to waive the provisions specified in Section 106.10.

Steel products are defined as products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated, otherwise similarly processed, or processed by a combination of two or more of these operations from steel made in the United States by the open hearth, basic oxygen, electric furnace, Bessemer, or any other steel-producing process. Included are cast iron products and machinery and equipment as listed in United States Department of Commerce Standard Industrial Classification 25, 35, and 37 and made of, fabricated from, or containing steel components. If a product, as delivered to the project, contains both foreign and United States steel, such product is considered to be a United States steel product only if at least 75% of the cost of the articles, materials, and supplies have been mined, produced, or manufactured, as the case may be, in the United States. On Federal-Aid projects, comply with the provisions specified in Section 106.10.

No payment will be made on the contract if unidentified steel products are supplied, until the hereinbefore requirements are met.

Any payments made that should not have been made may be recoverable from a manufacturer or supplier as well as from a contractor or subcontractor.

Any person who willfully violates the Steel Products Procurement Act will be prohibited from submitting bids for any contract for a period of 5 years from the date of determination that a violation has occurred. If a subcontractor, manufacturer or supplier, violates the Steel Products Procurement Act, such person will be prohibited from performing any work or supplying any materials to the Department for a period of 5 years from the date of determination that a violation has occurred.

If steel products are used as a construction tool or appurtenance and will not serve a permanent functional use in the project, compliance with the Steel Products Procurement Act is not required.

When standard manufactured items are specified and these items are identified by unit mass (unit weight), section dimensions, or similar characteristics, their identification will be considered to be nominal masses (weights) or dimensions. Unless more stringently controlled by specified tolerances, industry established manufacturing tolerances

will be accepted.

106.02 MATERIAL—

(a) Preliminary Acceptance and Approval. Have each material and material source of supply listed on Form CS-200 (Source of Supply – Materials) or Form CS-201 (Source of Supply – Traffic Control Devices) and approved before delivery to project. Department Bulletin listed material and material sources are available for use by the Contractor. If non-Bulletin material or material sources are proposed for use, the requirements specified in 106.02(a)2 must be met before these materials are delivered to the project. The Department reserves the right to obtain samples of any material provided by the Contractor for laboratory testing to verify compliance with specifications.

1. Bulletin Material, Material Application, and Material Source. Defined as any of the following:

- Any material and material source listed in Bulletin 14 and used in the material application as specified in the Bulletin, Publication 408, or a Special Provision.
- Any material and material source listed in Bulletin 15 and used in the material application as specified in the Bulletin, Publication 408, or a Special Provision.
- Any bituminous material and material application specified in Publication 408 and produced at a source listed in Bulletin 41.
- Any cement concrete material and material application specified in Publication 408 and produced at a source listed in Bulletin 42.

Submit a CS-200 or CS-201 to the Representative with the following information: contract item number, item description, material description/type/class, product name, manufacturer/producer plant location, applicable Bulletin supplier code, Bulletin number, and Publication 408 or Bulletin Section.

If a previously submitted Bulletin material source no longer provides the specified material, submit a change in material to the Representative as outlined on Form CS-200 or CS-201. Once written acceptance is received, furnish material from another Bulletin material source listed in Bulletin 14, 15, 41, or 42.

2. Non-Bulletin Material, Material Application, or Material Source. Defined as any of the following:

- Any material, product, or material source not listed in Bulletin 14 or Bulletin 15.
- Any material, product, or material source listed in Bulletin 14 or Bulletin 15 being used in an application not intended or specified in the Bulletin, Publication 408, or a Special Provision.
- Any bituminous material or product not produced at a source listed in Bulletin 41.
- Any bituminous material or product not specified in Publication 408 or a Special Provision.
- Any ready-mixed, cement concrete material or product not produced at a source listed in Bulletin 42.
- Any ready-mixed, cement concrete material or product not specified in Publication 408 or a Special Provision.

2.a. Construction-Aid Material. A necessary, temporary, or ancillary material that is not specified for use as part of a contract item or extra work item, but used by the Contractor only to aid in the completion of the work. The material is typically not a permanent part of the specified work (example: wood and nails for temporary formwork). The material need not be listed on Form CS-200 and does not require any Department approval for delivery to or use on the project. The Representative reserves the right to determine whether a material is a construction-aid material. Note temporary traffic control items are not construction-aid materials and do need listed on Form CS-201 since these items must be from Bulletin 15 listed sources and are specified for use as part of contract items or extra work items.

2.b. Project-Specific, LTS Approved Material. Non-Bulletin material proposed for use on a particular project as part of a contract item or extra work item, which requires approval by the LTS. Use of material is not meant to circumvent the use of available material sources listed in Bulletin 14, 15, 41, or 42. Have each material and material source listed on Form CS-200 or Form CS-201. The material is defined as any material, product, or material source that meets one or more of the following criteria:

- Meets specified requirements in Publication 408 or Special Provision, for the material and material application.
- Meets specified requirements in AASHTO or ASTM Standard for the material and material application.
- Meets specified requirements in project Special Provision for the material and material application.

Submit material to the LTS for evaluation and testing a minimum of 90 days before planned delivery to the project. Submit the following information to the LTS, with a copy to the Representative: source, description, specified use, QC Plan, independent lab test data showing material meets all specified requirements as determined on a single lot of material, and material samples of the kind and quality specified. Do not deliver material to the project until written acceptance is received from the Representative.

2.c. Project-Specific, Locally Approved Material. Non-Bulletin material proposed for use on a particular project as part of a contract item or extra work item, which does not require LTS approval because of the low risk to constructed Project performance, but does require local approval by the Representative (i.e. at the District or project level). This category of material is not meant to circumvent the use of available material sources listed in the Bulletins, or the requirements of Project-Specific, LTS Approved Materials. These materials must meet specification requirements and will be clearly identified in the specification as only needing local approval by the Representative. Have each material and material source listed on Form CS-200 or Form CS-201. Submit for local approval by the Representative all required information for the material, as indicated in the specification.

Examples of locally approved materials are project specific items, such as Section 860 (inlet filter bags), Section 867 (compost filter socks), and Section 868 (compost blanket and compost filter berms) where the specification indicates that these materials are to be locally approved. Bulletin 15 will reference specific Publication 408 Sections that apply to Locally Approved Materials. Bulletin 15 will not list actual materials or material sources for this category of materials as they will be accepted for use on a project-specific basis by local approval.

(b) Inspection. Inspect material delivered to the project and stockpile the material passing inspection for use. Do not incorporate questionable material, until material is tested by LTS and accepted in writing by the Representative. The Department reserves the right to reject questionable material delivered to the project when the LTS test results are not according to the specifications. Furnish assistance to the Inspector, as required to obtain samples.

Allow designated Department representatives to inspect material being used, or intended to be used, at any time before, during, or after material preparation, while being used during the progress of the work, or after the work has been completed. Furnish or arrange with producers or manufacturers to provide necessary material, labor, tools, and equipment for such inspection.

Inspections and tests, if made at any point other than the point of incorporation in the work, will not guarantee acceptance of the material. Inspection and testing performed by the Department will not relieve the Contractor's responsibility for QC.

106.03 TESTS AND ACCEPTANCE OF MATERIAL—

(a) Restricted Performance Specifications.

1. Responsibility. The Department will be responsible for determining the acceptability of the material and construction. Material will be reviewed for acceptance through the Department's specified acceptance procedures. Sample locations for acceptance testing will be determined by the Department.

Perform sampling and testing for acceptance in the presence of the Inspector, unless otherwise specified. Lot size will be specified. In the event that operational conditions cause work to be interrupted before the specified lot size has been achieved, the lot may be redefined by the Inspector. It is the intent of these specifications that each lot be evaluated based on the same number of samples. Transport acceptance samples from sampling point to testing site or other designated location in the presence of the Inspector.

The Contractor is responsible for the control and quality of the material and construction.

Prepare a QC Plan as specified in Section 106.03(a)2.a and submit it to the Inspector-In-Charge for review at the start of the project. Include QC sampling and testing frequencies and action points to initiate corrective measures. Notify the Inspector before performing QC sampling and testing. Perform QC sampling and testing and report results to the Inspector.

Obtain and test samples according to the Department's PTMs. If the required test method is not specified, use methods described in the AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, and Supplements, Standards and/or Tentatives of ASTM, or other testing procedures adopted by the Department.

Verification sampling and testing will be performed by the District, unless otherwise specified.

QA sampling and testing will be performed or witnessed by the CMD.

Independent Assurance sampling and testing will be administered by the CMD.

2. QC.

2.a Maintain a QC system that provides reasonable assurance that materials, products, and completed construction, submitted for acceptance, conform to contract requirements whether self-manufactured, processed, or procured from subcontractors or vendors. When specified, submit for review, a plan of the QC system to be used. Have performed or perform the inspections and tests required to substantiate product conformance to contract requirements. Make the inspection and test results available for review throughout the contract life. Procedures will be subject to the review of the Department before the work is started. Charts and records documenting QC inspections and tests are the property of the Department. Submit a QC Plan for use in compliance with the following guidelines, as a minimum:

2.a.1 Raw Materials. List the source of material along with methods of documentation and testing performed to assure the material quality.

2.a.2 Production Control. List lot size and samples required; include sample selection, labeling and test procedure; also include manufacturing phase.

2.a.3 Product Testing. List type and frequency of tests to be performed, along with method of documenting and reporting test results. List test equipment and calibration procedure (frequency) required. List procedure for retesting or rejecting items failing the tests. List the disposal methods and location for test samples and rejected lots.

2.a.4 Personnel. List the personnel in charge of QC and define their areas of responsibility.

2.a.5 Packaging and Shipping. List method of identifying, storing, loading, transporting, and unloading to assure safe delivery of acceptable material and products.

2.a.6 Documentation. List the procedures used for documentation and certification.

The QC Plan and process are subject to periodic review and inspection by the Department.

2.b Promptly record conforming and non-conforming inspection and test results on acceptable forms or charts. Keep these records complete and keep them available for inspection at all times during the performance of the work.

2.c Promptly correct any errors, equipment malfunctions, process changes, or other assignable causes which have resulted or could result in the submission of material, products, and completed construction not conforming to specification requirements.

2.d When required, provide or have provided and maintain measuring and testing devices necessary to ensure that material and products conform to contract requirements. In order to ensure continued accuracy, calibrate these devices at established intervals against Department standards.

2.e When required, make the measuring and testing equipment available to the Representative for use in determining conformance of material, products, or completed construction with contract requirements. In addition, make personnel available for the operation of such devices and for verification of the accuracy and condition of the devices. Have calibration results available at all times. The Department reserves the right to conduct periodic inspections of the measuring and testing devices to confirm both calibration and condition of operation.

2.f Failure to comply with the QC Plan may result in suspension of approval to provide material for Department use and/or removal from the approved list of material suppliers in the applicable bulletins.

3. Acceptance Plans.

3.a Percent Within Tolerance. The percentage of each lot within the specified tolerances will be determined by the following procedures:

3.a.1 The "n" sampling positions on the lot will be located by use of the table of random numbers found in PTM No. 1.

3.a.2 A measurement will be made at each location, or a test portion taken and the measurement made on the test portion.

3.a.3 The lot (X) measurements are averaged to find $\overline{X}$.

$$\overline{X} = \sum_{i=1}^{n} \frac{X_i}{n}$$

3.a.4 The Standard Deviation, "s," of the lot measurements will be determined as follows:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{n-1}}$$

3.a.5 The Quality Index (Q_U) is found by subtracting the average (X) of the measurements from the upper specification limit (U) and dividing the result by "s."

$$Q_u = \frac{(u - \overline{X})}{s}$$

3.a.6 The Quality Index (Q_L) is found by subtracting the lower specification limit (L) from the average and dividing the result by "s."

$$Q_L = \frac{(\overline{X} - L)}{s}$$

3.a.7 The percentage of material that will fall within the upper tolerance limit (U) is estimated by entering Table A or Table B with Q_U, using the column appropriate to the total number of measurements (n). Use Table A if Q_U has a negative value, or use Table B if Q_U has a positive value.

3.a.8 The percentage of material that will fall within the lower tolerance limit (L) is estimated by entering Table A or Table B with Q_L, using the column appropriate to the total number of measurements (n). Use Table A if Q_L has a negative value, or use Table B if Q_L has a positive value.

3.a.9 In cases where both upper (U) and lower (L) tolerance limits are concerned, the percentage of material that will fall within tolerance limits is found by adding the percent (P_U) within the upper tolerance limit (U) to the percent (P_L) within the lower tolerance limit (L) and subtracting 100 from the sum.

$$\text{Total percent within limits} = (P_U + P_L) - 100$$

3.a.10 When determining the percentage within tolerance when the calculated Quality Index (Q.I.) value is between two tabular values in Table A or Table B, the following procedure is used:

- The difference between the tabular Q.I. values on either side of the calculated value Q.I. value will be determined.

- The difference will be divided by 2 and the quotient added to the lower tabular Q.I. value, resulting in the interpolated Q.I. value.

- If the calculated Q.I. is equal to or greater than the interpolated value, the higher listed percent within tolerance will be used.

- If the calculated Q.I. is less than interpolated value, the lower listed percent within the tolerance will be used.

TABLE A
Estimating Percent of Lot Within Tolerance
(Standard Deviation Method)
Negative Values of Q_U or Q_L

Percent Within Tolerance	n=3	n=4	n=5	n=6	n=7
50	0.0000	0.0000	0.0000	0.0000	0.0000
49	0.0361	0.0300	0.0281	0.0272	0.0267
48	0.0722	0.0600	0.0562	0.0545	0.0535
47	0.1083	0.0900	0.0843	0.0818	0.0802
46	0.1444	0.1200	0.1124	0.1091	0.1070
45	0.1806	0.1500	0.1406	0.1364	0.1338
44	0.2158	0.1800	0.1689	0.1639	0.1608
43	0.2510	0.2100	0.1972	0.1914	0.1878
42	0.2863	0.2400	0.2256	0.2189	0.2148
41	0.3215	0.2700	0.2539	0.2464	0.2418
40	0.3568	0.3000	0.2823	0.2740	0.2689
39	0.3912	0.3300	0.3106	0.3018	0.2966
38	0.4252	0.3600	0.3392	0.3295	0.3238
37	0.4587	0.3900	0.3678	0.3577	0.3515
36	0.4917	0.4200	0.3968	0.3859	0.3791
35	0.5242	0.4500	0.4254	0.4140	0.4073
34	0.5564	0.4800	0.4544	0.4426	0.4354
33	0.5878	0.5101	0.4837	0.4712	0.4639
32	0.6187	0.5401	0.5131	0.5002	0.4925
31	0.6490	0.5701	0.5424	0.5292	0.5211
30	0.6788	0.6001	0.5717	0.5586	0.5506
29	0.7076	0.6301	0.6018	0.5880	0.5846
28	0.7360	0.6601	0.6315	0.6178	0.6095
27	0.7635	0.6901	0.6619	0.6480	0.6395
26	0.7905	0.7201	0.6919	0.6782	0.6703
25	0.8164	0.7501	0.7227	0.7093	0.7011
24	0.8416	0.7801	0.7535	0.7403	0.7320
23	0.8661	0.8101	0.7846	0.7717	0.7642
22	0.8896	0.8401	0.8161	0.8040	0.7964
21	0.9122	0.8701	0.8479	0.8363	0.8290
20	0.9342	0.9001	0.8798	0.8693	0.8626
19	0.9555	0.9301	0.9123	0.9028	0.8966
18	0.9748	0.9601	0.9453	0.9367	0.9315
17	0.9940	0.9901	0.9782	0.9718	0.9673
16	1.0118	1.0201	1.0125	1.0073	1.0032

TABLE A (continued)
Estimating Percent of Lot Within Tolerance
(Standard Deviation Method)
Negative Values of Q_U or Q_L

Percent Within Tolerance	n=3	n=4	n=5	n=6	n=7
15	1.0286	1.0501	1.0469	1.0437	1.0413
14	1.0446	1.0801	1.0819	1.0813	1.0798
13	1.0597	1.1101	1.1174	1.1196	1.1202
12	1.0732	1.1401	1.1538	1.1592	1.1615
11	1.0864	1.1701	1.1911	1.2001	1.2045
10	1.0977	1.2001	1.2293	1.2421	1.2494
9	1.1087	1.2301	1.2683	1.2866	1.2966
8	1.1170	1.2601	1.3091	1.3328	1.3465
7	1.1263	1.2901	1.3510	1.3813	1.3990
6	1.1330	1.3201	1.3946	1.4332	1.4562
5	1.1367	1.3501	1.4408	1.4892	1.5184
4	1.1402	1.3801	1.4898	1.5500	1.5868
3	1.1439	1.4101	1.5428	1.6190	1.6662
2	1.1476	1.4401	1.6018	1.6990	1.7615
1	1.1510	1.4701	1.6719	1.8016	1.8893

TABLE B
Estimating Percent of Lot Within Tolerance
(Standard Deviation Method)
Positive Values of Q_U or Q_L

Percent Within Tolerance	n=3	n=4	n=5	n=6	n=7
99	1.1510	1.4701	1.6719	1.8016	1.8893
98	1.1476	1.4401	1.6018	1.6990	1.7615
97	1.1439	1.4101	1.5428	1.6190	1.6662
96	1.1402	1.3801	1.4898	1.5500	1.5868
95	1.1367	1.3501	1.4408	1.4892	1.5184
94	1.1330	1.3201	1.3946	1.4332	1.4562
93	1.1263	1.2901	1.3510	1.3813	1.3990
92	1.1170	1.2601	1.3091	1.3328	1.3465
91	1.1087	1.2301	1.2683	1.2866	1.2966
90	1.0977	1.2001	1.2293	1.2421	1.2494
89	1.0864	1.1701	1.1911	1.2001	1.2045
88	1.0732	1.1401	1.1538	1.1592	1.1615
87	1.0596	1.1101	1.1174	1.1196	1.1202
86	1.0446	1.0801	1.0819	1.0813	1.0798
85	1.0286	1.0501	1.0469	1.0437	1.0413
84	1.0118	1.0201	1.0125	1.0073	1.0032
83	0.9940	0.9901	0.9782	0.9718	0.9673
82	0.9748	0.9601	0.9453	0.9367	0.9315
81	0.9550	0.9301	0.9123	0.9028	0.8966
80	0.9342	0.9001	0.8798	0.8693	0.8626
79	0.9122	0.8701	0.8479	0.8363	0.8290
78	0.8896	0.8401	0.8161	0.8040	0.7964
77	0.8661	0.8101	0.7846	0.7717	0.7642
76	0.8416	0.7801	0.7535	0.7403	0.7320
75	0.8164	0.7501	0.7227	0.7093	0.7011
74	0.7905	0.7201	0.6919	0.6782	0.6703
73	0.7635	0.6901	0.6619	0.6480	0.6395
72	0.7360	0.6601	0.6315	0.6178	0.6095
71	0.7076	0.6301	0.6018	0.5880	0.5846
70	0.6788	0.6001	0.5717	0.5586	0.5506
69	0.6490	0.5701	0.5424	0.5292	0.5211
68	0.6187	0.5401	0.5131	0.5002	0.4925
67	0.5878	0.5101	0.4837	0.4712	0.4639
66	0.5564	0.4800	0.4544	0.4426	0.4354
65	0.5242	0.4500	0.4254	0.4140	0.4073

TABLE B (continued)
Estimating Percent of Lot Within Tolerance
(Standard Deviation Method)
Positive Values of Q_U or Q_L

Percent Within Tolerance	n=3	n=4	n=5	n=6	n=7
64	0.4917	0.4200	0.3968	0.3859	0.3791
63	0.4587	0.3900	0.3678	0.3577	0.3515
62	0.4252	0.3600	0.3392	0.3295	0.3238
61	0.3912	0.3300	0.3106	0.3018	0.2966
60	0.3568	0.3000	0.2823	0.2740	0.2689
59	0.3215	0.2700	0.2539	0.2464	0.2418
58	0.2863	0.2400	0.2256	0.2189	0.2148
57	0.2510	0.2100	0.1972	0.1914	0.1878
56	0.2158	0.1800	0.1689	0.1639	0.1608
55	0.1806	0.1500	0.1406	0.1364	0.1338
54	0.1444	0.1200	0.1124	0.1091	0.1070
53	0.1083	0.0900	0.0843	0.0818	0.0802
52	0.0722	0.0600	0.0562	0.0545	0.0535
51	0.0361	0.0300	0.0281	0.0272	0.0267
50	0.0000	0.0000	0.0000	0.0000	0.0000

3.b Resampling of Lot. It is the intent of these specifications that lots will meet specification requirements at the time of submission. If permitted, nonconforming lots that can be corrected may be reworked and sampled.

3.c General Basis of Adjusted Payment. The related adjusted percentage of contract price will be determined by the method designated in the appropriate specification section.

(b) Specifications, Other than Restricted Performance.

1. Responsibility. The Department will be responsible for determining the acceptability of the material and construction. Material will be reviewed for acceptance through the Department's specified acceptance procedures. Sample locations for acceptance testing will be determined by the Department.

Perform sampling and testing for acceptance in the presence of the Inspector, unless otherwise specified. Transport acceptance samples from sampling point to testing site or other designated location in the presence of the Inspector.

The Contractor is responsible for the control and quality of the material and construction.

Prepare a QC Plan as specified in Section 106.03(a)2.a and submit it to the Inspector-In-Charge for review at the start of the project. Include QC sampling and testing frequencies and action points to initiate corrective measures. Notify the Inspector before performing QC sampling and testing. Perform QC sampling and testing and report results to the Inspector.

Do not incorporate any material into the work that is determined to be outside the specification limits.

Obtain and test samples according to the Department's PTMs. If the required test method is not specified, use methods described in the AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, and Supplements, Standards and/or Tentatives of ASTM, or other testing procedures adopted by the Department.

Verification sampling and testing will be performed by the District, unless otherwise specified.

QA sampling and testing will be performed or witnessed by the BOPD.

Independent Assurance sampling and testing will be administered by the BOPD.

2. QC. Section 106.03(a)2. and as follows:

Provide a plan of the QC system to be used for all construction work requiring acceptance testing by the Department, including QC test frequencies and action points to initiate corrective measures. Submit a copy of the QC Plan to the Project Engineer, to be maintained at the Department's project field office, before the start of work. A QC Plan is not required for items specified in Section 901.

3. Compliance Certification of Bulletin Materials. The Contractor is responsible for the control and quality of all materials, both Bulletin and non-Bulletin materials, arriving at the project. Each Bulletin material must be certified to be from a Bulletin source and to be in compliance with the specification requirements for the material. A properly completed and submitted Form CS-4171, Certificate of Compliance, is the means for certification of Bulletin materials. Bulletin materials are defined in Section 106.02(a)1.

The Department reserves the right to sample and test any material for verification that specification requirements are met. Materials of questionable quality delivered to the project will be sampled, tested, and approved by LTS before incorporation in any work. Materials on a reduced certification level may be required to be sampled, tested, and approved by LTS before incorporation in any work. Random field verification samples of the material may be taken by the Representative at the material source, from delivered project material, or at the place of the last manufacturer, fabricator, or producer before delivery. Random QA samples may also be taken by the Representative from delivered project material, at the place of supply, or at the place of the last manufacturer, fabricator, or producer before delivery. The random samples will be sent to the LTS for testing.

3.a Form CS-4171 Completion. Form CS-4171 is completed by the manufacturer, fabricator, or producer (Producer) of Bulletin material provided to the project. The Producer maintains the original Form CS-4171 and provides a copy of Form CS-4171 with each direct shipment to the project.

When a Producer sells a Bulletin 15 material to a distributor/supplier (shipper), the Producer provides a copy of Form CS-4171 with each delivery to the shipper. When a shipper provides Bulletin 15 material directly to the project, the shipper completes and signs a new Form CS-4171 and provides a copy with each direct shipment to the project. The shipper will maintain the copy of the Producer's Form CS-4171that they have received.

Form CS-4171 must be properly signed by a legally responsible company official.

3.b Form CS-4171 Submission for Project Shipments. Ensure that Form CS-4171 is received for each project shipment of Bulletin material. Submit to the Representative a properly completed and signed copy of Form CS-4171 for each project shipment. Do not incorporate any Bulletin material in the work until certification arrives on the project, unless otherwise approved by the Representative. Payment for material will be withheld until proper certification documentation is received.

Form CS-4171 may be submitted to the Department either in hard copy format or electronically. Contractors who wish to submit certification documentation to a project electronically, e.g. via e-mail, facsimile or through a PennDOT Project Collaboration Site, must notify the Department at the preconstruction meeting.

3.c Supplemental or Alternate Certification. Certain Bulletin materials require the submission of supplemental CS-4171 certification in addition to Form CS-4171, to provide traceability of materials in multi-step manufacturing processes.

- Epoxy coated or galvanized reinforcement steel requires the submission of supplemental certification Form CS-4171C (Epoxy Coating or Galvanizing Facility) and/or Form CS-4171F (Fabrication Facility).
- Structural steel, aluminum, or precast/prestressed concrete products, produced in a Bulletin 15 approved facility with an on-site Inspector or a Representative, must be stamped with an approved inspection stamp at the plant and certified with a Form CS-4171.
- Steel products containing foreign steel require the submission of supplemental Form CS-4171S.

Certain Bulletin materials require a form of certification other than the Form CS-4171, as identified in the particular material specification.

- Section 701 and Section 702 materials require a properly completed vendor bill of lading.
- Certification of daily bituminous mixtures by submission of Form CS-4171B.

- Certification of locally approved non-Bulletin materials by submission of Form CS-4171LA.

Organize and submit only Forms CS-4171 and supplemental or alternate certifications for material supplied to the project. Submissions containing irrelevant forms or documentation for materials not incorporated into the project will not be accepted.

3.d CS-4171 Record Retention. Retain Form CS-4171 and supplemental and alternate certifications as defined in Section 106.03(b)3.c, for a period of not less than 3 years from the date of the last project shipment. Make files available for inspection and verification by the Department.

Notify shippers that a certification file must be maintained for purchased Bulletin materials to provide an audit trail to the Producer. Certifications for purchased Bulletin materials must be maintained at their place of business for a period of not less than 3 years from the date of the last shipment to the project and must be available for inspection by the Department.

Notify Producers that all component certifications for purchased Bulletin materials must be maintained at their place of business for a period of not less than 3 years from the date of the last shipment to the project and must be available for inspection by the Department.

3.e Levels of Certification for Bulletin 15 Producers. The BOPD determines the Level of Certification for each Producer based on the Producer's ability to comply with the material specifications. The Levels of Certification are defined in Table C. Bulletin 15 will indicate if a Producer is at a certification level other than Level 1. Material provided by Producers listed in Bulletin 15 is approved for use only in its intended application(s).

TABLE C

Levels of Certification for Bulletin 15 Producers		Producer Material Shipment Procedure	Producer Additional Requirements
Level 1	Standard Certification	Ship on Certification with Form CS-4171*	None
Level 2	Standard Certification - Reduced	Ship on Certification with Form CS-4171*	See Section 106.03(b)3.e.2
Level 3	Lot Approval Certification	Ship only after Material Lot Approval using Modified Certification, with Form CS-4171*	See Section 106.03(b)3.e.3
Suspension or Removal	According to the State's Contractor Responsibility Program: • Producer may be suspended or removed from Bulletin 15 for any of the reasons stated in the Bulletin 15 Preface, regardless of Producer certification level. • Failure of Producer to advance above Certification Level 3 will result in PennDOT's initiating action for suspension or removal from Bulletin 15.		

* Certain Bulletin materials require supplemental or alternate forms of certification, as specified in Section 106.03(b)3.c.

3.e.1 LEVEL 1 (Standard Certification).

- Initial Level of Certification typically issued to Bulletin 15 listed Producers.
- Material is produced and tested in accordance with the Producer's approved QC Plan.
- No known material performance or quality issues exist that warrant a reduced level of certification.
- Material is shipped on certification using Form CS-4171.

3.e.2 LEVEL 2 (Standard Certification - Reduced).

- Reduced Level of Certification issued to Bulletin 15 listed Producers who have exhibited minor/moderate material performance or quality issues.

- Producer is required to work with PennDOT on submission of an improvement plan that may include, but is not limited to, any or all of the following items: a revised QC Plan, a failure analysis/action plan to assess why failures are occurring and how to prevent these failures from occurring in the future, correlation testing between in-house and independent lab testing to assist with validating results.
- Material is produced and tested in accordance with the improvement plan approved by PennDOT.
- Material is shipped on certification using Form CS-4171.

3.e.3 LEVEL 3 (Lot Approval Certification).

- This Level of Certification is issued to Bulletin 15 listed Producers who have exhibited major material performance or quality issues.
- Producer is required to work with PennDOT on an improvement plan as defined in Level 2.
- Material cannot be shipped to projects using the standard CS-4171 certification process.
- Producer must arrange for independent, in-plant acceptance testing (IPAT) that will be conducted side-by-side with "in-house" Producer testing at the designated frequencies in the revised QC plan. IPAT will be at the Producer's expense. PennDOT's LTS must approve the Producer's proposed IPAT provider, before it begins.
- Any material lot to be used on a project must be tested and approved by the IPAT as meeting the required PennDOT specification prior to shipment to the project.
- Each material lot meeting the specification may be shipped to a project using a modified certification process as follows: submit, to both the Project Representative and LTS, Form CS-4171 along with a signed letter from the IPAT (on their official letterhead) indicating that the material lot meets testing and specification requirements.
- Correlate results from parallel "in-house" Producer testing and IPAT testing, and submit to the LTS on a monthly basis.

106.04 USE OF MATERIALS FROM WITHIN THE PROJECT—With written permission, material found in the excavation areas and meeting the Department's specifications may be used in the project construction. Material used will be paid for, as specified in Section 110.01. However, replace any portion removed with suitable material, if required to complete the embankments. The replaced quantity will be 110% of the volume of stone or gravel removed and 100% of the volume of sand and other material removed. Do not use reserved material, as specified in Section 104.06, or as indicated in the proposal.

106.05 STORAGE OF MATERIAL—

(a) General. Store material to assure preservation of specified quality and fitness for the work.

Stored material, even though accepted before storage, may again be inspected before use in the work. Locate stored material to facilitate prompt inspection and control.

Adhere to the restrictions below for the storage of construction materials with known physical hazards (explosive, flammable, or combustible) or storage of any motorized equipment under any structure with vertical clearance measured:

- Less than 16 feet – No storage is allowed.
- Between 16 feet and 24 feet – Short term operational storage will be allowed provided the materials are stored in an enclosure which meets all ANSI and OSHA requirements for said material(s) and a fire prevention plan has been submitted for the short term operational storage. Short term operational storage is limited to the amount of material and/or equipment required for a 24-hour period.
- Greater than 24 feet – No restriction.

Vertical clearance is measured from the lowest structure member to the ground level below that member.

Do not use private property for storage purposes without written permission of the owner or lessee. Make copies of this permission available to the Department. Restore storage sites to conditions acceptable to property owners and the Department.

(b) Storage of Aggregates. Provide a separate stockpile for each aggregate size and type at cement concrete plants. Do not use aggregates that become segregated or mixed with earth or foreign material.

If divided aggregate bins are used for storage or for proportioning, take measures to prevent mixing of aggregates.

Provide an area for storage of aggregates for use in Portland cement concrete and bituminous concrete. Store aggregates on one of the following constructed according to standard practice:

- Bituminous concrete base course, 4 inches minimum depth.
- Class C concrete, or better, 4 inches minimum depth.

(c) Control of Aggregates. Have aggregates available for use in cement concrete at the proportioning plant in enough time before batching to allow inspection and testing. Handle the aggregates so they may be field tested and accepted, before storing them with previously accepted aggregates. Batch fine and coarse aggregates separately. Properly control uniformity of moisture and uniformity of gradation. Provide a system of water sprays, then use when required, to maintain coarse aggregate moisture control.

During cool and cold weather concrete production, maintain aggregates required for individual concrete placements, whether stored in proportioning bins or stockpiles, at a temperature of not less than 40F before and during batching operations, for a sufficient length of time to eliminate the presence of frost in or around the aggregate particles.

(d) Storage of Reinforcement. Satisfactorily store reinforcement above ground, in a clean and dry condition on a platform, in an orderly manner, plainly marked to facilitate inspection.

106.06 HANDLING AND TRANSPORTATION OF MATERIAL—

(a) General. Carefully handle material to preserve quality and fitness for the work and to prevent loss, segregation, or inconsistency in quantities after weighing or measuring for incorporation in the work.

(b) Aggregates. In dry batching operations, measure aggregates or weigh before placing in the compartments of the vehicle, unless otherwise specified or permitted. Clean the vehicles and provide tight batch partitions at least 4 inches higher than the batched aggregate level being hauled, to prevent any spillage from one compartment to another.

(c) Bulk Cement. Bulk cement may be used, as specified in Section 701.

If bulk cement is used, transport to the mixer in acceptable metal, rubber, or plastic, watertight containers or compartments.

(d) Bag Cement. If bag cement is used, dump the contents of the correct number of bags required for each batch into the mixer skip. If permitted, bag cement may be transported from storage to the mixer by placing the correct number of bags per batch on the batched aggregate in the aggregate compartments. When transported, the bag cement may be dumped on the aggregate after having been checked by the inspector, and if done not more than 100 feet from the mixer. Bag cement that is allowed to lie on the batched aggregates longer than 2 hours, or cement dumped on the batched aggregate longer than 1 hour, will be rejected.

106.07 UNACCEPTABLE MATERIAL—

(a) Restricted Performance Specifications.

1. Acceptance or Rejection. Following the application of the appropriate acceptance plan, the Representative's decision will be final as to the acceptance, rejection, or acceptance at an adjusted price of sampled lots.

2. Disposition of Lots. If permitted, lots not conforming to specifications may be reworked and resubmitted for acceptance sampling. For nonconforming lots that are not adaptable to correction by reworking, remove and replace them, have them accepted without payment, or have them accepted at an adjusted price as stated in the specifications or, if not stated, as directed.

(b) Specifications, Other than Restricted Performance. Material not conforming to the requirements of the specifications, whether in place or not, will be rejected. Remove such material promptly from the site of the work, unless otherwise directed. Do not return rejected material to the work site until defects have been corrected and the material has been accepted for use.

(c) Serviceable Precast or Prestressed Concrete, Fabricated Structural Steel and Aluminum Products. Plant produced fabricated materials or products having materials substitutions, dimensional deviations, specifications deficiencies, or damage which result in materials or products which may be serviceable but, do not meet all contract requirements will be addressed as follows:

1. Minor Deficiency or Defect. For materials or products with one or more minor deficiencies or defects, resolution of the deficiencies or defects will be made directly by the precaster or fabricator with the BDTD's Structural Materials Section. Minor defects and deficiencies are generally defined as those which will not require:

- engineering design review
- revisions to approved installation or erection plans or methods
- anticipated premature maintenance or rehabilitation

The Structural Materials Section may determine that one or more of the minor deficiencies or defects are actually significant deficiencies or non-conformances and require the precaster or fabricator to resolve the deficiency or defect as a significant deficiency or non-conformance as specified in Section 106.07(c)2.

2. Significant Deficiency or Non-Conformance. For materials or products having one or more significant deficiencies or non-conformances, which cannot be corrected to meet the contract specifications and which the Department determines may require one or more of the bulleted items listed in Section 106.07(c)1., submit documentation to support acceptance of the material or product (provided by the precaster or fabricator) and a request for Department evaluation and final disposition of the materials or products.

Where visible defects are present, or when otherwise requested, include detailed sketches, drawings, or photographs along with the supporting documentation form the precaster or fabricator to support acceptance of the material or product. Include a detailed repair procedure to correct the deficiency, if applicable.

For requests submitted for acceptance of the material or product "as is", provide supporting justification to demonstrate that the significant deficiency or non-conformance will not result in additional constructability issues during erection or construction or unanticipated premature maintenance work. Obtain approval of any revisions required to the shop drawings to reflect as built conditions prior to shipment.

Submit engineering calculations, when required or requested, to support the acceptability of the significant deficiency or non-conformance, sealed by a registered Professional Engineer that is licensed in the State. Submittals must include a statement by the Engineer that the defect will not compromise either the structural capacity or service life of the original design.

Submit the above to the District Assistant Construction Engineer with copies to the following:

- Chief Structural Materials Engineer, Bridge Design and Technology Division, Bureau of Project Delivery
- District Structural Control Engineer
- District Bridge Engineer
- Chief Bridge Engineer, Bridge Design and Technology Division, Bureau of Project Delivery (when calculations are required or requested).

Include the following minimum information on a cover page, attached to the submission:

- ECMS or other contract identification including State Route, Section and County
- Structure Number, if applicable
- Specific identification of the affected unit(s), i.e. girder-beam-culvert number, etc.
- Anticipated shipping date
- Detailed sketches, drawings or photographs of the defect, if visible or when requested.

After evaluation, the disposition of the material or product, including any conditions of acceptance, will be

provided by the Chief Structural Materials Engineer from information provided by the Engineering District. Replace materials or products which are rejected via this policy with those complying with the contract specifications and requirements.

106.08 DEPARTMENT FURNISHED MATERIAL—The Department will furnish material, if specified in the proposal, in the quantities required. Material will be delivered or made available at the point specified.

The cost of handling and placing material after delivery will be included in the contract price for the item.

After delivery and acceptance by the Contractor, the cost of replacing material due to shortages, deficiencies, or damage, including demurrage charges, will be deducted from money due or to become due.

106.09 PENNSYLVANIA TRADE PRACTICES ACT—This section does not apply to projects which are partially or totally financed with Federal funds.

(a) General. Pursuant to the PA Trade Practices Act, Act 226-1968, the Department will not specify, purchase, or permit to be furnished or used in any contract aluminum or steel products as set forth below made in the countries set forth below.

The Department may utilize the discretionary waiver provision of Act 3-1978 as to steel products. As to aluminum products, if the sole source is from a banned country relief may be permitted under the Statutory Construction Act, 1 PA C.S. 1901 et seq.

1. Brazil. Welded carbon steel pipes and tubes; carbon steel wire rod; tool steel; certain stainless steel products including hot-rolled stainless steel bar; stainless steel wire rod and cold-formed stainless steel bar; pre-stressed concrete steel wire strand; hot-rolled carbon steel plate in coil; hot-rolled carbon steel sheet; and cold-rolled carbon steel sheet.

2. Spain. Certain stainless steel products, including stainless steel wire rod, hot-rolled stainless steel bars, and cold-formed stainless steel bars; pre-stressed concrete steel wire strand; certain steel products, including hot-rolled steel plate, cold-rolled carbon steel plate, carbon steel structural shapes, galvanized carbon steel sheet, hot-rolled carbon steel bars; and cold-formed carbon steel bars.

3. South Korea. Welded carbon steel pipes and tubes; hot-rolled carbon steel plate; hot-rolled carbon steel sheet; and galvanized steel sheet.

4. Argentina. Carbon steel wire rod and cold-rolled carbon steel sheet.

106.10 BUY AMERICA PROVISIONS AND CONVICT PRODUCED MATERIALS—This section only applies to projects partially or totally financed with Federal funds.

(a) Buy America Provisions. Furnish steel or iron materials, including coating for permanently incorporated work according to 23 CFR 635.410 and as follows:

- Pig iron and processed, pelletized, and reduced iron ore manufactured outside of the United States is acceptable for use in domestic manufacturing process for steel and/or iron materials.

- All manufacturing processes of steel or iron materials in a product, including coating; and any subsequent process that alters the steel or iron material's physical form or shape, or changes its chemical composition; are to occur within the United States. This includes rolling, extruding, machining, bending, grinding, drilling, and coating. Coating includes all processes that protect or enhance the value of the material, such as epoxy coatings, galvanizing or painting.

- Provide certification to the Inspector-in-Charge, that all manufacturing processes for steel and iron materials in a product, including coating, have occurred in the United States; certify as specified in Section 106.01.

Products manufactured of foreign steel or iron materials may be used, provided the cost of such products as they are delivered to the project does not exceed 0.1% of the total contract amount, or $2,500, whichever is greater.

(b) Convict Produced Materials. Pursuant to 23 CFR 635.417, materials produced by convict labor after July 1, 1991 may not be used for Federal-aid highway construction projects, unless produced at a prison facility which had been producing convict-made materials for Federal-Aid construction projects before July 1, 1987.

Material produced by convicts who are on parole, supervised release, or probation from a prison may be incorporated in a Federal-Aid highway construction project.

SECTION 309—SUPERPAVE ASPHALT MIXTURE DESIGN, STANDARD CONSTRUCTION, HMA BASE COURSE

309.1 DESCRIPTION—This work is the Standard construction of a plant-mixed HMA base course on a prepared surface using a volumetric mixture design developed with the Superpave Gyratory Compactor (SGC).

309.2 MATERIAL—Section 409.2

309.3 CONSTRUCTION—Section 409.3 as specified for Standard construction and with additions and modifications as follows:

(b) Weather Limitations. Section 409.3(b). Replace with the following:

Do not place base course on prepared surfaces that are wet or when the temperature of the air or the prepared surface is 35F or lower. If work is halted because of weather conditions, the Representative may allow the Contractor to place limited quantities of base course that are en route to the project.

(h) Spreading and Finishing. Revise as follows:

1.b Spreading and Finishing. Add the following:

If the indicated compacted depth of a Superpave 25.0 mm HMA base course is more than 6 inches, place the HMA base course in two or more layers of approximately equal compacted depth, with no layer less than 3 inches or more than 6 inches. If the indicated compacted depth of a Superpave 37.5 mm HMA base course is more than 8 inches, place the HMA base course in two or more layers of approximately equal compacted depth, with no layer less than 4 inches or more than 8 inches.

(l) Surface Tolerance. Replace the requirement for defective pavement with the following:

The pavement is defective if irregularities are more than 1/4-inch.

(m) Tests for Depth. Replace with the following:

Control the loose depth of each layer to construct the base course to the compacted depth indicated and within the specified tolerance. On the top lift and in the presence of the Inspector, drill full-depth cores at one random location selected by the Inspector according to PTM No. 1 in each 3,000 square yards of completed base course and at other locations the Inspector suspects are deficient.

The Inspector will measure the depth of the full-depth cores according to PTM No. 737. Pavement deficient in depth by 1/2 inch or more and that cannot be satisfactorily corrected is defective. After the Inspector completes depth measurements, backfill, compact, and seal core holes with the mixture used to construct the course. Immediately start correcting courses or pavement that are deficient in depth at the core location and proceed longitudinally and transversely until the depth is within 1/2 inch of the design depth.

309.4 MEASUREMENT AND PAYMENT—Section 409.4(a), with modifications as follows:

(a) Bituminous Mixtures (Standard). Revise as follows:

1. HMA Courses. Add the following:

1.f Superpave Asphalt Mixture Design, HMA Base Course. Square Yard or Ton

SECTION 311—SUPERPAVE ASPHALT MIXTURE DESIGN, STANDARD CONSTRUCTION, WMA BASE COURSE

311.1 DESCRIPTION—This work is the Standard construction of a plant-mixed, dense-graded, WMA pavement base course on a prepared surface using a volumetric asphalt mixture design developed with the Superpave Gyratory Compactor (SGC), using prescribed manufactured additives or modifiers, and/or plant process modifications.

311.2 MATERIAL—Section 411.2

311.3 CONSTRUCTION—Section 411.3 with additions and modifications as follows:

(b) Weather Limitations. Section 411.3(b). Replace with the following:

Do not place base course on prepared surfaces that are wet or when the temperature of the air or the prepared surface is 35F or lower. If work is halted because of weather conditions, the Representative may allow the Contractor to place limited quantities of base course that are en route to the project.

(h) Spreading and Finishing.

1.b Spreading and Finishing. Section 409.3(h)1.b. Revise the second paragraph to read as follows:

If the indicated compacted depth of a 25.0 mm WMA base course is more than 6 inches, place the WMA base course in two or more layers of approximately equal compacted depth, with no layer less than 3 inches or more than 6 inches. If the indicated compacted depth of a 37.5 mm WMA base course is more than 8 inches, place the WMA base course in two or more layers of approximately equal compacted depth, with no layer less than 4 inches or more than 8 inches.

(l) Surface Tolerance. Section 409.3(l). Revise the last sentence to read:

The pavement is defective if irregularities are more than 1/4-inch.

(**m) Tests for Depth.** Section 409.3(m). Revise to read as follows:

Control the loose depth of each layer to construct the base course to the compacted depth indicated and within the specified tolerance. On the top lift and in the presence of the Inspector, drill full-depth cores at one random location selected by the Inspector according to PTM No. 1 in each 3,000 square yards of completed base course and at other locations the Inspector suspects are deficient.

The Inspector will measure the depth of the full-depth cores according to PTM No. 737. Pavement deficient in depth by 1/2 inch or more and that cannot be satisfactorily corrected will be considered defective. After the Inspector completes depth measurements, backfill, compact, and seal core holes with the mixture used to construct the course. Immediately start correcting courses or pavement that is deficient in depth at the core location and proceed longitudinally and transversely until the depth is within 1/2 inch of the design depth.

311.4 MEASUREMENT AND PAYMENT—Section 411.4(a) with modifications as follows:

(a) Standard WMA Construction.

1. WMA Courses. Section 411.4(a)1. Add the following:

1.f Superpave Asphalt Mixture Design, WMA Base Course. Square Yard or Ton

SECTION 360—ASPHALT TREATED PERMEABLE BASE COURSE

360.1 DESCRIPTION—This work is the construction of an asphalt treated permeable base course (ATPBC) on a prepared surface. When placed on subgrade, it includes the preparation of subgrade as specified in Section 210.

360.2 MATERIAL—

(a) Bituminous Material. Asphalt Cement, Class PG 64-22, as specified in Section 702.

(b) Coarse Aggregate. Type A, Section 703.2. When using crushed gravel, provide a minimum of 75% crushed particles with at least three faces resulting from fracture.

(c) Fine Aggregate. Type A or Type B, Section 703.1.

(d) Additives.

1. Hydrated Lime. Before adding the asphalt cement, add hydrated lime to the aggregate to reduce stripping potential.

Furnish hydrated lime conforming to ASTM C 1097 and add the lime as follows:

- Add at least 1% hydrated lime by weight of the total dry aggregate.
- Provide a separate bin or tank and feeder system to store and accurately proportion the lime, in dry form, into the aggregate.
- Provide a convenient and accurate means of calibrating the proportioning device.
- Interlock the proportioning device with the aggregate feed or weight system.
- Mix the lime and aggregate to uniformly coat the aggregate with lime.
- Furnish aggregate containing at least 3% free moisture.
- Do not stockpile lime treated aggregate.
- Control the feeder system by a proportioning device accurate to within 10% of the specified amount.
- Provide a flow indicator or sensor and interlock with the plant controls such that production is interrupted if there is a stoppage of the lime feed.
- Before production, obtain approval of the method to introduce and mix the lime and aggregate.

2. Heat-Stable, Anti-Stripping Additive. The Contractor may use an anti-stripping additive other than hydrated lime. Blend the additive with the asphalt cement before adding the additive and asphalt cement to the mixture. Use the manufacturer's recommended dosage of the additive, but not less than 0.25% by weight of the asphalt. Select an additive that does not harm the completed bituminous concrete mixture and that is compatible with the aggregate and asphalt supplied for the project.

(e) Mixture Design and Production.

1. Design. Size, uniformly grade, and combine aggregate fractions according to Table A below. Marshall test requirements do not apply. Design a JMF with an initial target bitumen content of 2.5% by weight. If necessary, adjust

the bitumen content within the range specified in Table A below to uniformly coat the aggregate and ensure the aggregate has no observable runoff of excess bitumen.

Test materials, proportions, and the mixture at the bituminous concrete plant laboratory. Verify conformance with the uniformity requirements specified in this Section. When required, the Department will perform the tests at the LTS. Provide a JMF that conforms to all Department requirements. Submit a copy of the JMF to the DME/DMM at least 3 weeks before the scheduled start of producing the mixture for the project. If the Department has not used the JMF on previous projects, provide test results from previous mixture production that show the mixture conformed to all JMF production tolerances.

2. QC Plan. Prepare and submit a QC Plan, as specified in Section 106, at the start of the project and at least annually thereafter. Do not start ATPBC production until after the Representative reviews the QC Plan.

3. Production. During the first day of production, take at least three bitumen content and gradation tests to verify the mixture conforms to the JMF. After the first day, perform tests for bitumen content and aggregate gradation according to the QC Plan and PTM No. 1. Produce ATPBC conforming to the gradation requirements in Table A and with a bitumen content within 0.8% of the JMF (n=1). Ensure the aggregate is uniformly coated with bitumen and no runoff of excess bitumen is observed.

4. Acceptance of the Mixture. Obtain material certification from the material producer using the results of QC tests for bitumen content and gradation. Provide the certification to the Inspector-in-Charge within 1 working day after taking QC tests.

TABLE A
Composition of Mixture
(Total Percent by Mass (Weight) Passing Square Openings Based on Laboratory Sieve Tests)

Sieve Size	Percent Passing
37.5 mm (1 1/2-inch)	100
25.0 mm (1-inch)	95 – 100
12.5 mm (1/2-inch)	35 - 65
4.75 mm (No. 4)	12 – 24
1.18 mm (No. 16)	6 - 16
75 μm (No. 200)	0 – 5
Bitumen Content	2.0% - 3.0%*

* For approved gravel and slag mixtures, the Representative may allow the Contractor to exceed the upper limit.

360.3 CONSTRUCTION— Section 409.3, with modifications as follows:

(b) Weather Limitations. Replace with the following:

Do not place ATPBC on surfaces that are unstable, frozen, or below a temperature of 35F. Do not place ATPBC when the air temperature is below 35F or during rain. If work is halted because of weather conditions, the Representative may allow the Contractor to place limited quantities of ATPBC that are en-route to the project.

(c) Bituminous Mixing Plant. Add the following:

3. Plant Requirements. The Contractor is not required to provide equipment for developing the design and control test.

4. Preparation of Mixture. Before mixing, dry the aggregate as necessary. Heat the bituminous material so that combining with aggregate produces a completed mixture. Coat the aggregate with the bituminous material to form a film of adequate thickness to provide the required binding properties. Produce ATPBC at a temperature below 320F

that also provides suitable viscosity for adequate coating of aggregate particles, and that does not cause segregation of asphalt and aggregate during transportation.

Do not stockpile ATPBC. The ATPBC must be placed within 8 hours from when it is made.

(f) Rollers. Replace with the following:

Use steel-wheel power rollers with a manufacturer's certified metal weight of 8 tons to 10 tons.

(h) Spreading and Finishing. Replace with the following:

Use a slip form paver, as specified in Section 409.3(e), or a mechanical spreader. Spread and strike off the mixture for the entire lane width or as much lane as practical. Place the mixture in maximum 4-inch compacted lifts. Adjust screed assemblies to provide the cross section and depth indicated. Construct the profile to the design grade line. Use fully automated sensors to control profile and transverse grade. Allow the mixture to cool to 100F before placing subsequent layers or pavement courses. Perform handwork at locations directed by the Representative.

(i) Compaction. Replace with the following:

Perform rolling as soon as the mat has cooled sufficiently to avoid shoving or lateral movement of the ATPBC. Seat ATPBC using an 8 ton to 10 ton, steel-wheeled roller, or vibratory roller operated in the static mode only. Compact ATPBC by applying four roller passes. One roller pass is defined as one trip of the roller in one direction over any one spot. Additional passes are allowed only to eliminate any surface irregularities, or creases. Do not compact the material to the point that it is not free draining or the aggregate is crushed.

(j) Mat Density Acceptance. Delete this section.

(k) Joints. Replace with the following

1. Longitudinal Joints. Spread the ATPBC to overlap the edge of the lane previously placed by 1 inch to 2 inches. Maintain the uniform uncompacted depth adjacent to a compacted lane necessary to provide a smooth joint after compaction.

2. Transverse Joints. At the end of each day's work and when more than a 30 minute interruption occurs in ATPBC paving operations, install a temporary vertical bulkhead to form a straight transverse construction joint. The joint shall be the full depth and width of the ATPBC. Instead of a temporary bulkhead, the Contractor may saw construction joints.

(l) Surface Tolerance. Replace the requirements for correcting irregularities with the following:

Test the finished surface at locations the Representative suspects are irregular and at transverse joints and paving notches. Test the surface in stages using a 10-foot straightedge. At each stage, hold the straightedge in contact with the surface and parallel to the road centerline and, in successive positions, test the pavement surface from one side to the other. Advance the test location to the next stage by moving the straightedge along the pavement centerline by not more than 5 feet.

Correct irregularities of more than 1/2 inch by loosening surface mixture and removing or adding ATPBC. For irregularities that develop after compaction is completed, correct the irregularity by a method that does not produce contaminating fines or damage the base. Do not grind or mill the ATPBC. The area is defective if irregularities or defects remain after final compaction.

(m) Tests for Depth: Binder and Wearing Courses. Replace with the following:

Carefully dig or drill one 6-inch diameter test hole to the full depth of the ATPBC for each 3,000 square yards, or less, of completed base course. The Representative may require additional test holes in areas the Representative suspects are deficient in depth. The Representative will measure the depth of the base course. Using material acceptable to the Representative, backfill the test holes and compact the material to fill the test hole flush with the completed base course.

Remove and replace sections deficient in depth by 1/2 inch or more. Start correction at the point of determined deficiency and continue correction longitudinally and transversely until the depth is within 1/2 inch of the indicated depth.

(n) Protection of Courses. Replace with the following:

Section 105.13 and as follows: Traffic is not permitted on the asphalt treated permeable base material, except for trucks and equipment required to place the next layer. Replace areas damaged or contaminated, as directed and at no cost to the Department. If necessary, re-compact the ATPBC before starting subsequent paving.

Protect the surface from damage before and during the concrete paving process.

(o) Defective Work. Replace with the following:

Unless otherwise directed in writing by the District Executive, remove and replace ATPBC deficient in surface tolerance, deficient in depth, defective in asphalt content, or excessive in percent passing the 75 µm (No. 200 sieve). The ATPBC is defective in asphalt content if production tolerances are exceeded, percent of coated aggregate particles is less than 95%, or the mixture contains observable runoff of excess bitumen.

With written permission from the District Executive, the Contractor may fill low areas during construction of the next pavement course.

Acceptance testing and QA testing does not relieve the Contractor of responsibility for defective material or workmanship.

360.4 MEASUREMENT AND PAYMENT—Square Yard or Ton

SECTION 405—EVALUATION OF BITUMINOUS PAVEMENT LONGITUDINAL JOINT DENSITY AND PAYMENT OF INCENTIVE/DISINCENTIVE

405.1 DESCRIPTION—This work is evaluating bituminous pavement longitudinal joint samples on the surface wearing course for determining densities and the incentive/disincentive. This work also includes any necessary corrective actions required as a result of the evaluation.

405.3 CONSTRUCTION—

(a) General Requirements. Longitudinal joint density lots will be established as specified in Section 405.3(b). These incentive/disincentive lots are completely independent from lots defined in other sections of these Specifications for pavement acceptance. The Representative will determine the payment addition or deduction along with any necessary corrective actions for each longitudinal joint lot based on the test results of the density cores.

(b) Lot Size. A full lot is 12,500 feet of longitudinal joint and will consist of 5 sublots of 2,500 feet. The Representative will designate lots as the longitudinal joints on the project are constructed, beginning on the first day wearing course paving abuts a previously placed wearing course, forming a longitudinal joint. Joints constructed with tandem pavers will be included, unless otherwise indicated. As paving progresses and longitudinal joints are constructed, drill one core per sublot until a full lot is obtained according to Section 405.3(e). Do not include the length of excluded joints in the 12,500 feet lot. A single lot need not be contiguous and may include multiple joints throughout the project limits.

Partial lots with less than three sublots will be combined with the previous lot. Partial lots with three or more sublots will stand as a separate lot.

(c) Quality Control Strip. On the first day paving abuts a previously placed mat, forming a longitudinal joint eligible for evaluation, determine the effectiveness of the material placement and compaction operations as well as the mixture design on longitudinal joint density. In addition to any incentive/disincentive payment sublot cores, obtain five 6-inch diameter core samples located randomly on the longitudinal joint for QC density testing. Test the cores according to PTM No. 715 or PTM No. 716 and provide the results of the tests to the Representative within 24 hours. The Contractor may elect to make adjustments to the mixture design or placement and compaction operations to ensure adequate in place density is being achieved. If proposing changes that impact the field quality control plan or job mix formula, submit any modifications or revisions to the Department for review.

(d) Excluded Areas. The following joint areas are to be excluded from the longitudinal joint lots. The Representative will not obtain samples from excluded areas to determine lot incentive/disincentive payment.

- Joints where one or both sides of the pavements forming the joint were accepted for density by means other than pavement cores
- Joints where one side of the joint is formed by existing pavement not constructed under this contract
- Areas within 1 foot longitudinally of an obstruction during construction of the wearing course (manholes, inlet grates, utilities, bridge structures, pavement notches, etc.)
- Small areas, such as intersections, gore areas or transitions, or anywhere the Representative determines paving and phasing methods do not allow for consistent longitudinal joint construction. Prior to paving, submit requests in writing to the Representative for consideration of any areas to be excluded on this basis. The Representative will make the final determination.

(e) Sampling. The Inspector will select one location in each sublot according to PTM No. 1 and PTM No. 729. The Contractor may take one companion core per sublot for quality control purposes. For vertical joints center joint cores on the line where the joint between the two adjacent lifts abut at the surface. For notched wedge joints, center joint cores 6-inches or one half the joint taper width away from the joint line in the direction of the wedge. With the Inspector present, drill 6-inch diameter cores as soon as possible, but no later than the day following the construction of the longitudinal joint at each sublot location. Do not compress, bend, or distort samples during cutting, handling, transporting, and storing. If samples are damaged, immediately obtain replacement samples, as directed by the

Inspector, from within 12 inches of the original sample location. Within 24 hours after coring, backfill the hole(s) with mixture of the same JMF or with mixture used for subsequent courses and compact and seal the mixture.

Identify the samples by longitudinal joint lot and sublot number, location, dates of placement, mixture type, and as acceptance samples (Sample Class AS). Provide the daily theoretical maximum specific gravity value from Section 409.2(e)1.d.4 for the mix on each side of the longitudinal joint. The average of the two values will be used for the density calculation of each sublot in accordance with PTM No. 729. Immediately package and deliver the samples to the Inspector according to the QC Plan. Use sample containers of sufficient strength to prevent samples from being damaged during transport.

Each joint core will be comprised of portions of two lanes, with the potential for two different JMFs within each core. The Representative will only include samples within a lot having the same JMF combination on one Form TR-447 for testing at the LTS. The Representative will submit separate samples and Forms TR-447 for sublots with different JMF combinations or after work stoppages of more than 5 days.

The LTS will test the density samples according to PTM No. 715, and if necessary PTM No. 716, to determine the percent compaction.

(f) Percent Within Tolerance (PWT). Once all test results for a lot have been received, the Representative will compute the PWT and average in place density for each lot according to Section 106.03(a)3.a and as follows. The lower specification limit (L) will be 90%. No upper specification limit (U) for density will be factored into the PWT determination.

(g) Corrective Action. Seal the entire length of the longitudinal joint(s) within each lot where the average in place lot density is less than 88.0% at no additional cost to the Department. Seal the surface at the longitudinal joint(s) with hot PG 64-22 asphalt cement. Heat and maintain asphalt cement sealant between 265F and 320F. Do not place sealant when the air temperature is below 40F, unless otherwise allowed by the Representative. Apply the sealant only to joints in pavement surfaces that are clean, dry, and free of any loose material and debris. Clean with a power broom as required. Utilize a pressure applicator with a wand or nozzle capable of applying hot asphalt sealant in a straight and consistent width band of 4 inches ±1 inch and thickness of 1/16 inch ± 1/32 inch at specified temperature range. Center the sealant band within 1 inch of the joint. Immediately level high spots with a squeegee or wand. Remove and dispose of excess sealant at no cost to the Department. Re-seal areas of the joint that are inconsistently or not completely covered at no additional cost to the Department. Complete any required rumble strip installation at joints before sealing operations. Replace pavement markings that are marred by sealing operations at no additional cost to the Department.

405.4 MEASUREMENT AND PAYMENT—Dollar

The proposal will include an item and a predetermined amount of money for Evaluation of Bituminous Pavement Longitudinal Joint Density and Payment of Incentive/Disincentive. The Contract item will have a unit of measure of DOLLAR, a unit price of $1.00, and a quantity equal to the predetermined amount. When bituminous pavement longitudinal joint density evaluation indicates that a disincentive adjustment is applicable, the appropriate amount will be deducted from money due or to become due to the Contractor through the processing of a contract adjustment.

Due to the incentive or bonus status of the payment being made the provisions of Section 110.02(d) are not applicable to this item.

Measured and paid for, under the Evaluation of Bituminous Pavement Longitudinal Joints and Payment of Incentive item as follows:

For each lot Table A will be used to determine the incentive/disincentive payment for longitudinal joint density.

The incentive/disincentive payment for a lot containing other than 5 sublots will be determined as a percentage of a full 12,500 feet lot, by the following:

N=3 (60% of the Table A amount)
N=4 (80% of the Table A amount)
N=6 (120% of the Table A amount)
N=7 (140% of the Table A amount)

For a full lot with a PWT ≥ 81, the Contractor will receive a prorated positive incentive payment up to a maximum of $5,000 calculated according to Table A. Lots with average density ≥ 92.0% will receive the maximum incentive regardless of PWT.

For a full lot with a PWT ≤ 49, the Contractor will receive a prorated negative adjustment (disincentive) up to a maximum of $10,000 for the longitudinal joint lot calculated according to Table A. Lots with PWT ≤ 49 and average density ≥ 89.0% will be assessed a disincentive up to a maximum of $1,000 per sublot regardless of PWT.

Costs associated with providing joint pavement cores will not be paid for separately and will be considered incidental to the construction items for the wearing courses eligible for the longitudinal joint evaluation. Costs associated with corrective action such as traffic control or other costs will not be paid for separately.

TABLE A

Lot by Lot Payment Schedule for Longitudinal Joint Incentive/Disincentive	
Lot PWT	**Amount**
PWT ≥ 81	(PWT -80)/20 x $5,000 (Incentive)
PWT = 50 to 80	$0
PWT ≤ 49	(50-PWT)/50 x -$10,000 (Disincentive)

SECTION 409—SUPERPAVE MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED HMA COURSES

409.1 DESCRIPTION—This work is the standard and RPS construction of plant-mixed HMA on a prepared surface using a volumetric mixture design developed with the Superpave Gyratory Compactor.

409.2 MATERIALS—

(a) Bituminous Material

1. Virgin Mix, Mix Containing 5% to 15% RAP, or Mix Containing 5% Recycled Asphalt Shingles (RAS). Furnish material conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder, AASHTO M 320, except as revised in Bulletin 25. Obtain material from a source listed in Bulletin 15 for the specified grade. Provide QC testing and certification as specified in Sections 106.03(b) and 702.1(b)1. Provide the Representative a copy of a signed Bill of Lading for bituminous material on the first day of paving and when the batch number changes.

2. Mix Containing More than 15% RAP or Mix Containing Both 5% RAS and 5% or More RAP. The LTS will evaluate the asphalt cement in the RAP and, if applicable, the RAS source material. The LTS will determine the class (grade) of asphalt cement that the Contractor is required to use in the mixture.

Furnish material conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder, AASHTO M 320, except as revised in Bulletin 25. Obtain material from a source listed in Bulletin 15 for the specified grade. Provide QC testing and certification as specified in Sections 106.03(b) and 702.1(b)1. Provide the Representative a copy of a signed Bill of Lading for bituminous material on the first day of paving and when the batch number changes.

(b) Aggregate and RAM.

1. General Requirements. Provide aggregate from sources listed in Bulletin 14. Aggregate and RAM shall conform to the quality requirements for Superpave Asphalt Mixture Design as specified in Bulletin 27. For wearing courses, provide aggregate with at least the SRL designation specified. To achieve the specified SRL, the Contractor may provide a blend of two aggregates if the blend has an SRL designation equal to or better than that specified. Blends are 50% by mass (weight) of each aggregate. Blend the aggregates using an approved method. Do not use 4.75 mm asphalt mixtures in applications that require an SRL designation higher than L.

2. Fine Aggregate. Section 703.1, except Table A gradation does not apply and as follows:

Determine the uncompacted void content according to AASHTO T 304, Method A, or use the value listed in Bulletin 14, and conform to AASHTO M 323, Table 5. Determine the sand-equivalent value according to AASHTO T 176 and conform to AASHTO M 323, Table 5.

3. Coarse Aggregate. Type A, Section 703.2, except Table C gradation does not apply and revise the following quality requirements of Table B:

- Abrasion, Maximum Percent as specified in Bulletin 27, Chapter 2A, Table 5A
- Thin and Elongated Pieces, Maximum Percent as specified in AASHTO M 323, Table 5, for Flat and Elongated
- Crushed Fragments, Minimum Percent, as specified in AASHTO M 323, Table 5, for Fractured Faces, Coarse Aggregate

(c) Recycled Asphalt Material

1. RAP. If RAP material is proposed for use in the mixture, use at least 5% RAP consisting of cold milled or crushed hot-mix bituminous mixture. Include a plan to control RAP and the procedures to handle RAP of significantly different composition in the producer QC Plan. Maintain all processed material free of foreign materials and minimize segregation. Process the RAP so that the final mixture conforms to Section 409.2(e).

2. Manufacturer Waste Recycled Asphalt Shingles (RAS). If RAS material is proposed for use in the mixture, use 5% RAS by mass (weight) of the total mixture consisting of manufacturer waste shingles that are rejected asphalt shingles or shingle tabs that are discarded in the manufacturing process of new asphalt roofing shingles. Do not use post-consumer asphalt roofing shingles that are removed from the roofs of existing structures. Due to significant composition differences, keep rejected asphalt shingles manufactured with fiberglass felt or paper or organic felt separate. Do not use both fiberglass felt, and paper or organic felt asphalt roofing shingles in the same mixture. Obtain certification, as specified in Section 106.03(b)3, from the manufacturer of the waste shingles certifying that the waste shingles were discarded during the manufacturing process of new asphalt roofing shingles and certifying the type of felt used during manufacturing of the waste shingles. Maintain and provide the Representative access to all certification records for manufacturer waste shingles.

Process and RAS material by shredding, screening or other methods so that 100 percent passes the 12.5 mm (1/2 inch) sieve. RAS may be uniformly blended with fine aggregate as a method of preventing the agglomeration of RAS material. If RAS and fine aggregate are blended, blend at 50% by mass (weight) of each material.

Include a plan to stockpile and control RAS and the procedures to handle RAS of significantly different composition in the producer QC Plan. Maintain all processed material free of foreign materials and minimize segregation. Process the RAS so that the final mixture conforms to Section 409.2(e).

(d) Filler. Section 703.1(c)1. Do not use flyash if the design traffic is greater than or equal to 3 million Equivalent Single Axle Loads (ESALs).

(e) Mixture Composition for Standard and RPS Construction.

1. Virgin Material Mixtures. Size, uniformly grade, and combine aggregate fractions in proportions to produce a JMF that conforms to the material, gradation, and volumetric Superpave Asphalt Mixture Design requirements as specified in Bulletin 27, Chapter 2A, for the specified nominal maximum aggregate size (NMAS) and design ESALs.

Submit a copy of each completed JMF, signed by a certified HMA Level 2 plant technician, to the DME/DMM at least 3 weeks before the planned start of mixture production. Include a list of all material sources and the HMA producer in the JMF. Provide the calibration factors (C_f and 200 C_f) required by PTM No. 757 with the JMF. Do not start mixture production until after the DME/DMM reviews the JMF.

Submit a new JMF with a change in material sources or if a new JMF is necessary to produce a mixture conforming to this specification.

1.a Producer QC Plan. Each producer must prepare a QC Plan as specified in Section 106 and conforming to the additional QC requirements of this specification. Submit the QC Plan to the DME/DMM annually at least 3 weeks before the planned start of mixture production and do not start production until the DME/DMM reviews the QC Plan.

1.a.1 QC Organization Chart.

- Names of personnel responsible for QC.
- Area of responsibility of each individual.
- List outside agencies, e.g., testing laboratories and a description of services provided.

1.a.2 Testing Plan with Action Points.

- List of all tests to be performed.
- Frequency of testing.
- List action points to initiate corrective procedures.

- Recording method to document corrective procedures.
- Procedures for conducting JMF verification testing.

1.a.3 Materials Storage and Handling.

- Aggregate/RAP/RAM/RAS stockpiles.
- Cold-feed systems for aggregates/RAP/RAM/RAS.
- Additives or modifiers for mixture
- Modified asphalt/liquid additive storage tanks.
- Surge/storage silos for mixture. Do not store more than one JMF in a surge/storage silo at any given time.
- All measuring and conveying devices, including calibration procedures.
- Haul vehicle loading procedures.

1.b Plant Technicians. During mixture production, provide a certified HMA Level 1 plant technician at the plant and an on-call certified HMA Level 2 plant technician, both meeting the requirements outlined in Publication 351. Instruct and train the certified technicians to perform all tests and to control plant operation. The Department may use its own certified HMA plant technicians to verify tests and to work in close cooperation with the producer's technicians. All technicians must carry a valid certification card during mixture production.

1.c Annual JMF Verification. During initial production of each JMF, verify, according to the QC Plan, that the mixture conforms to this specification. If the mixture does not conform to the single and multiple sample tolerances in Tables A and B within 2 days of production, suspend shipping the mixture to the project. Do not ship the mixture to the project until after the Representative reviews and verifies that results conform to the single and multiple sample tolerances in Tables A and B. During JMF verification, mixture acceptance is according to the approved acceptance level of Table C.

1.d Production. After JMF verification, sample and test the mixture according to the QC Plan. For daily production of each JMF greater than 50 tons, determine asphalt content, gradation, and theoretical maximum specific gravity from the same sample at least once each day. For daily production of each JMF greater than 150 tons, determine asphalt content, gradation, theoretical maximum specific gravity and perform volumetric analysis of compacted specimens from the same sample at least once each day. Perform additional sampling and testing as directed. Produce a mixture within the following production limits:

1.d.1 Apparent Moisture Content. If the water absorption of a coarse aggregate, as determined by AASHTO T 85, exceeds 2.0%, sample the mixture according to PTM No. 1 and at the frequency in the producer QC Plan. Determine the apparent moisture content in the mixture according to PTM No. 749. Produce a mixture with the apparent moisture content not to exceed 0.5%.

1.d.2 Asphalt Content. Include in the producer QC Plan a frequency of obtaining mixture samples according to PTM No. 1 and performing asphalt content tests to verify that the mixture conforms to the tolerances of Table A. Test the samples according to either PTM No. 757, PTM No. 702, or PTM No. 742. After obtaining a minimum of three test results, determine compliance with the multiple sample tolerances in Table A. After obtaining five or more test results, determine compliance with the multiple sample tolerances in Table A using the running average of the last five consecutive test results.

Printed ticket results may be used in place of laboratory test results for QC of asphalt content of the mixture if the producer is currently approved to use printed tickets according to Bulletin 27. During mixture production, maintain 90% of printed ticket results for each day of production within 0.2 percentage points of the JMF. If RAP or RAS is used in the mixture, determine asphalt content by testing samples of the completed mixture.

1.d.3 Gradation. Sample the completed mixture, or sample the combined aggregate from the hot bins of a batch plant or the combined aggregate belt of a drum plant, according to PTM No. 1 and at the frequency in the producer QC Plan. If mineral filler RAP, or RAS are used in the mixture, determine gradation by testing samples of the completed mixture.

- Test the completed mixture according to PTM No. 757 or according to PTM No. 702 and PTM No. 739.
- Test combined aggregate samples according to PTM No. 743.

Produce a mixture within the tolerances of Table A. Determine compliance with the multiple-sample tolerance after obtaining a minimum of three test results for the mixture. After obtaining five or more test results for the mixture, determine compliance with the multiple-sample tolerances using the running average of the last five consecutive test results.

1.d.4 Theoretical Maximum Specific Gravity. Sample the mixture according to PTM No. 1 at the frequency required in Bulletin 27. Condition and test the samples according to Bulletin 27.

Calculate the percentage of unfilled voids and the theoretical maximum density of the mixture using the most recently determined theoretical maximum specific gravity value or average value as specified in Bulletin 27. Certify the theoretical maximum specific gravity value to the Inspector daily using Form CS-4171B. If the theoretical maximum specific gravity value varies 0.030 or more from the previous test or from the JMF value, immediately notify the DME/DMM.

1.d.5 Volumetric Analysis of Compacted Specimens. Sample the completed mixture according to PTM No. 1 and at the frequency in the producer QC Plan. Prepare a minimum of two specimens from each sample according to AASHTO T 312.

Produce a mixture with volumetric properties conforming to the tolerances of Table B. Determine the bulk specific gravity of the specimens as specified in AASHTO T 312 and calculate air voids (V_a) and Voids in Mineral Aggregate (VMA) at N_{design} according to AASHTO R 35 and as specified in Bulletin 27. Determine compliance with the multiple specimen tolerances using the average of the results for all specimens prepared from the sample.

TABLE A
Job-Mix Formula
Composition Tolerance Requirements of the Completed Mix

		Single Sample (n = 1)	Multiple Samples (n ≥ 3)
Gradation			
Passing 12.5 mm (1/2 inch) and Larger Sieves		±8%	±6%
Passing 9.5 mm (3/8 inch) to 150 µm (No. 100) Sieves (Inclusive)		±6%	±4%
Passing 75 µm (No. 200) Sieve		±3.0%	±2.0%
Asphalt Content			
19.0 mm HMA mixtures and smaller		±0.7%	±0.4%
25.0 mm HMA mixtures and larger		±0.8%	±0.5%
Temperature of Mixture (F)			
Class of Material	**Type of Material**	**Minimum**	**Maximum**
PG 58-28	Asphalt Cement	260	310
PG 64-22	Asphalt Cement	265	320
PG 76-22	Asphalt Cement	285	330
All other PG Binders	Asphalt Cement	As specified in Bulletin 25 (Specifications for Bituminous Materials)	

TABLE B
Job-Mix Formula
Volumetric Tolerance Requirements of the Laboratory Compacted Mix

Property	Each Specimen	Multiple Specimens
Air Voids at N_{design} (V_a)	(±2%)	(±1.5%)
Minimum VMA % for 4.75 mm mixes	16.0	-
Minimum VMA % for 9.5 mm mixes	15.0	-
Minimum VMA % for 12.5 mm mixes	14.0	-
Minimum VMA % for 19.0 mm mixes	13.0	-
Minimum VMA % for 25.0 mm mixes	12.0	-
Minimum VMA % for 37.5 mm mixes	11.0	-

1.e Corrective Actions. Immediately take corrective actions if one or more of the following occurs:

- QC test results on a single sample (n=1) for percent passing the 2.36 mm (No. 8) sieve, the 75 µm (No. 200) sieve, or asphalt content are not within the tolerances in Table A.
- The average of multiple samples (n≥3) for percent passing any sieve or asphalt content, as determined according to Section 409.2(e)1.d, are not within the tolerances in Table A.
- QC test results on each specimen or on multiple specimens are not within the tolerances in Table B.
- Independent assurance (IA) or QA sample results tested at the producer's plant are not within the tolerances of Tables A or B.

After taking corrective actions, sample the completed mixture within 150 tons of production. After sampling, test the mixture and provide test results to the Representative within 500 tons of production. If less than three samples are tested for mixture composition, determine conformance with Table A by comparing each result to the multiple sample tolerances. If the mixture does not conform to the single and multiple sample tolerances in Table A and the single and multiple specimen tolerances in Table B, suspend production and shipping to the project and determine the cause of the problem. Provide a written explanation of the problem and a proposed solution to the Department. After the Representative reviews the proposed solution and authorizes production to continue, resume production and perform JMF verification according to the QC Plan. During corrective actions and JMF verification, mixture acceptance is according to the approved acceptance level of Table C.

2. Mixtures with RAM, 5% or More RAP, and/or 5% RAS. Section 409.2(e)1 and as follows:

2.a RAM and RAP SRL. For HMA wearing courses, limit the total combination of RAM and RAP to a maximum of 15% of the mixture by mass (weight) unless documentation of the SRL designation of the coarse aggregate in the RAM and RAP materials is provided to the DME/DMM and the RAM and RAP meet the specified SRL or can be blended for SRL as specified in Section 409.2(b)1.

2.b RAP and/or RAS Asphalt Content and Gradation. Determine the average asphalt content and gradation of the RAP and/or RAS stockpile(s) according to Bulletin 27. Determine the proportions of RAP, RAM, RAS, and virgin materials necessary to conform to the JMF requirements. Maintain and provide the Representative access to records of all sampling, testing, and calculations.

(f) Mixture Acceptance.

1. General. For standard construction, the Department will accept the mixture according to the appropriate level

in Table C. For RPS construction, the Department will accept the mixtures by lot acceptance as specified in Section 409.3(h)2.

TABLE C
Mixture Acceptance

Acceptance Level	Acceptance Method
Certification Acceptance	Producer Certification of Mixture (Section 409.2(f)2)
Lot Acceptance	Mixture Acceptance Sample Testing (Section 409.3(h)2)

2. Certification Acceptance. Acceptance by certification is appropriate for the following mixtures, conditions, or applications:

- Scratch courses, leveling courses less than 2 inch depth and driveway adjustments.
- Mixtures used by Department maintenance forces.
- Mixtures purchased by local or municipal governments.
- Mixtures placed in quantities not exceeding 500 tons in a continuous placement operation unless otherwise directed by the Representative.
- Mixtures used for parking lots.
- All 4.75 mm asphalt mixture applications will be accepted by Certification Acceptance.
- Other mixtures, conditions, or applications as approved by the Representative.

2.a General. Obtain certification from the mixture producer. Use all QC tests during mixture production as acceptance tests. Certify mixtures using Form CS-4171B. Include, or attach, the QC test results on the form. Provide the form to the Inspector-in-Charge within 1 working day after completing the QC tests. Certify mixtures as specified in Section 106.03(b)3 and the requirements below.

2.b Certification of Mixture. Certify each mixture daily if QC test results conform to the single sample and multiple sample JMF production tolerances of Table A. The acceptance values will be:

- Asphalt Content
- Percent Passing the 2.36 mm (No. 8) sieve (not applicable for 4.75mm asphalt mixtures)
- Percent Passing the 75 μm (No. 200) sieve

If using printed ticket results in place of laboratory test results for asphalt content, certify that at least 90% of each day's printed ticket results for asphalt content are within 0.2 percentage points of the JMF.

If the mixture does not conform to the above requirements, do not certify the mixture. Instead, provide all QC test results to the Inspector-in-Charge. If using printed ticket results for asphalt content, provide the percentage of daily printed ticket results within 0.2 percentage points of the JMF to the Inspector-in-Charge. Payment will be determined according to Table H based on the QC test results.

If a day's production is interrupted by corrective action, material produced after the corrective action may be certified if QC test results conform to production tolerances.

2.c Maintaining Approval to Certify Mixtures. The Department may suspend a plant's approval to certify mixtures if QC is not performed according to the producer QC Plan, mixtures are not produced according to Bulletin 27, a mixture cannot be certified on 2 consecutive production days, or as described below.

The Department may take IA samples of the completed mixture at the plant. In the presence of the Department, test the IA samples for asphalt content and gradation according to the test methods indicated in the producer QC Plan. Take immediate corrective actions if the mixture does not conform to Table A.

The Department may take QA samples of the completed mixture at the plant or on the roadway directly from the uncompacted mixture placed by the paving equipment specified in Section 409.3(e). The Department will test QA samples according to PTM No. 757 or PTM No. 702, Modified Method D, if previously identified problematic aggregates are used in the mixture, for conformance to Table A. If the results of the QA samples do not comply with Table A, review the producer QC Plan and the QC test results that followed the QA samples for conformance to Table A. If QC results do not conform to Table A, perform the corrective actions necessary to provide a mixture conforming to Table A.

After completing corrective actions or the sample review, the Department will perform an on-site evaluation of the producer's plant operation and QC and then take a sample of the completed mixture at the plant. In the presence of the Representative, test the sample. If the sample does not comply with Table A, the Department will suspend certification. Immediately suspend shipping mixtures accepted by certification to the project.

After testing verifies that the produced mixture conforms to Tables A and B and with the Representative present, conduct JMF verification according to the producer QC Plan. After successfully completing JMF verification, resume both certification and shipping mixtures accepted by certification to the project.

409.3 CONSTRUCTION—

(a) Preplacement Requirements.

1. Paving Operation QC Plan. Prepare a paving operation QC Plan, as outlined on Form CS-409, for field control and evaluation of bituminous concrete paving operations. Submit the QC Plan to the Representative before or at the pre-construction conference. The QC Plan shall describe the construction equipment and methods necessary to construct and test the bituminous concrete courses as specified in Section 409.3. Do not start paving until after the Representative reviews the QC Plan.

2. Preplacement Meeting. At least 2 weeks before placing bituminous paving mixtures, schedule a bituminous preplacement meeting with the Representative to review at a minimum the specification, paving operation QC Plan, sequence of paving operations, mixture acceptance, density acceptance and the care and custody of bituminous acceptance samples.

(b) Weather and Seasonal Limitations. Do not place any bituminous paving mixtures outside of the following dates, unless an extension of the paving season, as specified in Section 409.3(b)1, is granted in writing by the District Executive.

- For all PG 76-22 wearing courses, >10 million ESALs wearing courses, 4.75 mm wearing courses, or other wearing courses placed at compacted depths less than 1.5 inches, paving may begin April 1 and complete all paving no later than October 15.
- For all other courses, paving may begin April 1 and complete all paving by October 31.

Do not place bituminous paving mixtures when surfaces are wet or when the air or surface temperature is 40 F or lower. If work is halted because of weather conditions, the Representative may allow the Contractor to place limited quantities of mixture that are en route to the project.

1. Paving Season Extensions. Submit requests in writing for paving outside of the dates listed in Section 409.3(b) at least 14 calendar days prior to performing any extended-season paving operations. With the written request, submit an Extended-Season Paving Plan on Form CS-409ES that addresses quality control operations in detail. The plan must address steps at the plant and in the field to ensure that a quality product will be delivered and constructed. Do not commence paving during the extended-season until the Representative reviews the Extended-Season Paving Plan.

An extension of the paving season will be granted in writing by the District Executive with the following additional requirements:

- For all PG 76-22 wearing courses, >10 million ESALs wearing courses, 4.75 mm wearing courses, or other wearing courses placed at compacted depths less than 1.5 inches, paving may begin April 1 and complete all paving no later than November 15.
- For all other courses, paving may begin March 1 and complete all paving by December 15.
- Density acceptance will be by pavement cores, regardless of quantity, for mixtures placed at the minimum compacted depths in Table G. For pavements not meeting the requirements for pavement cores, density acceptance will be by optimum-rolling pattern. For non-RPS pavements the Representative may waive the

pavement core requirement at their sole discretion provided the contractor's quality control efforts give confidence that optimum density has been achieved throughout the course.

- Utilize a Material Transfer Vehicle (MTV) as specified in Section 108.05(c)5 on any day when the paving length will exceed 1,500 linear feet, unless the Representative determines the MTV to be infeasible for the location.
- Use an approved Warm Mix Asphalt (WMA) JMF, according to the temperature restrictions specified in Section 409, Table A (hot mix temperatures).
- Do not ship material to the project until the Representative on the project releases the shipment.
- At least five days before extended-season paving, schedule an extended-season preplacement meeting with the Representative to review, at a minimum, the details of the Extended-Season Paving Plan.
- If the Representative determines that the Extended-Season Paving Plan is not being followed, stop paving operations, modify processes to comply with the Extended-Season Paving Plan, and communicate process modifications to the Representative. Do not resume paving operations until the Representative authorizes paving operations to continue.
- Within 24 hours of paving completion, provide Form CS-409EQC to the Representative with all documentation and measurements associated with the extended-season paving operations outlined in the Extended-Season Paving Plan. Payment will not be made until the documentation is received.
- Paving work completed during the fall portion of the Extended-Season will be subject to a spring evaluation and manual survey by the Department to be conducted by May 1. Manual surveys will be conducted in accordance with Publication 336. The Department will evaluate the material and workmanship looking at characteristics of fatigue cracking, transverse and miscellaneous cracking, raveling/weathering, rutting, flushing, potholing, joint and edge deterioration, and loss of bond/delamination to determine acceptance or remedial action as outlined below:

Extended Season Paving Performance Requirements and Remedial Actions

Performance Criterion	Threshold Level	Remedial Action
Fatigue Cracking**	All low, medium or high severity*	Remove and replace as specified in Section 496, Table A
Transverse and Miscellaneous Cracking	All low to medium severity*	Crack seal as specified in Section 469
	All high severity*	Remove and replace as specified in Section 496, Table A
Raveling/Weathering	All medium or greater severity*	Remove and replace as specified in Section 496, Table A
Rutting	> ¼ inch	Remove and replace as specified in Section 496, Table A
Flushing	All	Remove and replace as specified in Section 496, Table A
Potholes, Loss of Bond, Delamination	All	Remove and replace as specified in Section 496, Table A for Potholes
Longitudinal Joint or Edge Joint Deterioration	All low severity*	Crack seal as specified in Section 469
	All medium or greater severity*	Remove and replace distressed layer full lane width on both sides transversely of the distressed area and a minimum of 24 inches beyond the distressed area in all longitudinal directions.

* The Threshold Level as defined in Publication 336.
** Fatigue cracking will only be considered in those portions of the pavement under which the contractor has performed base course placement operations

The Department will solely make the determination and notify the Contractor whether the work is accepted or remedial action is required. The contractor may witness the manual performance survey. As specified in 409.3(o), the BOPD, CMD will review Representative determinations of defective material or workmanship. Remove and replace or repair defective work as directed at no additional cost to the Department. Should the distance between repair areas be less than 100 feet, make one continuous repair. All repairs must meet the surface tolerance requirements in Section 409.3(l).

- A Final Acceptance Certificate will not be issued for paving completed during the extended season until the spring evaluation and any repair work is completed.
- Any necessary changes to means, methods, or materials are at no additional cost to the Department. Complete all work by the Required Completion Date or Construction Engineering Liquidated Damages, as specified in Section 108.07(a), will apply. If repairs are required following the spring evaluation, liquidated damages will not be applied during the winter shutdown period on the project and will be applied during the repair and associated work period.

(c) Bituminous Mixing Plant. Obtain bituminous mixtures from a plant fully automated and recordated and currently listed in Bulletin 41. The necessary facilities for inspection include a plant office as specified in Section 714.5(a), except the minimum floor space is 120 square feet. For recycled mixtures, add the following requirements:

1. Batch Plant. Modify the batch plant to measure the mass (weight) of the RAP and/or RAS before adding it into the pug mill. Design the cold-feed bin(s), conveyor system(s), charging chute(s), and all special bins to prevent RAP and/or RAS from segregating and sticking. Dry the virgin aggregate and RAM and then heat the virgin aggregate and RAM to a temperature that, after adding RAP and/or RAS, produces a completed mixture within the temperatures specified in Table A for the class and type of material used. Ensure that virgin aggregate is free of unburned fuel oil when delivered to the pug mill.

2. Drum Mixer Plant. Modify the drum mixer plant to prevent RAP and/or RAS from directly contacting the burner flame and prevent RAP and/or RAS from overheating. Design the cold-feed bin(s), conveyor system(s), charging chute(s), and all special bins to prevent RAP and/or RAS from segregating and sticking. Produce a completed mixture within the temperatures specified in Table A for the class and type of material used.

(d) Hauling Equipment. Haul the mixtures in tightly sealed vehicles that do not contain petroleum oils, solvents, or other materials that adversely affect bituminous concrete. Provide covers of sufficient size and quality to protect the entire load under all conditions. Maintain the proper and uniform placement temperature specified in Section 409.3(h)1. Provide insulation on all sides of the truck body, a double-walled truck body, or a heated truck body when the air temperature is below 50 ºF from October 1 to April 30.

(e) Paving Equipment

1. Bituminous Pavers. Provide self-contained, power-propelled units with activated screeds or activated strike-off assemblies and with automatic screed controls, capable of producing a finished surface of specified evenness and texture. Provide heated units capable of spreading and finishing the mixture to the widths and depths indicated. Provide units capable of being operated at forward speeds consistent with satisfactory placement of the mixture, equipped with receiving hoppers having sufficient capacity for uniform spreading, and equipped with distribution systems that place the mixture uniformly in front of the screeds.

Use hydraulic or other extension types against abutting lanes or longitudinal joints only if the unit feeds and activates the extension by the same method as the main screed. At the outside edge of pavement widths that cannot be uniformly placed, the Contractor may use a non-activated extension when approved by the Inspector-in-Charge.

Do not use equipment that tears, shoves, or gouges the mixture, or that causes tracks, indented areas, flushing, segregation, or other permanent blemishes. Do not use blade graders or drags.

2. Bituminous Wideners. Provide self-contained, power-propelled units with strike-off assemblies capable of producing a finished surface of specified evenness and texture. Provide units capable of spreading and finishing the mixture to the widths and depths indicated. Provide units capable of being operated at forward speeds consistent with satisfactory placement of the mixture, equipped with receiving hoppers having sufficient capacity for uniform spreading, and equipped with distribution systems that place the mixture uniformly in front of the strike-off assemblies.

Do not use equipment that tears, shoves, or gouges the mixture, or that causes tracks, indented areas, flushing, segregation, or other permanent blemishes.

(f) Rollers. Use steel-wheel, pneumatic-tire, vibratory, or oscillating rollers as specified or allowed in Section 108.05(c)3a, 3b, 3c, 3e, 3f, 3h, or 4. Operate rollers according to manufacturer's recommendations. Use vibratory and oscillating rollers with separate controls for frequency and amplitude.

(g) Preparation of Existing Surface.

1. Conditioning of Existing Surface. Before delivering bituminous mixtures, remove and dispose of loose and foreign material and excess joint sealer and crack filler from the surface of existing pavement or previously placed pavement courses. If necessary, use a broom.

Before placing a wearing course, correct irregularities in the binder course. If practical, do not allow traffic on the binder course to prevent contamination. Remove and replace binder course that cannot be cleaned to the Representative's satisfaction.

Paint existing vertical surfaces of curbs, structures, gutters, and pavements that will be in contact with bituminous mixtures with a uniform coating of either emulsified asphalt, consisting of PennDOT Material Class TACK or NTT/CNTT, applied in two or more applications, or hot bituminous material of the class and type designated for the bituminous course.

Before overlaying existing surfaces, apply a tack coat as specified in Section 460 unless otherwise indicated. Apply a tack coat to previously placed courses if the Representative determines a tack coat is necessary to ensure bonding between the two courses.

2. Scratch and Leveling Courses. Where indicated, place a separate scratch or leveling course ahead of resurfacing operations. Use a scratch course to fill wheel ruts and other local small depressions even with the surrounding pavement. Use a leveling course to provide a relatively uniform working platform for placing binder or wearing courses.

3. Paving Notches. Mill the existing pavement surface at tie-in locations of the wearing course in accordance with the Standard Drawing RC-28M, or as otherwise indicated. Perform milling as specified in Section 491.

(h) Spreading and Finishing.

1. General Requirements.

1.a Placing. Unless otherwise allowed, deliver, place, and compact bituminous paving mixtures during daylight hours. Ensure the mixture does not contain lumps of cold material. Deliver and place mixtures at the laying temperatures specified in Table A for the type and class of material used.

Utilize a Material Transfer Vehicle (MTV) as specified in Section 108.05(c)5 for RPS pavements unless otherwise approved by the Representative.

1.b Spreading and Finishing. Spread and strike off the mixture for the entire lane width or as much lane width as practical. Adjust screed assemblies to provide the required cross section and depth. After spreading, do not add mixture to the pavement mat that is segregated, below the minimum temperature, contains either a deficiency or an excess of asphalt content, or is otherwise unsuitable to add to the pavement mat.

If the course is more than 6 inches in compacted depth, construct it in two or more layers of approximately equal depth, with no layer less than 3 inches or more than 6 inches in compacted depth. For binder or leveling courses that have isolated areas exceeding 6-inch compacted depth, use a scratch or leveling course to eliminate the isolated areas before full-depth paving.

Immediately after placing the bituminous mixture, work the exposed outer edges to eliminate sharp, ragged, and open edges, to eliminate an unfinished appearance, and to reduce edge breakdown. Immediately repair edge breakdowns.

In areas where mechanical spreaders cannot be used, place and screed the mixture with suitable hand tools. Do not use rakes.

Adjacent to flush curbs, gutters, and other abutting structures, place the wearing course mixture uniformly higher so that after compaction the finished surface is slightly above the edge of the abutting structure. Remove harmful material, clean, and seal the surface of wearing courses adjacent to curbs to form a bituminous gutter. Seal

the mixture surface with a hot bituminous material of the class and type listed in Table A. Evenly apply the bituminous material a minimum width of 12 inches from the curb. The Contractor may use emulsified asphalt, consisting of PennDOT Material Class TACK or NTT/CNTT, instead of hot bituminous material if allowed by the Inspector-in-Charge. Control the application rate so residual asphalt completely fills surface voids and provides a watertight joint along the curb. If necessary, apply emulsified asphalt in two or more applications. After sealing, remove excess sealant material.

1.c Field Technician. Provide a certified HMA field technician, with the qualifications outlined in Publication 351, to control the placement of bituminous mixtures. Instruct and train the certified HMA field technician to control the paving operation so that the completed paving work complies with the specified requirements. A certified HMA field technician must be onsite and carry a valid certification card during placement of all HMA mixtures.

2. Mixture Lot Acceptance (Standard and RPS Construction). Lot acceptance is appropriate for standard construction placed in quantities that allow consistent operation of the plant and is appropriate for RPS construction.

2.a Lots and Sublots. Material will be accepted in the field on a lot by lot basis. Lots will be established cumulatively and will be specific for each JMF. Each lot consists of five equal sublots (n=5). A completed sublot has a mixture acceptance box sample as specified in Section 409.3(h)2.b and either a core collected according to PTM No. 1 or other density acceptance as specified in Section 409.3(j).

A normal lot size is 2,500 tons with five, 500 ton sublots (n=5), unless operational conditions or project size dictate otherwise. If operational conditions or project size dictate, readjustment of the lot will be made as specified in Table D. Breakdowns or stoppages of short periods due to such causes as weather or equipment failure will not be considered as reasons to adjust the lot size. The original lot will be continued when work resumes after short stoppages of less than 5 days. If a lot is ended due to a stoppage of 5 days or more, adjust the lot size and number of sublots as specified in Table D. If the work stoppage is 5 days or more, a new lot will be established.

TABLE D
Re-adjustment of Lot Size and Associated Number of Sublots

Remaining Quantity* Following Last Full Lot	Action
Less than 500 tons without a combination of one mixture acceptance sample and one core**	Quantity combined with the previous lot, (n=5)
Less than 500 tons with a combination of one mixture acceptance sample and one core**	One new sublot defined and quantity combined with the previous lot, (n=6)
500 tons to less than 1,000 tons without a combination of two mixture acceptance samples and two cores**	One new sublot defined and quantity combined with the previous lot, (n=6)
500 tons to less than 1,000 tons with a combination of two mixture acceptance samples and two cores**	Two new sublots defined and quantity combined with the previous lot, (n=7)
1,000 tons to less than 1,500 tons without a combination of three mixture acceptance samples and three cores**	Two new sublots defined and quantity combined with the previous lot, (n=7)
1,000 tons to less than 1,500 tons with a combination of three mixture acceptance samples and three cores**	New lot defined, (n=3)
1,500 tons to less than 2,000 tons without a combination of four mixture acceptance samples and four cores**	New lot defined, (n=3)
1,500 tons to less than 2,000 tons with a combination of four mixture acceptance samples and four cores**	New lot defined, (n=4)
2,000 tons to less than 2,500 tons without a combination of five mixture acceptance samples and five cores**	New lot defined, (n=4)
2,000 tons to less than 2,500 tons with a combination of five mixture acceptance samples and five cores**	New lot defined, (n=5)
*For contract items bid on an area basis, compute equivalent tons based on design depth of paving course and design density as specified in Section 110.04(b)4.b. ** If mat density is accepted using pavement cores and mixture acceptance is by lots.	

2.a.1 Partially Completed Lots (n=2 or less). When process conditions change to an extent that a partially completed lot cannot be combined with the most recently completed lot, samples will be independently evaluated on the partially completed lot. For asphalt content and percent passing the 75 μm (No. 200) sieve, mixture acceptance samples will be evaluated individually using Section 409.2(e), Table A (n=1) criteria. For density, mat density acceptance samples will be evaluated individually using the criteria in Table E.

If samples tested for asphalt content and percent passing the 75 μm (No. 200) sieve meet the n=1 criteria of Table A, and samples tested for density meet the criteria in Table E, payment will be 100 percent of the contract unit price. If samples tested for asphalt content and percent passing the 75 μm (No. 200) sieve do not meet the n=1 criteria of Table A, the material will be considered defective work. If samples tested for density are no more than 2 percent below the minimum or no more than 2 percent above the maximum limits of Table E, payment will be 90 percent of the contract unit price. If samples for density are more than 2 percent below the minimum or more than 2 percent above the maximum limits of Table E, the pavement will be considered defective work.

Unless otherwise directed in writing by the District Executive, remove and replace defective work.

TABLE E
Density Limits for Partially Completed Lots

MIXTURE NMAS	DENSITY LIMITS
All RPS 9.5 mm, 12.5 mm, 19 mm, and 25 mm Wearing or Binder Courses	≥ 92 and ≤ 97
All Standard 9.5 mm, 12.5 mm, 19 mm, and 25 mm Wearing or Binder Courses	≥ 90 and ≤ 97
All 25 mm and 37.5 mm Base Courses	≥ 90 and < 100

2.a.2 For JMF's placed in quantities less than 2,500 tons. For JMF's placed in quantities of greater than 500 tons and less than 2,500 tons the tonnage will be considered a lot. The lot will be divided into five equal sublots.

For JMF's placed in quantities of 500 tons or less, the tonnage may be considered a lot if density acceptance is by pavement cores, however mixture acceptance will be by certification. The lot will be divided into three equal sublots.

2.b Mixture Acceptance Samples. The Inspector will select different sample locations in each sublot according to PTM No. 1 and PTM No. 746. In the presence of the Inspector, obtain one loose mixture sample for each sublot directly from the uncompacted mixture placed by the paving equipment specified in Section 409.3(e) and immediately package. For 19 mm and smaller NMAS mixtures, package individual samples in cardboard boxes dimensioned approximately 3 3/4 inches x 4 3/4 inches x 9 1/2 inches. For 25 mm and larger NMAS mixtures, package individual samples in cardboard boxes dimensioned approximately 5 inches x 5 1/2 inches x 9 inches. Do not package samples in cardboard boxes with any one dimension greater than 10 1/4 inches or any one dimension smaller than 3 1/2 inches.

Immediately after packaging and in the presence of the Inspector, identify the samples by ECMS project number, lot and sublot number, location (station and offset), date of placement, mixture type, and as acceptance samples (Sample Class AS). Leave at least one side of the cardboard sample box free of any writing or marking for LTS use in testing the samples.

Immediately after identifying, submit the samples to the Inspector.

For quality control purposes, a maximum of one loose sample per sublot may be obtained. No loose mixture or core samples may be taken by the Contractor for mixture composition testing after the mixture acceptance samples are obtained. Do not obtain any other pavement samples, except those which are directed by and surrendered to the Department, unless allowed in writing from the District Executive.

2.c Mixture Acceptance Sample Testing. Utilize LTS Testing unless otherwise indicated in the proposal. These procedures apply to standard and RPS construction.

2.c.1 LTS Testing. The LTS will test the mixture acceptance samples according to PTM No. 757 or PTM No. 702, Modified Method D, if previously identified problematic aggregates are used in the mixture, to determine asphalt content and the percent passing the 75 μm (No. 200) sieve. The LTS will use the calibration factors (C_f and 200 C_f) provided with the JMF for PTM No. 757. The LTS will analyze the test results for extreme values according to PTM No. 4 at the 5% significance level. If discarding an extreme value reduces a lot to less than three remaining

test results, the Department will accept the lot as specified in Section 409.3(h)2.a.1. The Department will accept lots with three or more test results as specified in Section 409.4(a)4 or Section 409.4(b).

If the asphalt content or the percent passing the 75 μm (No. 200) sieve is not within the single sample (n=1) or multiple sample (n≥3) tolerances in Table A for two consecutive lots or a total of three lots, stop all production of the JMF. Determine the cause of the problem and provide a proposed solution to the Department.

Do not resume production of the JMF until the Representative reviews the proposed solution and authorizes production to continue.

3. Pattern Segregation. Pattern segregation is continuous or repeated areas of non-uniform distribution of coarse and fine aggregate particles in the finished mat. The Department will address pattern segregation as follows:

3.a Evaluating Pattern Segregation. If the Representative observes pattern segregation that may result in defective pavement, then:

- The Inspector will notify the Contractor of the observed pattern segregation.
- The Contractor may continue to work at his or her own risk while he or she immediately and continually adjusts the operation to eliminate the pattern segregation from future work.
- As a minimum and in the presence of the Representative, determine the average depth of pavement surface macrotexture according to PTM No. 751 in areas with the pattern segregation and in areas with non-segregated pavement. The pattern segregation is unacceptable if the difference in average pavement texture depth between the non-segregated and segregated areas exceeds 0.024 inch. The Representative will determine if the pavement is defective as specified in Section 409.3(h)3.c.

3.b Test Section. If the macrotexture tests identify unacceptable pattern segregation, then:

- Immediately suspend placing the bituminous course. Evaluate the cause of pattern segregation according to the Paving Operation QC Plan and as directed. Provide proposed corrective actions to the Representative and do not resume placing the bituminous course until after the Representative reviews the proposed corrective actions and authorizes paving to continue.
- Determine if the pattern segregation resulted in defective pavement as specified in Section 409.3(h)3.c.
- After the Representative allows paving to resume, place a test section not to exceed 200 tons. If the corrective actions do not eliminate observed pattern segregation, the Department will suspend paving, even if it is before the Contractor places the entire test section. Propose additional corrective actions, and construct another test section. Resume normal paving operations after constructing an entire test section without pattern segregation as determined by the Representative.

3.c Defective Pavement. At locations selected by the Inspector and with the Inspector present, drill a minimum of three 6-inch diameter cores from the area of pattern segregation and a minimum of three cores from the pavement representing a non-segregated area. Do not compress, bend, or distort samples during cutting and handling and immediately provide the cores to the Inspector. The Inspector will transport cores to the producer's laboratory. With the Inspector present, test the cores at the plant for density, asphalt content, and gradation. The Department may request additional tests as part of its evaluation of pattern segregation. Determine the maximum theoretical density according to Bulletin 27, the core density according to PTM No. 715, and asphalt content according to PTM No. 757 if previously identified problematic aggregates are used in the mixture, PTM No. 702 modified Method D, or other test method identified in the producer QC Plan.

An area of pattern segregation contains defective pavement if the summation of absolute deviations from any two sieves is 20% or more from the JMF, the core density is defective, the mixture is defective in asphalt content, or the mixture is defective for percent passing the 75 μm (No. 200) sieve. Remove and replace the full width of the affected lane and a minimum of 5 feet beyond each end of the area with unacceptable pattern segregation. Construct replacement pavement conforming to the appropriate surface tolerances as specified in Section 309.3(l)12 or Section 409.3(l).

4. Flushing. Provide a mix that will not flush. Flushing is continuous or repeated areas of excessive asphalt on the pavement surface. The Department may recognize flushing until the Department approves the project through final inspection. The Department will address flushing as follows:

4.a Evaluating Flushing. When the Representative observes flushing, then:

- The Representative will immediately notify the Contractor of the observed flushing.
- The Contractor may continue work at its own risk while it immediately and continually adjusts the operation to eliminate flushing from future work.
- In the presence of the Representative, determine the average depth of pavement surface macrotexture according to PTM No. 751 in areas of suspected flushing. If the average texture depth is less than or equal to 0.006 inches, then the pavement will be considered to be flushed and is defective.

4.b Test Section. If the macrotexture tests identify flushing, then:

- Immediately suspend placing the paving course. Evaluate the cause of flushing according to the Paving Operation QC Plan and as directed. Provide proposed corrective actions to the Representative and do not resume placing the paving course until after the Representative reviews the proposed corrective actions and authorizes paving to continue.
- Remove and replace the defective wearing course at no cost to the Department for the full width of the affected lane and a minimum of 5 feet beyond each end of the area of defective wearing course. Construct replacement wearing course conforming to the appropriate surface tolerances as specified in Section 409.3(l).
- After the Representative allows paving to resume, place a test section not to exceed 200 tons. If the corrective actions do not eliminate observed flushing, the Department will suspend paving even if it is before the Contractor places the entire test section. Propose additional corrective actions and construct another test section. Resume normal paving operations after constructing an entire test section without flushing as determined by the Representative.

(i) Compaction. Compact the mixture to achieve the density acceptance requirements and to eliminate all roller marks. Compact the mixture while it is in proper condition and adjust roller speed, amplitude, frequency, pattern, and roller size to eliminate displacement, shoving, cracking, and aggregate breakage. Satisfactorily correct displacement resulting from reversing roller directions and other causes.

Without using excess water, maintain wheels of steel-wheel rollers moist and clean to prevent the mixture from adhering to the wheels. Use suitable methods to clean wheels of pneumatic-tire rollers.

Use pneumatic-tire rollers for compacting scratch courses.

For areas inaccessible to rollers, compact with mechanical vibrating hand tampers.

Remove areas that are loose, broken, mixed with dirt, or show an excess or deficiency of bituminous material. Replace removed mixture with fresh hot mixture and compact the mixture even with the surrounding pavement surface.

(j) Mat Density Acceptance.

1. General. The Department will accept the mat density of standard construction according to one of the levels in Table F. Areas may be accepted by non-movement or optimum-rolling pattern based on the criteria in Sections 409.3(j)2 and 409.3(j)3. Do not place mixtures for non-movement or optimum-rolling pattern acceptance until the Department has approved the density-acceptance level.

The Department will accept the mat density of RPS construction by lots and pavement cores as specified in Section 409.3(j)4. The Department will accept mat density of all 4.75 mm asphalt material by non-movement or optimum-rolling pattern.

TABLE F
Density Acceptance

Density Acceptance Level	Acceptance Criteria
Non-Movement	Table H
Optimum-Rolling Pattern	Table H
Pavement Cores*	Table I

2. Non-Movement. The Inspector-in-Charge will approve density acceptance by non-movement for the following materials, conditions, or applications:

- Scratch courses or leveling courses less than 1-inch in depth or equal to or less than 110 pounds per square yard.

- Areas of paving or patching less than 4 feet in width or narrow enough to cause bridging of the area by approved compaction equipment.

The Inspector-in-Charge will accept density by non-movement for the following materials, conditions, or applications if they are determined by the Representative to be non-critical for density:

- Materials placed in small quantities not exceeding 500 tons in a continuous placement.

- Mixtures placed on unstable or non-uniform bases.

- Mixtures used for patching, road widening, shoulders, driveway adjustments, parking lots, and other miscellaneous applications determined by the Representative. Shoulders where density is critical will be accepted by pavement cores as specified in Section 409.3(j)4.a.

The Department will accept the density when the mixture does not move under the compaction equipment.

3. Optimum-Rolling Pattern. The Inspector-in-Charge may accept density using an optimum-rolling pattern for the following materials, conditions, or applications:

- Materials placed in small quantities not exceeding 500 tons in a continuous placement.

- Mixtures placed on unstable or non-uniform bases.

- Leveling courses or other courses that are greater than or equal to 1-inch in depth or greater than or equal to 110 pounds per square yard.

- Mixtures used for patching, road widening, driveway adjustments, parking lots, shoulders where density is not critical, and other miscellaneous applications determined by the Representative. Shoulders where density is critical will be accepted by pavement cores as specified in Section 409.3(j)4.a.

- Mixtures placed at less than the minimum compacted depths in Table G.

With the Representative and the Contractor's certified HMA field technician present, determine density with an approved nuclear gauge according to PTM No. 402, or determine density with an approved electrical impedance gauge according to PTM No. 403. Nuclear gauges must be operated by a licensed nuclear gauge operator. In the presence of the Representative, establish the optimum-rolling pattern for each course according to PTM No. 402 or PTM No. 403. Document optimum-rolling patterns using the appropriate Form TR-4276B or Form TR-4276C and provide the completed forms to the Representative. Compact the course according to the optimum-rolling pattern. During paving, the Representative may require the Contractor to verify the target density established by the optimum-rolling pattern. If the target density is not achieved, establish a new optimum-rolling pattern as directed. The Representative will suspend paving when the optimum-rolling pattern is not being followed.

Use one of the following gauges or approved equal:

- Troxler Electronics, Model 3411B or Model 4640B
- Campbell Pacific Nuclear, Model MC-2
- Seaman Nuclear, Model MC-2
- TransTech Systems, Inc., PQI™, Model 300 or Model 301
- Troxler Electronic Laboratories, PaveTracker™

Submit a copy of the certificate of nuclear gauge annual calibration according to ASTM D2950 and documentation of training of the nuclear gauge operator. Recalibrate any nuclear gauge that is damaged or repaired.

4. Pavement Cores (Standard and RPS Construction).

4.a General. Pavement cores are required for accepting the density of RPS construction. Pavement cores are required for standard construction of extended-season paving, unless waived by the Representative as specified in Section 409.3(b)1. Pavement cores are appropriate for accepting the density of standard construction if all of the following materials, conditions, or applications exist:

- Materials placed at compacted depths greater than or equal to the minimum depths specified in Table G.

- Materials placed on stable and uniform bases.

TABLE G
Mixture Minimum Compacted Depths

Mixture	Minimum Depth
9.5 mm Wearing Course	1 1/2 in.
12.5 mm Wearing Course	2 in.
19 mm Binder Course	2 1/2 in.
25 mm Binder Course	3 in.

4.b Lots and Sublots. Section 409.3(h)2.a.

4.c Density Acceptance Samples. The Inspector will select different sample locations in each sublot according to PTM No. 1, PTM No. 729, and PTM No. 746. With the Inspector present, drill 6-inch diameter cores as soon as possible but no later than the day following placement. Do not compress, bend, or distort samples during cutting, handling, transporting, and storing. If samples are damaged, immediately obtain replacement samples, as directed by the Inspector, from within 12 inches of the original sample location. Within 24 hours after coring, backfill the hole with mixture of the same JMF or with mixture used for subsequent courses and compact and seal the mixture.

In the presence of the Inspector, identify the samples by ECMS project number, lot and sublot number, location (station and offset), date of placement, mixture type, and as acceptance samples (Sample Class AS). Provide the daily theoretical maximum specific gravity value from Section 409.2(e)1.d.4 for the density calculation of the lot. If density samples from the lot are taken from more than 1 day's placement, the average of the daily theoretical maximum specific gravity values from the days the lot was placed will be used to calculate the density. Immediately deliver the samples to the Inspector and provide sample containers of sufficient strength to prevent samples from being damaged during transport. The Representative will submit samples for one lot in one container.

For quality control purposes, a maximum of one pavement core per sublot may be obtained unless the Representative allows additional cores. No cores may be taken by the Contractor after the acceptance cores are obtained. Do not obtain any other pavement cores, except those which are directed by and surrendered to the Department, unless allowed in writing by the District Executive.

4.d Acceptance Sample Testing. These procedures apply to standard and RPS construction.

4.d.1 LTS Acceptance Testing. The LTS will test the density acceptance samples according to PTM No. 715, and if necessary PTM No. 716, to determine the percent compaction. The Department will determine acceptance, with respect to density, as specified in Section 409.4(a)4 or Section 409.4(b).

If cores are not taken within 1 day after placing the mixture, or if the density for two consecutive lots or for a total of three lots does not meet the density payment factor percentage of 100, stop paving operations for the project as directed. Review and evaluate the operation and determine the cause of the problem. Do not resume paving until after the Representative reviews the proposed solution and authorizes paving to continue.

(k) Joints.

1. Longitudinal Joints.

1.a General. Offset joints in a layer from the joint in the layer immediately below by approximately 6 inches. Plan joint locations to ensure that the joint in the top layer is at the approximate pavement centerline for two-lane roadways and within 12 inches of the lane lines for roadways with more than two lanes. Avoid joint locations directly beneath planned pavement marking applications where possible.

Before placing abutting lanes, paint the entire area of the joint with a uniform coating of bituminous material, the PG-Binder used in the pavement course or PG 64-22. Painting of the joint face is not required for scratch courses.

Place and compact the mixture at the joint according to the Paving Operation QC Plan. Ensure the surface across the joint and along the joint is within the surface tolerances specified in Section 409.3(l).

Adhere to the following additional requirements for the construction of longitudinal joints that will not be evaluated as specified in Section 405:

Assure a true line when paving. Place and closely follow lines or markings for this purpose. When compacting loose mixture at an unsupported edge, make the first roller pass with the edge of the roller drum extending beyond and overhanging the unsupported edge by 3 to 6 inches. Do not allow pneumatic-tire rollers to cause lateral movement at any unsupported edge.

When placing uncompacted mixture adjacent to a previously compacted lane, operate the paver so that the material overlaps the edge of the previously placed lane by 1 to 1 1/2 inches. Ensure that mixture behind the screed is tightly pushed against the free face of the existing lane. Maintain the uncompacted mixture uniformly higher than the existing lane by at least 1/4 inch per inch of material being placed to assure full compaction. When possible, use automated joint matchers when constructing joints between traveled lanes. Do not bump back or lute the overlapped material unless overlap inadvertently exceeds the specified tolerances. When compacting the loose mix at the longitudinal joint, keep the roller drum approximately 6 to 12 inches from the joint for the first pass forward. On the backward and subsequent passes, overlap the joint 2 to 6 inches. Ensure that the joint receives at least as many roller passes as the rest of the mat.

If traffic or other cause distorts the lane edge, restore the lane edge to its original shape, using acceptable procedures.

1.b Vertical Joints.

- The Contractor may use vertical joints for base, binder, and wearing courses.
- If traffic or other cause distorts the lane edge, carefully saw a vertical lane edge before painting.
- Place the abutting lane on the same day, and if necessary, leave only short lane sections, normally less than 25 feet in length, where the abutting lane is not placed the same day.

1.c Notched Wedge Joints.

- The Contractor may use notched wedge joints for wearing and binder courses with NMAS mixtures of 19.0 mm or smaller.
- Remove and dispose of all loose and foreign material before opening the lane to traffic.
- Construct the joint according to Standard Drawing RC-28M.

- If the joint is next to opposing traffic, place the abutting lane within 1 working day after placing the mixture. If the joint is next to traffic in the same direction, place the abutting lane within 2 working days after placing the mixture.

- If both lanes that make the joint are not placed on the same day, amend the Maintenance and Protection of Traffic Plan and install additional signing for uneven lane at no additional cost to the Department. Install "Uneven Lane" signs according to Publication 212, Publication 213, and MUTCD and 1/2-mile before the notched wedge joint area and every 1/2-mile within the uneven pavement area.

2. Transverse Joints. Construct joints perpendicular to the pavement centerline. The Contractor may saw transverse joints. If used, install bulkheads straight and perpendicular to the surface. If a bulkhead is not used and the roller moves over the rounded edge of new mixture, locate the joint a sufficient distance from the rounded edge to provide a true surface and cross section. Paint the joint face with a thin coating of bituminous material, the PG-Binder used in the pavement course or PG 64-22, before placing fresh mixture against the joint face. Painting of the joint face is not required for scratch courses.

3. Other Joints. Where placing a wearing course abutting to existing pavement at locations such as paving notches, lane additions, or utility openings, seal the joint with hot bituminous material of the class and type designated for the wearing course. Evenly apply the sealant a minimum of 6 inches on both sides of the joint. The Contractor may use emulsified asphalt, consisting of PennDOT Material Class TACK or NTT/CNTT, instead of hot bituminous material. Before sealing, clean and remove harmful material from the area to be sealed. Control the application rate so residual asphalt completely fills surface voids and provides a watertight joint. If necessary, use two or more applications of emulsified asphalt. Remove excess bituminous material and immediately cover the sealed area with a light application of dry sand that is acceptable to the Representative.

(l) Surface Tolerance. Test the finished surface with a 10-foot straightedge at areas the Representative determines may be deficient or irregular, and at transverse joints and paving notches. Hold the straightedge in contact with the surface and in successive positions parallel to the road centerline to check the entire width of the pavement. Advance along the pavement in stages of not more than one-half the length of the straightedge until the entire area is tested. The pavement is defective if irregularities are more than 3/16 inch.

(m) Tests for Depth: Binder and Wearing Courses. Construct the pavement to the depth indicated and within the specified tolerances.

For courses with density acceptance by lots, the Inspector will measure the depth of each sublot according to PTM No. 737 using the density acceptance samples.

For courses with a designed course depth and density acceptance by non-movement or optimum rolling pattern, the Inspector will calculate the mass per square meter (weight per square yard) for verification of yield. If yield results indicate insufficient course depth, drill one 6 inch diameter core for each 500 tons of material placed to determine the extent of the deficient depth. Core locations will be determined using PTM No. 1. For courses with density acceptance by lots, the inspector will measure the depth of each sublot according to PTM No. 737 using density acceptance samples.

Pavement deficient in depth by more than 1/4 inch is defective work. Pavement deficient in depth by more than 1/8 inch in three or more adjacent core locations is defective work. The extent of the defective work is the entirety of all sublots represented by the adjacent deficient core samples. After the Inspector completes depth measurements, backfill, compact, and seal core holes with the mixture used to construct the course. Immediately start correcting courses or pavement that are deficient in depth at the core location and proceed longitudinally and transversely until the depth is within 1/4 inch of the design depth.

(n) Protection of Courses. Do not allow vehicular traffic or loads on newly compacted courses for 24 hours or until the course uniformly cools to a temperature of 140 F or less. Provide alternate routes as indicated or as directed. If both lanes that form a longitudinal joint are placed on the same day and public safety is not restricted, do not allow vehicular traffic or loads on the lanes until adequate stability and adhesion is obtained and the material has uniformly cooled to 140 F or less. Maintain the course, as specified in Sections 105.13, 107.15, and 901.

(o) Defective Work. As specified in Section 105.12 and as follows:

Department acceptance and QA testing shall not relieve the Contractor of responsibility for material or workmanship that the Representative determines is defective before the Department issues the acceptance certificate. Remove and replace or repair defective work as directed. The BOPD, CMD will review Representative determinations of defective material or workmanship.

Remove and replace pavement defective for pattern segregation as specified in Section 409.3(h)3, for flushing as specified in Section 409.3(h)4, surface tolerance as specified in Section 409.3(l) or Section 309.3(l) and depth as specified in Section 409.3(m), or Section 309.3(m). Remove and replace pavement defective for percent within tolerance or Payment Factor Percentages as specified in Tables H and I.

409.4 MEASUREMENT AND PAYMENT—

(a) Standard HMA Construction.

1. HMA Courses.

1.a Superpave Asphalt Mixture Design, HMA Wearing Course. Square Yard or Ton

1.b Superpave Asphalt Mixture Design, HMA Wearing Course (Scratch). Ton

1.c Superpave Asphalt Mixture Design, HMA Wearing Course (Leveling). Ton

1.d Superpave Asphalt Mixture Design, HMA Binder Course. Square Yard or Ton

1.e Superpave Asphalt Mixture Design, HMA Binder Course (Leveling). Ton

2. Bituminous Tack Coat. Section 460.4.

3. Mixture Acceptance by Certification and Density Acceptance by Non-Movement, Optimum-Rolling Pattern, or Pavement Cores. The Representative will pay at the contract unit price, adjusted according to Table H. The total payment factor percentage is the sum of adjustments for each test criterion subtracted from 100%. The adjustment for an individual test criterion is the payment factor percentage subtracted from 100%. The pavement will be considered defective if the payment factor for asphalt content, percent passing the 75 μm (No. 200) sieve, and percent passing the 2.36 mm (No. 8) sieve (No. 8 sieve not applicable for 4.75 mm asphalt mixtures) are all 85%. For pavements with density acceptance by cores, the pavement will be considered defective if the pavement density cores result in a percent within tolerance less than 64.

TABLE H
Contract Unit Price Adjustments - Mixture Acceptance by Certification

Mixture NMAS	Test Criteria	Test Value		Payment Factor Percentage
Asphalt Content				
All sizes	Printed Tickets	At least 90% of Daily Printed Tickets Within 0.2% of JMF		100
		Less than 90% of Daily Printed Tickets Within 0.2% of JMF		85
19.0 mm and smaller	QC Sample Testing**	Single Sample (n=1)	Multiple Samples (n≥2)	
		±0.7%	±0.5%	100
		±0.8% to 1.0%	±0.6%	85
		> ±1.0%	≥ ±0.7%	*
25.0 mm and larger	QC Sample Testing**	±0.8%	±0.6%	100
		±0.9% to ±1.2%	±0.7%	85

		> ±1.2%	≥ ±0.8%	*
Gradation				
		Single Sample (n=1)	Multiple Samples (n≥2)	
All sizes	QC Sample Testing for % Passing 75 µm (No. 200) Sieve**	±3.0%	±2.1%	100
		±3.1% to ±4.0%	±2.2% to ±2.7%	85
		> ±4.0%	≥ ±2.8%	*
All sizes	QC Sample Testing for % Passing 2.36 mm (No. 8) Sieve**	±6%	±4%	100
		±7% to ±8%	±5%	85
		> ±8%	≥ ±6%	*
Mat Density				
All sizes	Non-Movement	Section 409.3(j)2.		100
	Optimum-Rolling Pattern	Section 409.3(j)3.		100
Sizes from Table I	Acceptance Sample Testing of Pavement Cores	Table I		Table I

* Defective pavement. Remove and replace or, when permitted by the District Executive in writing, leave in place and the Department will pay 50% of the contract unit price.

** For these test criteria, the daily Payment Factor Percentage will be determined by the single sample test result from the daily QC sample. If more than one QC sample test result is available for a day, the Payment Factor Percentage will be determined based on the average of the results using multiple sample tolerances. If corrective action is taken, Payment Factor Percentages will be independently determined for material placed before and after the corrective action.

4. Mixture Acceptance by Lot and Density Acceptance by Non-Movement, Optimum-Rolling Pattern, or Pavement Cores. The Department will pay on a lot-by-lot basis at the contract unit price, adjusted for Payment Factor Percentages as specified in Table I. For the payment factor percentages based on percent within tolerance, the Department will determine the percent within tolerance according to Section 106.03(a)3, using the upper and lower specification limits in Table J.

TABLE I
Contract Unit Price Adjustments - Mixture Acceptance by Lots

Mixture NMAS	Test Criteria	Test Value	Payment Factor Percentage
Asphalt Content			
All sizes	Acceptance Sample Testing	All individual sublot acceptance sample test results for the lot are within the n=1 tolerances in Table A and the lot average is within the n≥3 tolerances in Table A*	100
		Percent Within Tolerance if any individual sublot acceptance sample test result for the lot is not within the n=1 tolerances in Table A or the lot average is not within the n≥3 tolerances in Table A	Table K
Gradation			
All sizes	Acceptance Sample Testing for % Passing 75 µm (No. 200) Sieve	All individual sublot acceptance sample test results for the lot are within the n=1 tolerances in Table A and the lot average is within the n≥3 tolerances in Table A*	100
		Percent Within Tolerance, if any individual sublot acceptance sample test result for the lot is not within the n=1 tolerances in Table A or the lot average is not within the n≥3 tolerances in Table A	Table K
Mat Density			
All sizes	Non-Movement	Section 409.3(j)2.	100

	Optimum-Rolling Pattern	Section 409.3(j)3.	100
All RPS 9.5 mm, 12.5 mm, 19 mm and 25 mm Wearing or Binder Courses	Acceptance Sample Testing of Pavement Cores	All individual sublot test results for the lot are ≥92% and ≤97% of maximum theoretical density	100
		Percent Within Tolerance if any individual sublot test result for the lot is not ≥92% and ≤97% of maximum theoretical density	Table K
All Standard 9.5 mm, 12.5 mm, 19 mm and 25 mm Wearing or Binder Courses	Acceptance Sample Testing of Pavement Cores	All individual sublot test results are ≥90% and ≤97% and the lot average is ≥92% and ≤97% of the maximum theoretical density	100
		Percent Within Tolerance if any individual sublot test result is not ≥90% and ≤97% or if the lot average is not ≥92% and ≤97% of the maximum theoretical density	Table K
All 25 mm and 37.5 mm Base Courses	Acceptance Sample Testing of Pavement Cores	All individual sublot test results are ≥90% and <100%of the maximum theoretical density	100
		Percent Within Tolerance if any individual sublot test result is not ≥90% and <100% of the maximum theoretical density	Table K
* The Department may elect to randomly select and test only one sublot mixture acceptance sample from each lot to verify conformance to the specifications. If only one sublot mixture acceptance sample is tested, tighter tolerances than those in Table A will be used to verify conformance to the specifications for the entire lot. If the one sublot is within ±0.2% of the JMF for asphalt content and within ±1.0% of the JMF for percent passing the 75 µm (No. 200) sieve, the lot will be considered to conform with the specifications and the lot's payment factor percentage will be determined according to this table. If the one sublot fails to meet the tighter tolerances, all mixture acceptance samples from the lot will be tested to determine the payment factor percentage according to this table.			

TABLE J
Upper and Lower Specification Limits for Calculating Percent Within Tolerance

	Testing Criteria	
Mixture NMAS	**Lower Specification Limit (L)**	**Upper Specification Limit (U)**
	Asphalt Content from JMF Value, %	
9.5 mm, 12.5 mm, and 19 mm	-0.4	+0.4
25 mm and 37.5 mm	-0.5	+0.5
	Percent Passing the 75 µm (No. 200) sieve from JMF Value, %	
All sizes	-2.0	+2.0
	Mat Density*	
9.5 mm, 12.5 mm, 19 mm, and 25 mm Wearing and Binder Courses	0.91T	0.98T
25 mm and 37.5 mm Base Courses	0.89T	1.00T
* Where T = Current Maximum Theoretical Density, lbs./cu. ft.		

TABLE K
Payment Factor Based on Percent Within Tolerance

Percent Within Tolerance	Payment Factor Percentage
99	97
98	97
97	97
96	96

95	96
94	96
93	95
92	95
91	95
90	95
89	93
88	91
87	90
86	88
85	86
84	84
83	83
82	81
81	79
80	78
79	76
78	74
77	72
76	71
75	69
74	67
73	66
72	64
71	62
70	60
69	59
68	57
67	55
66	54
65	52
64	50
Less than 64	Defective Lot**

**Remove and replace the lot. If only one lot characteristic has a percent within tolerance less than 64, the District Executive may allow the Contractor to leave the defective lot in place. The Department will pay for the defective lot at 50% of the contract unit price.

4.a Payment. The Representative will compute the percent of the contract unit price paid as follows:

$$\text{Lot Payment} = C_P(2P_D + P_B + P_A)/400$$

C_P = Contract unit price per lot (unit price times lot quantity)

P_D = Payment Factor Percentage for density

P_B = Payment Factor Percentage for asphalt content.

P_A = Payment Factor Percentage for percent passing the 75 µm (No. 200) sieve

4.b Dispute Resolution. For mixture acceptance testing or density acceptance testing performed by the LTS, the Contractor may request in writing that the Department retest a lot if the initial test results indicated a defective lot (remove and replace) except for density when one or more density acceptance cores in the lot were coated with paraffin wax as a result of PTM No. 716 during the original density acceptance testing. Provide written retest requests to the District Executive within 3 weeks of the date the LTS test results are released. Retests will not be allowed if a written retest request is not received within 3 weeks of the date the LTS test results are released. Provide quality control test

results and control charts, companion sample test results (if available), test data trend evaluation, and any other pertinent information to justify the retest request. The Department will evaluate the information and may allow retesting if the information submitted provides a reasonable basis to conclude that the failing test results may not represent the in-place material. The LTS will perform the retest with the Contractor present, unless otherwise agreed to in writing with the Contractor.

For retesting of materials failing for asphalt content or percent passing 75 µm (No. 200) sieve, the Inspector will identify the locations where the original box samples were collected. The Inspector will select retest sample locations 24 inches from the original sample locations longitudinally in the direction of traffic. If the 24 inch offset causes the retest sample location to fall outside of the sublot, the Inspector will select the retest sample location 24 inches from the original sample locations longitudinally in the opposite direction from traffic.

With the Inspector present, provide appropriate traffic control and drill 6-inch diameter cores for retesting purposes. Within 24 hours after coring, backfill the hole with mixture of the same JMF or with mixture used for subsequent courses and compact and seal the mixture. Provide traffic control, core, and backfill the core holes at no cost to the Department. The test method used for asphalt determination during the original acceptance testing (PTM No. 757 or PTM No. 702) will be used for the retest, unless the (DME/DMM) grants written approval for a change in test method. The cores will be rinsed with water before testing. The results of the retest cores will be used to calculate payment for both asphalt content and percent passing the 75 µm (No. 200) sieve for the lot.

For retesting of density acceptance, the original density acceptance cores will be utilized. The LTS will not retest a lot for density acceptance when one or more density acceptance cores in the lot were coated with paraffin wax as a result of PTM No. 716 during the original density acceptance testing. Upon completing the retesting of the original density acceptance cores, the LTS will evaluate testing repeatability using both the original density test values and the density retest values according to PTM No. 5. After evaluating the testing repeatability, the density test values used to determine the final payment factor percentage for density will be as follows:

- If repeatable, the original test values will be used.
- If lack of repeatability (i.e., non-repeatable), the retest values will be used.

The Department will deduct from the payment the cost per lot associated with conducting a retest as follows in Table L:

TABLE L
Dispute Resolution Retest Cost Table

Test Method	Mixture Acceptance Retest Cost if Retest Results Indicate 100% Pay Factor(s)	Mixture Acceptance Retest Cost if Retest Results Indicate <100% Pay Factor(s)
PTM No. 702/739	$900	$3,500
PTM No. 757	$500	$2,000
	Density Acceptance Retest Cost if Retest Results Indicate a Lack of Repeatability	**Density Acceptance Retest Cost if Retest Results are Repeatable**
PTM No. 715	$200	$750

(b) HMA RPS Construction. Square Yard or Ton

1. Mixture Acceptance by Lot and Density Acceptance by Pavement Cores. Section 409.4(a)4, except for RPS, the Department will determine mat density by pavement cores only.

SECTION 410 – SUPERPAVE MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED HMA FINE-GRADED COURSES

410.1 DESCRIPTION— This work is the standard and RPS construction of a plant-mixed HMA wearing course on a prepared surface using a volumetric mixture design developed with the Superpave Gyratory Compactor and modified to be a fine-graded (FG) mixture.

410.2 MATERIALS— Section 409.2 using the procedure and volumetric tolerances for the 9.5 mm nominal maximum aggregate size mixture and modified as follows:

(e) Mixture Composition for Standard and RPS Construction.

1. Virgin Material Mixtures. Submit a JMF meeting all of Bulletin 27 requirements for a 9.5 mm nominal maximum aggregate size mixture, except the JMF must have a minimum percent passing the No. 8 sieve of 47% and a maximum percent passing the No. 8 sieve of 67%.

410.3 CONSTRUCTION— Section 409.3 using the test procedures, limits and tolerances for a 9.5 mm nominal maximum aggregate size mixture except where procedures, limits and tolerances are specifically indicated for a 9.5 mm fine-graded nominal maximum aggregate size mixture and as modified as follows:

Revise Table G to include 9.5 mm Fine Grade Wearing Course as follows:

TABLE G
Mixture Minimum Compacted Depths

Mixture	Minimum Depth
9.5 mm Fine Grade Wearing Course	1 in.

410.4 MEASUREMENT AND PAYMENT—Square Yard or Ton

Paid in accordance with the requirements of Section 409.4 for a 9.5 mm Wearing Course.

SECTION 411—SUPERPAVE MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED WMA COURSES

411.1 DESCRIPTION—This work is the Standard and RPS construction of a plant-mixed, dense-graded, WMA pavement course on a prepared surface using a volumetric asphalt mixture design developed with the Superpave Gyratory Compactor (SGC), using prescribed manufactured additives or modifiers, and/or plant process modifications.

411.2 MATERIAL—Section 409.2 with additions and modifications as follows:

(a) Bituminous Material. Section 409.2(a). Add the following subsections:

3. WMA Technology Additives or Modifiers Blended at the Bituminous Material Supplier's Refinery or Terminal. Provide refinery or terminal blended bituminous material blended with a WMA Technology additive or modifier from an approved manufacturer and source listed in Bulletin 15. Include in the bituminous material Producer QC Plan, the WMA Technology additive or modifier manufacturer name, WMA Technology name, and source, dosage rates, blending method, QC testing, corrective action points, disposition of failed material, storage, handling shipping, and bill of lading information following the applicable requirements in Section 702. Include the WMA Technology additive or modifier and dosage rate on the bill of lading. Provide certification that the refinery or terminally blended bituminous material modified with the WMA Technology additive or modifier meets the requirements of Section 409.2(a)1 or Section 409.2(a)2 for the specified grade.

4. WMA Technology Additives or Modifiers Blended at the Bituminous Mixture Producer's Plant. Provide a blended bituminous material consisting of an approved WMA Technology additive or modifier from an approved manufacturer and source listed in Bulletin 15 that is blended with a base bituminous material of the specified grade conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder, AASHTO M 320, except as revised in Bulletin 25 and from an approved source listed in Bulletin 15, Section 702. Prepare a Producer QC Plan as specified in Section 106 and conforming to the Producer QC Plan requirements in Section 409.2(e)1.a and the additional Producer QC Plan requirements within this specification. Provide certification that the bituminous material blended with the WMA Technology additive or modifier at the bituminous mixture production plant meets the requirements of Section 409.2(a)1 or Section 409.2(a)2 for the specified grade.

(e) Mixture Composition for Standard and RPS Construction.

1. Virgin Material Mixtures. Section 409.2(e)1. Replace the first paragraph with the following:

Size, uniformly grade, and combine aggregate fractions, bituminous material, and either WMA Technology additive(s) or modifier(s) in proportions to produce a JMF that conforms to the material, gradation, and volumetric Superpave Asphalt Mixture Design requirements as specified in Bulletin 27, Chapter 2A, for the specified nominal maximum aggregate size and design ESALs except as procedurally modified by the WMA Technology Manufacturer Technical Representative (Technical Representative) to address laboratory procedures when preparing, compacting and testing WMA mixtures and to achieve a uniform blend. Special additive(s) or modifier(s) need not be used if mixture temperature, workability, and compaction can be achieved solely through plant mechanical modification to produce foamed asphalt. Develop a Hot Mix Asphalt (HMA) JMF and incorporate the WMA Technology additive, modifier, or process into that JMF during production. Do not develop a volumetric WMA JMF based on incorporating the WMA Technology additive, modifier or process during the volumetric asphalt mixture design process. For tracking purposes, create a separate WMA JMF cover sheet (TR-448A) for approval containing the WMA Technology used, additive dosage rate or percent water added for foaming, material code, and the TSR data from the WMA moisture sensitivity testing.

1.a.2. Testing Plan with Action Points. Section 409.2(e)1.a.2. Add the following additional bullets:

- Blended bituminous material lot size/quantity and lot designation method.
- List of all tests to be performed on the blended bituminous material.

- Testing and certification of the blended bituminous material and WMA Technology additive or modifier for conformance to Section 409.2(a)1 or Section 409.2(a)2.
- Frequency of testing of the blended bituminous material.
- List action points to initiate corrective procedures for the blended bituminous material.
- Recording method to document corrective procedures for the blended bituminous material.
- Handling and disposition of blended bituminous material failing to meet the bituminous material specification requirements.

1.a.3. Materials Storage and Handling. Section 409.2(e)1.a.3. Add the following additional bullets:

- WMA Technology additive or modifier manufacturer name, WMA Technology name, and source as listed in Bulletin 15.
- WMA Technology additive or modifier storage and handling prior to blending.
- All measuring, conveying and blending devices for the WMA Technology and anti-strip additive (if required), including calibration procedures.
- WMA Technology additive or modifier and anti-strip additive (if required) method of introduction, dosage rates, blending with the bituminous material and method of automation, recordation and print outs.
- Storage and handling of the blended bituminous material with the WMA Technology additive or modifier.
- WMA production temperature range for normal paving and any specific temperature ranges for special conditions or situations.
- WMA laboratory compaction temperature for QC volumetric analysis. Determine the SGC compaction temperature for the mix design which yields the same target air voids as the related HMA mixture.

1.c. Annual JMF Verification. Section 409.2(e)1.c. Add the following:

Perform annual verification of the WMA mixture JMF even if the equivalent HMA mixture JMF was previously annually verified.

1.d. Production. Section 409.2(e)1.d. Add the following:

Prepare and test WMA mixtures, including SGC specimens for quality control using the same test methods, procedures and frequencies as specified for HMA, except as modified by the Producer QC Plan. Maintain records of the testing of WMA and make available for review by the Representative when requested.

1.d.6 Degree of Particle Coating. For all WMA mixtures, sample the mixture according to PTM No. 1 and at the frequency in the Producer QC Plan. Examine the completed WMA mixture for particle coating. Produce a WMA mixture with fully coated particles. Increase the plant mixing time or make other plant adjustments if particle coating is deficient. Produce a WMA mixture capable of being handled, placed, and compacted without stripping the bituminous material from the aggregate.

Table A
Job-Mix Formula
Composition Tolerance Requirements of the Completed Mix

Section 409.2(e), Table A. Revise the Temperature of Mixture (F) requirements as follows:

Temperature of Mixture (F)				
Class of Material	**Type of Material**	**Chemical, Organic, Foaming Additives Minimum***	**Mechanical Foaming Equipment/Process Minimum***	**Maximum***
PG 58-28	Asphalt Cement	215	230	310
PG 64-22	Asphalt Cement	220	240	320
PG 76-22	Asphalt Cement	240	255	330
All other Binders	Asphalt Cement	The higher of 215 or the minimum temp. specified in Bulletin 25 minus 45	The higher of 230 or the minimum temp. specified in Bulletin 25 minus 30	As specified in Bulletin 25
* Outline in the Producer QC Plan and follow any additional temperature requirements provided by the Technical Representative for production and placement of the mixture. Determine the SGC compaction temperature for the mix design which yields the same target air voids as the related HMA mixture. Include the SGC compaction temperature in the Producer QC Plan. Compact the completed mixture in the SGC for QC volumetric analysis at the SGC compaction temperature according to the guidelines provided by the Technical Representative.				

(g) WMA Technologies (Additive(s), Modifier(s), or Processes) and WMA Manufacturers. Produce the WMA mixture using approved or provisionally approved WMA Technologies, including additives, modifiers or processes from manufacturers listed in Bulletin 15. If blending WMA additives or modifiers with bituminous material, provide bituminous material blended with the WMA additive or modifier according to Section 411.2(a)3 or Section 411.2(a)4. For WMA Technology additives or modifiers blended with the bituminous mixture at the bituminous mixture production plant, prepare a QC Plan as specified in Section 106 and also conforming to the additional Producer QC Plan requirements within this specification. Submit the QC Plan to the DME/DMM annually and at least 3 weeks before the planned start of the blending of WMA Technologies with bituminous material. Do not start blending until the DME/DMM reviews the QC Plan.

(h) Anti-Strip Additives. Incorporate a liquid anti-strip additive at the same dosage rate as the dosage rate for the HMA JMF for which the WMA JMF is based. If the WMA Technology includes an anti-strip additive as part of its WMA Technology, additional liquid anti-strip additive is not required in mixtures where the moisture sensitivity analysis cannot be performed as specified in Section 411.2(e)1. If the WMA Technology includes an anti-strip additive as part of its WMA Technology and moisture sensitivity analysis can be performed according to Section 411.2(e)1 add additional anti-strip additive or make other adjustments to the JMF and meet the specified moisture sensitivity requirements. Use either a compatible, heat stable, amine-based liquid anti-strip or a compatible alternate anti-strip additive.

(i) WMA Technology Manufacturer Technical Representative (Technical Representative). Identify and provide a Technical Representative that is knowledgeable in how the WMA Technology will affect the storage, handling, blending, mixture production, mixture QC testing, placement, and compaction requirements of the mix. Either have the Technical Representative present during the initial production of the WMA and subsequently at the project location during the initial placement operations or, if not required to be on site, on-call and capable of being in direct, verbal contact with the Producer, Contractor, and/or Department Representative within 2 hours after initial contact. Have the Technical Representative review and sign the Producer's QC Plan and include their current direct contact telephone numbers (office and mobile) in the Producer's QC Plan. If unable to sign the QC Plan, have the Technical Representative submit documentation that supports all of the data outlined in Sections 411.2(e)1.a.2 and 411.2(e)1.a.3.

If the WMA Producer is using a fully approved (not provisionally or conditionally approved) WMA Technology listed in Bulletin 15 and the WMA Producer has previously produced WMA mixture using the WMA Technology to the satisfaction of the DME/DMM responsible for the production plant, a Technical Representative is not required to be present during the production and placement of the WMA material. During all WMA production and placement operations, have the Technical Representative identified in the Producer's QC Plan remain on-call for technical support.

If the WMA Producer is using a provisionally or conditionally approved WMA Technology listed in Bulletin 15 or is using a fully approved WMA Technology for the very first time, have a Technical Representative present at the

plant during initial production and subsequently at the project location during initial placement of the specified WMA pavement course. Have the Technical Representative present at the project location until at least 1 lane mile of the specified pavement course has been placed and compacted. If there are no apparent technical issues, request that the Department Representative agree to release the Technical Representative from being present on-site. The Department may direct that a Technical Representative is not required to be present on-site during initial production and placement operations for provisionally or conditionally approved WMA Technologies. If the Department directs a Technical Representative is not required to be present on-site, have the Technical Representative identified in the Producer's QC Plan remain on-call for technical support.

(j) WMA Mixture Production, Delivery and Placing Temperatures When Placing Over Membrane Systems Specified in Section 467 or Section 680. If a project includes an item or items of work for membrane systems, as specified in Section 467 or Section 680, produce and place WMA on top of the membrane at elevated mixture temperatures as per the membrane manufacturer's recommendation. Ensure proper adhesion between the asphalt pavement overlay and the underlying membrane.

411.3 CONSTRUCTION—Section 409.3 with additions and modifications as follows:

(a) Preplacement Requirements.

1. Paving Operation QC Plan: Section 409.3(a)1. Add the following:

Prepare and submit additional information specifically related to all aspects of the field control of WMA concrete paving operations to the Representative as part of the paving operation QC Plan that addresses all recommendations and direction from the Technical Representative. Do not incorporate any material delivered outside the temperature limits specified in Table A. Describe the construction equipment and methods necessary to control the WMA paving operations including the testing, delivery, placement, compaction, and protection of the WMA concrete courses for all placement applications including handwork as specified in Section 409.3.

(c) Bituminous Mixing Plant. Section 409.3(c). Add the following:

Make any plant modifications needed to introduce the WMA Technology additives, modifiers, or processes according to specific recommendations and direction from the Technical Representative or process manufacturer to achieve a uniform blend of the WMA Technology additive, modifier or foaming process and produce a WMA mixture meeting these specifications.

1. Batch Plant. Section 409.3(c)1. Replace the last sentence with the following:

Dry the aggregate according to the specific recommendations and direction from the Technical Representative and heat to a suitable temperature so that the resulting completed mixture temperature is within the mixture temperature recommended by the Technical Representative or manufacturer and Table A. Ensure that the aggregate is free of unburned fuel oil and excess moisture as defined in Section 409.2(e)1.d.1 when delivered to the pug mill.

2. Drum Mixer Plant. Section 409.3(c)2. Replace the last sentence with the following:

Produce a completed mixture that is within the mixture temperature range recommended by the Technical Representative or manufacturer and Table A. Ensure that the aggregate and completed mixture is free of unburned fuel oil and excess moisture as defined in Section 409.2(e)1.d.1.

411.4 MEASUREMENT AND PAYMENT—Section 409.4 with modifications as follows:

(a) Standard WMA Construction.

1. WMA Courses. Section 409.4(a)1. Replace with the following:

1.a Superpave Asphalt Mixture Design, WMA Wearing Course. Square Yard or Ton

1.b Superpave Asphalt Mixture Design, WMA Wearing Course (Scratch). Ton

1.c Superpave Asphalt Mixture Design, WMA Wearing Course (Leveling). Ton

1.d Superpave Asphalt Mixture Design, WMA Binder Course. Square Yard or Ton

1.e Superpave Asphalt Mixture Design, WMA Binder Course (Leveling). Ton

(b) WMA RPS Construction. Square Yard or Ton

SECTION 419—STONE MATRIX ASPHALT MIXTURE DESIGN, RPS CONSTRUCTION OF PLANT-MIXED HMA/WMA WEARING COURSES

419.1 DESCRIPTION—This work is the RPS construction of plant-mixed Stone Matrix Asphalt (SMA), on a prepared surface using a volumetric mixture design developed with the Superpave Gyratory Compactor. The SMA is to be produced as either HMA or WMA as indicated, with the WMA produced using an approved WMA technology.

419.2 MATERIALS—

(a) Bituminous Material

1. Virgin Mix. Furnish material conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder, AASHTO M 320, except as revised in Bulletin 25. Obtain material from a source listed in Bulletin 15 for the specified grade. Provide QC testing and certification as specified in Sections 106.03(b) and 702.1(b) 1. Provide the Representative a copy of a Bill of Lading for bituminous material on the first day of paving and when the batch number changes.

When producing a mixture with a WMA technology, adhere to the following requirements:

1.a WMA Technology Additives or Modifiers Blended at the Bituminous Material Supplier's Refinery or Terminal. Provide refinery or terminal blended bituminous material blended with a WMA Technology additive or modifier from an approved manufacturer and source listed in Bulletin 15. Include in the bituminous material Producer QC Plan, the WMA Technology additive or modifier manufacturer name, WMA Technology name, and source, dosage rates, blending method, QC testing, corrective action points, disposition of failed material, storage, handling shipping, and bill of lading information following the applicable requirements in Section 702. Include the WMA Technology additive or modifier and dosage rate on the bill of lading. Provide certification that the refinery or terminally blended bituminous material modified with the WMA Technology additive or modifier meets the requirements for the specified grade.

1.b WMA Technology Additives or Modifiers Blended at the Bituminous Mixture Producer's Plant. Provide a blended bituminous material consisting of an approved WMA Technology additive or modifier from an approved manufacturer and source listed in Bulletin 15 that is blended with a base bituminous material of the specified grade conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder, AASHTO M 320, except as revised in Bulletin 25 and from an approved source listed in Bulletin 15, Section 702. Prepare a Producer QC Plan as specified in Section 106 and conforming to the Producer QC Plan requirements in Section 409.2(e)1.a and the additional Producer QC Plan requirements within this specification. Provide certification that the bituminous material blended with the WMA Technology additive or modifier at the bituminous mixture production plant meets the requirements for the specified grade.

(b) Aggregate.

1. General Requirements. Provide aggregate from sources listed in Bulletin 14. Provide aggregate with at least the SRL designation specified. To achieve the specified SRL, the Contractor may provide a blend of two aggregates if the blend has an SRL designation equal to or better than that specified. Blends are 50% by weight of each aggregate. Blend the aggregates using an approved method.

2. Fine Aggregate. Section 703.1, except as follows: Determine Sand Equivalent Value in accordance with AASHTO T 176 and meet requirements of 45% minimum sand equivalent. Do not exceed 15% sodium sulfate soundness loss in five cycles. Determine the uncompacted void content in accordance with AASHTO T 304, Method A, or use the value listed in Bulletin 14. Provide a fine aggregate that meets 45% minimum uncompacted void content.

3. Coarse Aggregate. Type A, Section 703.2, except as follows: Meet the aggregate quality requirements of Table A.

TABLE A
Coarse Aggregate Quality Requirements

Characteristic	Required Values
Abrasion, Max. %	35
Flat and Elongated Particles, Max % ASTM D4791 (measured by mass, on material retained on and above the 4.75 mm (No.4) sieve) 3 to 1 5 to 1	 20 5
Absorption, Max % AASHTO T 85	2.0
Crushed Fragments, Min. %	100 for one fracture face 90 for two fracture faces

(c) Mineral Filler. Furnish mineral filler consisting of finely divided mineral matter such as rock or crushed limestone dust free of organic impurities. Furnish material with a maximum plasticity index of 4 and conforming to the grading requirements of AASHTO M 17. Submit a hydrometer analysis performed as indicated in AASHTO T 88 for mineral filler.

(d) Stabilizer. Provide mineral fiber, cellulose fiber, or crumb rubber (CR) stabilizers conforming to the requirements below and added at a rate specified in Table B. Use the dosage rate prescribed in the JMF.

1. Requirements for All Fiber Types. Fibers must prevent draindown in the mixture according to the tolerances in Table B. Use a fiber of the type and properties appropriate to the plant's metering and delivery system.

2. Cellulose Fibers. Fibers must be of sufficient quality to prevent mixture draindown.

3. Cellulose Pellets. Use cellulose fiber stabilizing additive in pellet form that disperses sufficiently at mixing temperature to blend uniformly into the asphalt mixture. Use pellets that do not exceed 0.25 inch average 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 122F.

Note: If the binder material constitutes more than 3% of the pellet weight, base the dosage rate on the net fiber content.

4. Mineral Fibers. Use mineral fibers made from virgin basalt, diabase, slag, or other silicate rock. Use an approved mineral fiber meeting the following requirements for shot content, as tested according to ASTM C612.

Sieve	Percent Passing
250 µm (No. 60)	85 - 95
63µm (No. 230)	60 - 80

5. Crumb Rubber (CR). Use CR derived from the processing of recycled tires. Rubber tire buffings produced by the retreading process qualify as a source of CR. Furnish processed, free flowing CR from a manufacturer listed in Bulletin 15, certified as specified in Section 106.03(b)3.

5.a Gradation. Meet the following gradation as determined according to ASTM D5461 using 200 mm diameter sized sieves and maintaining a maximum allowable loss after sieve analysis of 7.65%. As an alternative dry sieve analysis test method, perform the sieve analysis of the CR according to Florida Test Method, FM 5-559.

CR Gradation

Sieve Size	Percent Passing
4.75 mm (No. 4)	100
2.36 mm (No. 8)	98-100
75 µm (No. 200)	0-3

5.b Contaminants. Provide CR relatively free from fabric, wire, cord, and other contaminating materials to

a maximum total contaminant content of 2.5% (maximum of 1.0% iron, 1.0% fiber, and 0.5% other contaminants by weight of total CR sample components).

Remove rubber particles from the fiber balls before weighing. Determine the metal content by thoroughly passing a magnet through a 50 ± g (1.76 ± 0.004 ounces) sample. Determine fiber content by weighing fiber balls, which are formed during the gradation test procedure.

(e) Mixture Composition.

1. Virgin Material Mixtures. Design and control SMA in accordance with the requirements of Bulletin 27, Chapter 2B. Size, uniformly grade, and combine aggregate fractions, bituminous material, and an approved WMA Technology when WMA is indicated in such proportions that the total aggregate and bitumen in the JMF conform to the material, gradation, and volumetric requirements for the SMA mixture specified in Tables B and C. Do not use RAP in the mix.

For WMA mixtures, the WMA Technology Manufacturer Technical Representative (Technical Representative) will address laboratory procedure modifications necessary to prepare, compact, and test WMA mixtures and to achieve a uniform blend. When WMA is indicated, develop a HMA JMF and incorporate the WMA Technology additive, modifier, or process into that JMF during production. Do not develop a volumetric WMA JMF based on incorporating the WMA Technology additive, modifier or process during the volumetric asphalt mixture design process. For all WMA JMFs, perform moisture susceptibility analysis according to Bulletin 27. Ensure the WMA Technology additive, modifier, or process is not detrimental to the moisture resistance of the mixture. For tracking purposes, create a separate WMA JMF cover sheet (TR-448A) for approval containing the WMA Technology used, WMA Technology dosage rate, material code, and the AASHTO T 283 (TSR) data from the WMA moisture susceptibility testing.

TABLE B
Mix Design Requirements for SMA Mixtures

AGGREGATE GRADATION REQUIREMENTS, PERCENT PASSING		
Sieve Size	**9.5-mm Mixture**	**12.5-mm Mixture**
19.0 mm (3/4 inch)	-	100
12.5 mm (1/2 inch)	100	90 – 99
9.5 mm (3/8 inch)	75 – 95	70 – 85
4.75 mm (No. 4)	30 – 50	28 – 40
2.36 mm (No. 8)	20 – 30	18 – 30
1.18 mm (No. 16)	-	-
600 μm (No. 30)	-	-
300 μm (No. 50)	-	-
150 μm (No. 100)	-	-
75 μm (No. 200)	8 – 13	8 – 11
VOLUMETRIC DESIGN REQUIREMENTS		
Design Gyrations (N_{design})	100	
Voids in Mineral Aggregate	18.0 % Minimum	
Voids in Course Aggregate (VCA)	$VCA_{mix} < VCA_{dry\ rodded}$	
Design air voids	3.5 - 4.0 %	
Minimum asphalt binder content	Table C	
Binder grade	PG 76-22	
Stabilizer content	Cellulose: 0.2 to 0.4 % by total mix weight Mineral: 0.3 to 0.4 % by total mix weight CR: 0.3 to 1 % by total mix weight	
Draindown	0.3 % maximum	

TABLE C
Minimum Asphalt Binder Requirements for SMA Mixtures

Combined Aggregate	**Minimum Asphalt Content,**

Bulk Specific Gravity	% by Total Mix Weight
2.40	7.4
2.45	7.2
2.50	7.1
2.55	7.0
2.60	6.8
2.65	6.7
2.70	6.6
2.75	6.5
2.80	6.4
2.85	6.3
2.90	6.2
2.95	6.1
3.00	6.0

Perform draindown testing according to AASHTO T 305 using a 1 hour reading. Design a mix meeting the tolerances outlined in Table B.

Design each SMA mix within the job-mix tolerances specified in Tables B and C. Test the materials, proportions, and the mixture at the HMA plant laboratory.

Submit a copy of each completed JMF, signed by a certified HMA Level 2 plant technician, to the DME/DMM at least 3 weeks before the planned start of mixture production. Include a list of all material sources and the HMA producer in the JMF. Provide the calibration factors (C_f and 200 C_f) required by PTM No. 757 with the JMF. Do not start mixture production until after the DME/DMM reviews the JMF.

Submit a new JMF with a change in material sources or if a new JMF is necessary to produce an SMA mixture conforming to this specification.

1.a Producer QC Plan. Section 409.2(e)1.a for HMA and Section 411.2(e)1.a for WMA, except RAP/RAS/RAM is not allowed in the mixture.

1.b Plant Technicians. Section 409.2(e)1.b

1.c Annual JMF Verification. During initial production of each JMF, verify, according to the QC Plan, that the mixture conforms to this specification. If the mixture does not conform to the single and multiple sample tolerances in Tables D and E within 2 days of production, suspend shipping the mixture to the project. Do not ship the mixture to the project until after the Representative reviews and verifies that results conform to the single and multiple sample tolerances in Tables D and E. Perform annual verification of the WMA mixture JMF even if the equivalent HMA mixture JMF was previously annually verified.

1.d Production. Section 409.2(e)1.d, except as follows :

When producing WMA, produce and test mixtures, including Superpave Gyratory Compactor (SGC) specimens for quality control using the same test methods, procedures and frequencies as specified for HMA, except as modified by the Producer QC Plan. Maintain records of the testing of WMA and make available for review by the Representative when requested.

1.d.3 Gradation. Section 409.2(e)1.d.3, except RAP and RAS are not allowed. Produce the mix within the tolerances of Table D.

1.d.5 Volumetric Analysis of Compacted Specimens. Sample the completed mixture according to PTM No. 1 and at the frequency in the producer QC Plan. Prepare a minimum of two specimens from each sample according to AASHTO T 312.

Produce a mixture with volumetric properties conforming to the tolerances of Table E. Determine the bulk specific gravity of the specimens as specified in AASHTO T 312 and calculate air voids (V_a) and Voids in Mineral Aggregate (VMA) at N_{design} according to AASHTO R 35 and as specified in Bulletin 27. Determine compliance with the multiple specimen tolerances using the average of the results for all specimens prepared from the sample.

1.d.6 Mixture Draindown. Sample the completed mixture according to PTM No. 1 a minimum of once daily. Perform draindown testing according to AASHTO T 305 along with the first mixture samples for each day's production. Produce a mixture that meets the tolerances of Table D.

1.d.7 Degree of Particle Coating. For all WMA mixtures, sample the mixture according to PTM No. 1 and at the frequency in the Producer QC Plan. Determine the degree of particle coating of the completed WMA mixture according to AASHTO T 195. Produce a WMA mixture with percent coated particles ≥ 95.0%. Increase the plant mixing time or make other plant adjustments if the required percent of coated particles is not met. Produce a WMA mixture capable of being handled, placed, and compacted without stripping the bituminous material from the aggregate.

TABLE D
Composition Tolerance Requirements of the Completed Mix

		Single Sample (n = 1)	**Multiple Samples (n ≥ 3)**
Gradation			
Passing 9.5 mm (3/8 inch) and Larger Sieves		±5%	±4%
Passing 4.75 mm (No. 4) to 150 µm (No. 100) Sieves (Inclusive)		±4%	±3%
Passing 75 µm (No. 200) Sieve		±3.0%	±2.0%
Asphalt Content			
% Asphalt by Weight		±0.7%	±0.4%
Draindown			
% by Weight		0.3 % maximum	
Temperature of Mixture (F)			
Class of Material	**Type of Material**	**Minimum**	**Maximum**
PG 76-22	Asphalt Cement (HMA)	285	330
PG 76-22	Asphalt Cement (WMA)	260	330

TABLE E
Volumetric Tolerance Requirements of the Laboratory Compacted Mix

	Single Specimen (n = 1)	**Multiple Specimens (n ≥ 2)**
Air Voids at N_{design} (V_a)	±2.0% from JMF	±1.5% from JMF
Minimum VMA	17.0	_

1.e Corrective Actions. Immediately take corrective actions if one or more of the following occurs:

- QC test results on a single sample (n=1) for percent passing the 4.75 mm (No. 4) sieve, the 2.36 mm (No. 8) sieve, the 75 µm (No. 200) sieve, or asphalt content are not within the tolerances in Table D.
- The average of multiple samples (n≥ 3) for percent passing any sieve or asphalt content, as determined according to Section 419.2(e)1.d, are not within the tolerances in Table D.
- QC test results on a single specimen (n=1) or on multiple specimens (n≥ 2) are not within the tolerances in Table E.
- Draindown test result(s) are not within the tolerances in Table D.
- Independent Assurance (IA) or QA sample results from testing at the producer's plant are not within the tolerances of Tables D or E.

After taking corrective actions, sample the completed mixture within 150 tons of production. After sampling, test the mixture and provide test results to the Representative within 500 tons of production. If less than three samples are tested for mixture composition, determine conformance with Table D by comparing each result to the multiple sample tolerances. If the mixture does not conform to the single and multiple sample tolerances in Table D and the single and multiple specimen tolerances in Table E, suspend production and shipping to the project and determine the cause of the problem. Provide a written explanation of the problem and a proposed solution to the Department. After the Representative reviews the proposed solution and authorizes production to continue, resume production and perform JMF verification according to the QC Plan.

(f) Mixture Acceptance.

1. General. The Department will accept the mixtures by lot acceptance as specified in Section 419.3(i)2.

2. Certification. SMA material will not be accepted by certification

(g) WMA Technologies (Additive(s), Modifier(s), or Processes) and WMA Manufacturers. For WMA mixtures, Section 411.2(g)

(h) Anti-Strip Additives. For WMA mixtures, Section 411.2(h)

(i) WMA Technology Manufacturer Technical Representative (Technical Representative). For WMA mixtures, Section 411.2(i)

(j) Mixture Production, Delivery and Placing Temperatures When Placing Over Membrane Systems Specified in Section 467 or Section 680. If a project includes an item or items of work for membrane systems, as specified in Section 467 or Section 680, SMA that is to be placed on top of the membrane must be produced and placed at mixture temperatures as per the membrane manufacturer's recommendations except not to exceed the minimum and maximum limits in Table D. Ensure proper adhesion between the asphalt pavement overlay and the underlying membrane. For WMA mixtures, have the Technical Representative indicate that producing and placing mixture at the membrane manufacturer's recommended temperatures is an acceptable practice for their specific WMA Technology.

419.3 CONSTRUCTION—

(a) Preplacement Requirements. Provide HMA or WMA as indicated for the entire project unless approved by the Department in writing to use both.

1. Paving Operation QC Plan. Prepare a paving operation QC Plan, as outlined on Form CS-409, for field control and evaluation of bituminous concrete paving operations. Submit the QC Plan to the Representative before or at the pre-construction conference. Include in the QC Plan a description of the construction equipment and methods necessary to construct and test the bituminous concrete courses as specified in Section 419.3. For WMA mixes, have the Technical Representative provide all recommendations and direction specific to the WMA technology in the paving operation QC Plan. Do not start paving until after the Representative reviews the QC Plan.

2. Preplacement Meeting. At least 2 weeks before placing bituminous paving mixtures, schedule a bituminous preplacement meeting with the Representative to review at a minimum the specification, paving operation QC Plan, sequence of paving operations, mixture acceptance, density acceptance, and the care and custody of bituminous acceptance samples.

(b) Weather Limitations. Do not place SMA paving mixtures from October 1 to March 31 in Districts 1-0, 2-0 (except Juniata and Mifflin Counties), 3-0, 4-0, 5-0 (Monroe and Carbon Counties only), 9-0 (Cambria and Somerset Counties only), and 10-0; and from October 16 to March 31 in Districts 2-0 (Juniata and Mifflin Counties only), 5-0 (except Monroe and Carbon Counties), 6-0, 8-0, 9-0 (except Cambria and Somerset Counties), 11-0 and 12-0. Exceptions require the written permission of the District Executive. Do not place bituminous paving mixtures when surfaces are wet or when the air or surface temperature is 50F or lower. If work is halted because of weather conditions,

the Representative may allow the Contractor to place limited quantities of mixture that are en route to the project.

(c) Bituminous Mixing Plant. Section 409.3(c), except the following requirements are for SMA mixes.

Obtain bituminous mixtures from a plant fully automated and recordated and currently listed in Bulletin 41. The necessary facilities for inspection include a plant office as specified in Section 714.5(a), except the minimum floor space is 120 square feet.

Ensure that both the aggregates and the completed mixture are free of unburned fuel oil and excess moisture as defined in Section 409.2(e)1.d.1.

For WMA mixtures, make any plant modifications needed to introduce the WMA Technology additives, modifiers, or processes according to specific recommendations and direction from the Technical Representative or process manufacturer to achieve a uniform blend of the WMA Technology additive, modifier or foaming process and produce a WMA mixture meeting these specifications. For batch plants, dry the aggregate according to the specific recommendations and direction from the Technical Representative.

1. Mineral Filler System. Follow the requirements listed in Chapter 1, Section 2.5 of Bulletin 27.

2. Stabilizer Supply System. Add stabilizer through specialized equipment that can accurately proportion and meter, by weight, the proper amount per batch for batch plants, or continuously and in a steady uniform manner for drum plants. Do not feed fiber, pelletized or loose, through the cold feed bins or through the RAP bins.

Provide proportioning devices that are interlocked with the plant system and controlled to ±10% of the weight of the fibers required. During the trial demonstration specified in Section 419.3(g), perform an equipment calibration to the satisfaction of the Representative to show that the fiber is being accurately metered and uniformly distributed into the mix.

Include the following on the stabilizer supply system:

- low level indicators
- no-flow indicators
- a printout of feed rate status in pounds/ minute
- a section of transparent pipe in the stabilizer supply line for observing consistency of flow or feed.

Have the Representative approve all stabilizer addition systems.

When a batch plant is used, add the stabilizer to the aggregate in the weigh hopper and increase both dry and wet mixing times. Ensure that the stabilizer is uniformly distributed before the injection of asphalt cement into the mixture. When a drum plant is used, do not allow the fibers to become entangled in the exhaust system. If there is any evidence of fiber in the bag-house or wet washer fines, relocate the liquid asphalt binder line and/or the fiber line so that the fiber is captured by liquid asphalt spray and incorporated into the mix. If there is any evidence of clumps of fibers or pellets at the discharge chute, increase the mixing time and/or intensity.

Store stabilizer in a dry environment.

3. Hot-Mixture Storage. Ship material within 1 hour of plant mixing. Stored SMA material that does not consistently meet the same quality as material discharged directly into hauling vehicles will be rejected.

(d) Hauling Equipment. Section 409.3(d)

(e) Bituminous Pavers. Section 409.3(e)1.

(f) Rollers. Use a minimum of three steel-wheeled rollers, each weighing a minimum of 10 tons and as specified in Section 108.05(c)3. Operate rollers according to manufacturer's recommendations. Use rollers equipped with a watering or soapy watering system that prevents material from sticking to the rollers. Do not use pneumatic wheeled rollers.

Do not use rollers in vibratory mode unless it can be demonstrated during the trial demonstration specified in Section 419.3(g) and to the satisfaction of the Representative that no breaking of aggregate or flushing of asphalt binder results from the vibration. Monitor pavement cores for aggregate breakage on every lot. Discontinue vibration if aggregate breakage or flushing of asphalt binder occurs.

(g) Demonstration. Before proceeding with the actual work, demonstrate to the Representative that the proposed

SMA mix can be produced, placed, and compacted to meet the requirements of this specification. Place a minimum of 100 tons outside the project limits for each trial demonstration. Simulate the hauling time for the demonstration. Obtain and test three loose mixture samples at the plant for asphalt content, gradation, and draindown and three pavement cores from the demonstration pavement for density. Test one set of volumetric specimens for Air Voids at N_{design} (V_a) and test for one maximum specific gravity of the mixture value. If test results do not meet specification limits for both single and multiple sample tolerances for any parameter, perform another demonstration.

This work is incidental to the wearing course. If vibratory rolling is proposed, demonstrate to the satisfaction of the Inspector-in-Charge that no breaking of aggregate or flushing of asphalt binder results from the vibration.

(h) Preparation of Existing Surface. Section 409.3(g)

(i) Spreading and Finishing.

1. General Requirements.

1.a Placing. Unless otherwise allowed, deliver, place, and compact SMA paving mixtures during daylight hours. Ensure the mixture does not contain lumps of cold material. Deliver and place SMA mixtures at the temperatures specified in Table D.

Use a material transfer vehicle (MTV) as specified in Section 108.05(c)5 to apply the final surface course. Have the MTV perform additional mixing of the SMA material and then deposit the mixture into the paver at a uniform temperature and consistency.

1.b Spreading and Finishing. Section 409.3(h)1.b and as follows: Plan and schedule operations to minimize hand work of SMA. Do not allow the finished pavement surface to flush. Flushing is continuous or repeated areas of excessive asphalt on the pavement surface. Areas that are determined to be flushed will be considered defective work.

1.c Field Technician. Section 409.3(h)1.c

2. Mixture and Density Lot Acceptance (RPS Construction). Lot acceptance is required for RPS construction.

2.a Lots and Sublots. Section 409.3(h)2.a except as follows: A completed sublot has either three core samples collected according to PTM No. 1 or two core samples collected according to PTM No. 1 and one loose mixture sample as specified in 419.3(i)2.b.

2.a.1 Partially Completed Lots (n=2 or less). When process conditions change to an extent that a partially completed lot cannot be combined with the most recently completed lot, samples will be independently evaluated on the partially completed lot. If a lot is terminated before a sample point is reached, obtain one sample for mixture acceptance and one sample for mat density acceptance as specified in 419.3(i)2.a at a location provided by the Representative. For asphalt content and percent passing the 75 μm (No. 200) sieve, mixture acceptance samples will be evaluated individually using Section 419.4(a), Table G (n=1) criteria. For density, mat density acceptance samples will be evaluated individually using the criteria in Table F.

If samples tested for asphalt content and percent passing the 75 μm (No. 200) sieve meet the n=1 criteria of Table G, and samples tested for density meet the criteria in Table F, payment will be 100 percent of the contract unit price. If samples tested for asphalt content and percent passing the 75 μm (No. 200) sieve do not meet the n=1 criteria of Table G, the material will be considered defective work. If samples tested for density are no more than 2.0 percent below the minimum or no more than 2.0 percent above the maximum limits of Table F, payment will be 90 percent of the contract unit price. If samples for density are more than 2.0 percent below the minimum or more than 2.0 percent above the maximum limits of Table F, the pavement will be considered defective work.

Unless otherwise directed in writing by the District Executive, remove and replace defective work.

TABLE F
Density Limits for Partially Completed Lots

MIXTURE NMAS	DENSITY LIMITS
All RPS 9.5 mm, 12.5 mm Wearing Courses	≥ 93.0 and ≤ 98.0

2.a.2 For JMF's placed in quantities less than 2,500 tons. For JMFs placed in quantities of greater than 500 tons and less than 2,500 tons the tonnage will be considered a lot. The lot will be divided into five equal sublots.

For JMF's placed in quantities of 500 tons or less, the tonnage will be divided into three equal sublots and sampled as specified in 419.3(i)2.a.

2.b Mixture Acceptance and Theoretical Maximum Specific Gravity (Gmm) Verification Samples. The Inspector will select different sample locations in each sublot according to PTM No. 1, PTM No. 729, and PTM No. 746. In the presence of the Inspector, obtain two core samples (One for acceptance and one for Gmm verification), or one core sample (for acceptance) and one loose mixture sample (for Gmm verification) for each sublot at each sample location and immediately package. If the contractor elects to obtain a loose mixture sample for the Gmm verification sample, obtain the sample from uncompacted placed mixture or from the paver screed. One core sample at each location will be used to determine the mixture acceptance and the second core sample or the loose mixture sample at each location will be used to determine the theoretical maximum specific gravity (Gmm) value. Both sets of mixture samples will be submitted to the testing laboratory on separate TR-447 sample identification forms.

Package individual loose mixture samples in cardboard boxes dimensioned approximately 3 3/4 inches x 4 3/4 inches x 9 1/2 inches. Do not package samples in cardboard boxes with any one dimension greater than 10 1/4 inches or any one dimension smaller than 3 1/2 inches. Package individual core samples in plastic 6 inch diameter concrete cylinder molds.

Immediately after packaging and in the presence of the Inspector, identify the samples by ECMS project number, lot and sublot number, location (station and offset), date of placement, mixture type, and as either mixture acceptance samples (Sample Class AS) or as Gmm verification samples (Sample Class FV). Leave at least one side of the cardboard sample box or cylinder mold free of any writing or marking for LTS use in testing the samples.

Immediately after identifying, submit the samples to the Inspector.

For quality control purposes, a maximum of one loose sample per sublot may be obtained. No loose mixture or core samples may be taken by the Contractor for mixture composition testing after the mixture acceptance samples and Gmm verification samples are obtained. Do not obtain any other pavement samples, except those which are directed by and surrendered to the Department, unless allowed in writing from the District Executive.

2.c Mixture and Density Acceptance Sample Testing. LTS Testing will be utilized unless otherwise indicated in the contract.

2.c.1 LTS Testing. The LTS will test the density acceptance samples according to PTM No. 715, and if necessary PTM No. 716, to determine the percent compaction. The LTS will analyze the bulk density test results for extreme values according to PTM No. 4 at the 5% significance level. If discarding an extreme value reduces a lot to less than three remaining test results, the Department will accept the lot as specified in Section 419.3(i)2.a.1.

The LTS will then randomly select one of the Gmm verification cores or loose mixture samples obtained as specified in Section 419.3(i)2.b from the lot according to PTM No. 1. The LTS will test the randomly selected Gmm verification core or loose mixture sample to determine the theoretical maximum specific gravity (Gmm) of the compacted mixture according to AASHTO T 209 as modified in Bulletin 27, with the following exception:

- The samples will be obtained as specified in Section 419.3(i)2.b.

The LTS will compare the randomly selected Gmm verification sample test result with the Contractor's daily Gmm value for that same production or placement date. If the LTS and Contractor Gmm values do not differ by more than ±0.030, the Contractor's daily Gmm values in the whole lot will be considered verified and the Contractor's daily Gmm values will be used to determine the percent of theoretical maximum density for each density acceptance sample placed on that date. If the initial randomly selected LTS Gmm verification sample test result differs from the Contractor's daily Gmm value for that same production or placement date by more than ±0.030, the LTS Gmm test result value will be used as the acceptance Gmm value to determine the percent of theoretical maximum density for the individual density acceptance cores produced or placed on that same date. The Department reserves the right to select more than one Gmm verification sample from the lot representing the same production or placement date and to select other Gmm verification samples from the lot representing different production or placement dates to verify the Contractor's daily Gmm values. When more than one Gmm verification sample is selected from the lot representing the same production or placement date, the LTS Gmm test results will be averaged and the averaged used to verify to the Contractor's daily Gmm value for that same production and placement date.

The Department will accept density lots with three or more test results as specified in Section 419.4(a)3.

The LTS will test the mixture acceptance samples according to PTM No. 757 or PTM No. 702, Modified Method D, if previously identified problematic aggregates are used in the mixture, to determine asphalt content and the percent passing the 75 μm (No. 200) sieve. For PTM No. 757, the LTS will use the calibration factors (C_f and 200 C_f) provided with the JMF. The LTS will analyze the test results for extreme values according to PTM No. 4 at the 5% significance level. If discarding an extreme value reduces a lot to less than three remaining test results, the Department will accept the lot as specified in Section 419.3(i)2.a.1. The Department will accept lots as specified in Section 419.4(a).

Stop all paving operations if any of the following conditions exist:

- cores are not taken within 1 day after placing the mixture
- the density for two consecutive lots or a total of three lots does not meet the density payment factor percentage of 100
- asphalt content is not within the single sample (n=1) or multiple sample (n≥3) tolerances in Table D for two consecutive lots or a total of three lots
- the percent passing the 75 μm (No. 200) sieve is not within the single sample (n=1) or multiple sample (n≥3) tolerances in Table F for two consecutive lots or a total of three lots
- the pavement exhibits flushing as outlined in 419.3(i)1.b.

Determine the cause of the problem and provide a proposed solution to the Department. Do not resume paving until the Representative reviews the proposed solution and authorizes production to continue.

(j) Compaction. Begin rolling material immediately after placement. Compact the SMA mixture to achieve the density acceptance requirements and to eliminate all roller marks while not producing flushing of the asphalt binder. Compact the mixture while it is in proper condition and adjust roller speed, pattern, and roller size (and/or amplitude and frequency if vibratory rolling is approved by the Representative) to eliminate displacement, shoving, cracking, and aggregate breakage as specified in Section 419.3(f). Satisfactorily correct displacement resulting from reversing roller directions and other causes.

Without using excess water, maintain wheels of steel-wheel rollers moist and clean to prevent the mixture from adhering to the wheels.

For areas inaccessible to rollers, compact with mechanical vibrating hand tampers.

(k) Mat Density Acceptance. The Department will accept the mixtures by lot acceptance as specified in Section 419.3(i)2. The acceptance criteria will be as shown in Table F. The Department will determine acceptance with respect to density, as specified in Section 419.4(a)3.

The Inspector will select different sample locations in each sublot according to PTM No. 1, PTM No. 729, and PTM No. 746. With the Inspector present, drill 6-inch diameter cores as soon as possible but no later than the day following placement. The core at each location will be used to determine the bulk specific gravity (Gmb) and density (pounds per cubic foot) of the compacted mix. Do not compress, bend, or distort samples during cutting, handling, transporting, and storing. If samples are damaged, immediately obtain replacement samples, as directed by the Inspector, from within 12 inches of the original sample location. Within 24 hours after coring, backfill the hole with mixture of the same JMF or with mixture used for subsequent courses and compact and seal the mixture.

In the presence of the Inspector, identify the samples by ECMS project number, lot and sublot number, location (station and offset), date of placement, mixture type, and as acceptance samples (Sample Class AS). Provide the daily theoretical maximum specific gravity value from Section 419.2(e)1.d.4 for the density calculation of the lot. If density samples from the lot are taken from more than 1 day's placement, the daily theoretical maximum specific gravity values from each production day will be used to calculate the percent of theoretical density for each individual density acceptance core placed on that production day upon Gmm verification as described in Section 419.3(i)2.c.1. Immediately deliver the samples to the Inspector and provide sample containers of sufficient strength to prevent samples from being damaged during transport and sufficient size to accommodate the density samples from one lot. The Representative will submit samples for one lot in one container.

For quality control purposes, a maximum of one pavement core per sublot may be obtained unless the Representative allows additional cores. No cores may be taken by the Contractor after the acceptance cores are obtained. Do not obtain any other pavement cores, except those which are directed by and surrendered to the Department, unless allowed in writing by the District Executive

(l) Joints. Section 409.3(k).

(m) Surface Tolerance. Section 409.3(l)

(n) Tests for Depth. Section 409.3(m)

(o) Protection of Courses. Section 409.3(n)

(p) Defective Work. As specified in Section 105.12 and as follows:

Department acceptance and QA testing does not relieve the Contractor of responsibility for material or workmanship that the Representative determines is defective before the Department issues the acceptance certificate. Remove and replace or repair defective work as directed. The CMD will review Representative determinations of defective material or workmanship.

Unless otherwise directed in writing by the District Executive, remove and replace pavement defective for flushing as specified in Section 419.3(i)1.b, surface tolerance as specified in Section 409.3(l) and depth as specified in Section 409.3(m). Remove and replace pavement defective for percent within tolerance or Payment Factor Percentage as specified in Table F.

419.4 MEASUREMENT AND PAYMENT—

(a) SMA RPS Construction.

1. SMA Wearing Course RPS. Square Yard or Ton

2. Bituminous Tack Coat. Section 460.4.

3. Mixture and Density Acceptance by Lot using Pavement Cores. The Department will pay on a lot-by-lot basis at the contract unit price, adjusted for Payment Factor Percentages as specified in Table G. For the payment factor percentages based on percent within tolerance, the Department will determine the percent within tolerance according to Section 106.03(a)3, using the upper and lower specification limits in Table H.

3.a Payment. Section 409.4(a)4.a

TABLE G
Contract Price Adjustments

Test Criteria	Test Value	Payment Factor Percentage
Asphalt Content		
Acceptance Sample testing of % Asphalt	All acceptance sample test results are within ±0.7% for n=1 and ±0.4% for n≥ 3 of the JMF	100
	Percent Within Tolerance if all acceptance sample test results are not within ±0.7% for n=1 and ±0.4% for n≥ 3 of the JMF	Section 409.4(a) Table K
Gradation		
Acceptance Sample Testing of % Passing 75 µm (No. 200) Sieve	All acceptance sample test results are within +4.0% and -2.0% for n=1, and +3.0% and -1.5% for n≥ 3 of the JMF	100
	Percent Within Tolerance if all acceptance sample test results are not within +4.0% and -2.0% for n=1, and +3.0% and -1.5% for n≥ 3 of the JMF	Section 409.4(a) Table K
Mat Density		
Acceptance Sample Testing of Pavement Cores	All individual results for the lot are ≥ 93.0 % and ≤ 98.0 % of the maximum theoretical density	100

	Percent Within Tolerance if any individual sublot test result for the lot is not ≥ 93.0 % and ≤ 98.0 % of the maximum theoretical density.	Section 409.4(a) Table K

TABLE H
Upper and Lower Specification Limits for Calculating Percent Within Tolerance

Testing Criteria	
Lower Specification Limit (L)	**Upper Specification Limit (U)**
Asphalt Content from JMF Value, %	
-0.4	+0.4
Percent Passing the 75 µm (No. 200) sieve from JMF Value, %	
-1.5	+3.0
Mat Density*	
92.0	98.0
* The Percent of Theoretical Maximum Density	

3.b Dispute Resolution. For mixture acceptance testing or density acceptance testing performed by the LTS, the Contractor may request in writing that the Department retest a lot if the initial test results indicated a defective lot (remove and replace) except for density when one or more density acceptance cores in the lot were coated with paraffin wax as a result of PTM No. 716 during the original density acceptance testing. Provide written retest requests to the District Executive within 3 weeks of the date the LTS test results are released. Retests will not be allowed if a written retest request is not received within 3 weeks of the date the LTS test results are released. Provide quality control test results and control charts, companion sample test results (if available), test data trend evaluation, and any other pertinent information to justify the retest request. The Department will evaluate the information and may allow retesting if the information submitted provides a reasonable basis to conclude that the failing test results may not represent the in-place material. The LTS will perform the retest with the Contractor present, unless otherwise agreed to in writing with the Contractor.

For retesting of materials failing for asphalt content or percent passing 75 µm (No. 200) sieve, the Inspector will identify the locations where the original mixture acceptance samples were collected. The Inspector will select retest sample locations 24 inches from the original sample locations longitudinally in the direction of traffic. If the 24 inch offset causes the retest sample location to fall outside of the sublot, the Inspector will select the retest sample location 24 inches from the original sample locations longitudinally in the opposite direction from traffic.

With the Inspector present, provide appropriate traffic control and drill 6-inch diameter cores for retesting purposes according to the procedure for drilling in PTM No. 729. Ensure drilling procedures include washing off and towel drying the core samples immediately after drilling. Within 24 hours after coring, backfill the hole with SMA or Superpave mixture of the same NMAS and PG asphalt grade as the material sampled or with mixture used for subsequent courses and compact and seal the mixture. Provide traffic control, core, and backfill the core holes at no cost to the Department. The test method used for asphalt determination during the original acceptance testing (PTM No. 757 or PTM No. 702) will be used for the retest, unless the DME/DMM grants written approval for a change in test method. The results of the retest cores will be used to calculate payment for both asphalt content and percent passing the 75 µm (No. 200) sieve for the lot.

When a request is received for retesting of density acceptance, the original density acceptance cores will be utilized. The LTS will not retest a lot for density acceptance when one or more density acceptance cores in the lot were coated with paraffin wax as a result of PTM No. 716 during the original density acceptance testing. The LTS will retest each original density acceptance core according to PTM No. 715 and PTM No. 716, as necessary, to determine the Gmb and bulk density values. The LTS will not perform Gmm testing for lots where the Contractor's Gmm value was previously considered verified according to Section 409.3(j)4.d.1. After Gmb testing is completed, for lots where the Contractor's Gmm value was not verified, the LTS will select one original density acceptance pavement core from each production or placement date represented by the density acceptance cores in the lot. Each core selected will be the core with the highest bulk density for that production or placement date from the retest results (e.g., if a lot was placed over three production days, and the lot density acceptance cores include at least one core from each production or placement day, the original density cores selected during a density retest to perform Gmm testing

will be 3; one from each production or placement date). The LTS will perform Gmm testing on the selected cores according to AASHTO T 209 as modified in Bulletin 27, with the following exceptions:

- the samples will be obtained as specified in Section 409.3(j)4.c,
- no conditioning, only drying, will be performed on the sample,
- the minimum sample size will be waived, as necessary, to use the 6-inch diameter pavement core sample, and
- the supplemental procedure for mixtures containing porous aggregate will only be performed when either the coarse aggregate or fine aggregate in the mixture has a water absorption value ≥ 1.5% as indicated on the JMF and then only when the calculated percent of theoretical maximum density indicates any one individual failing sublot which results in a density pay factor less than 100.00.

The LTS Gmm value(s) determined will be the Gmm values used to determine the percent of theoretical maximum density for the cores represented by the applicable production or placement dates in the lot. Either the previously verified Contractor's Gmm value(s) or the newly tested LTS Gmm value(s) will be used for acceptance to determine the percent theoretical maximum density for each sublot core in the lot. Upon completing the retesting of the original density acceptance cores, the LTS will evaluate testing repeatability for the bulk density results of PTM No. 715 and PTM No. 716, if necessary, using both the original bulk density test values and the bulk density retest values according to PTM No. 5. After evaluating the testing repeatability, the density test values used to determine the final payment factor percentage for density will be as follows:

- If repeatable, the original test values will be used.
- If lack of repeatability (i.e., non-repeatable), the retest values will be used.

The Department will deduct from the payment the cost per lot associated with conducting a retest as follows in Table I:

TABLE I
Dispute Resolution Retest Cost Table

Test Method	**Mixture Acceptance Retest Cost if Retest Results Indicate 100% Pay Factor(s)**	**Mixture Acceptance Retest Cost if Retest Results Indicate <100% Pay Factor(s)**
PTM No. 702/739	$900	$3,500
PTM No. 757	$500	$2,000
	Density Acceptance Retest Cost if Retest Results Indicate a Lack of Repeatability	**Density Acceptance Retest Cost if Retest Results are Repeatable**
PTM No. 715, or PTM No. 716 only	$200	$750
PTM No. 715, or PTM No. 716, and AASHTO T 209 as specified in Section 409.3(j)4.d.1	$1,100	$4,000

SECTION 420—PERVIOUS BITUMINOUS PAVEMENT SYSTEM

420.1 DESCRIPTION—This work is the construction of plant-mixed bituminous concrete pervious pavement on a prepared surface designed to allow the infiltration of storm water into the subsoil. The pervious bituminous surface layer is a horizontal plane that is permeable to water and air. The second layer of the storm water system is an open graded, angular stone layer that is used for temporary storm water detention.

420.2 MATERIAL—

(a) Aggregate. Section 703

1. Coarse Aggregate.

1.a For use in Bituminous JMF. Course Aggregate, Type A, Section 703.2, except Table C gradation does not apply and revise the following quality requirements of Table B.

- Abrasion, Maximum Percent as specified in Bulletin 27, Chapter 2A, Table 5A
- Thin and Elongated Pieces, Maximum Percent as specified in AASHTO M 323, Table 5, for Flat and Elongated
- Crushed Fragments, Minimum Percent, as specified in AASHTO M 323, Table 5, for Fractured Faces, Coarse Aggregate

1.b For use in Detention Basin. Either AASHTO No. 3 as the primary detention coarse aggregate topped with AASHTO No. 57 as a choker and leveling coarse; or AASHTO No. 57 only, as designed and specified.

2. Fine Aggregate.

2.a For use in Bituminous JMF. Section 703.1, except Table A gradation does not apply and as follows: Determine the un-compacted void content according to AASHTO T 304, Method A, or use the value listed in Bulletin 14, and conform to AASHTO M 323, Table 5. Determine the sand-equivalent value according to AASHTO T 176 and conform to AASHTO M 323, Table 5.

2.b For use in Detention Basin. Fine Aggregate, Type A or Type B.

(b) Fibers. Section 711.3(g)

(c) Geotextile, Class 4, Type A. Section 212

(d) Edge Restraints. Provide asphalt edge restraints (as a locally approved material as specified in Section 106.02(a)2.c) when specified and of sufficient strength to resist lateral roller forces where the pervious asphalt adjoins landscaped areas to provide a clean, durable edge for the pavement. Other edge restraints may be utilized with the approval of the Representative. For manufactured edge restraints, install in accordance with the manufacturer's guidelines. Provide black edge restraints when permanently incorporated into the project.

(e) Bituminous Material.

1. Pervious 9.5 mm Wearing Course. Asphalt Cement, Class PG 70-22 or PG 76-22 as specified in Section 702. Approved polymer additives or ground tire rubber may be used to meet the PG grade.

2. Pervious 19.0 mm Binder Course. Asphalt Cement, Class PG 64-22 as specified in Section 702.

(f) Recycled Asphalt Pavement. Limit RAP to a maximum of 10% of the mixture.

(g) Additives. Incorporate an anti-strip additive or hydrated lime for pervious mixes utilizing the same aggregates as approved 9.5 mm or 19.0 mm dense graded mixtures and with the same PG grade binder where an anti-strip additive

was required. If no history exists for an approved dense graded mixture, perform testing in accordance with ASTM D 3625 on the finished mix with a minimum of 90% coating to determine moisture susceptibility and an anti-strip additive is required.

1. Heat-Stable, Anti-Stripping Additive. Blend the additive with the asphalt cement before adding the additive and asphalt cement to the mixture. Use the manufacturer's recommended dosage of the additive, but not less than 0.25% by weight of the asphalt. Select an additive that does not harm the completed bituminous concrete mixture and that is compatible with the aggregate and asphalt supplied for the project.

2. Pervious Asphalt Stabilizer. Perform testing in accordance with AASHTO T 305 to determine whether a stabilizer is required. When required, provide cellulose fibers in the mixture according to the tolerances in Table B. Stabilizer dosage rate must be within 0.2% to 0.4% by weight of the total mix.

(h) Mixture Design and Production.

1. Design. Size, uniformly grade, and combine aggregate fractions according to Table A. Determine air voids using any method from Table B for bulk specific gravity. Determine the maximum theoretical specific gravity in accordance with AASHTO T 209. Gyrate two specimens in accordance with AASHTO T 312 and determine bulk specific gravity by averaging them, employing one of the methods in Table B to calculate air voids.

Test materials, proportions, and the mixture at the bituminous concrete plant laboratory. Verify conformance with the uniformity requirements of this specification. Verification testing may be performed by the LTS at the Department's discretion. Provide a JMF that conforms to all Department requirements. Submit a copy of the JMF to the DME/DMM at least 3 weeks before the scheduled start of producing the mixture for the project. If the Department has not used the JMF on a previous project, provide test results from previous mixture production that indicate the mixture conformed to all JMF production tolerances when submitting the design for initial review.

TABLE A
Composition of Mixture
(Total Percent by Mass (Weight) Passing Square Openings Based on Laboratory Sieve Tests)

	Pervious 9.5 mm Wearing	**Pervious 19.0 mm Binder**
Sieve Size	**Percent Passing**	**Percent passing**
25.0 mm (1-inch)		100
19.0 mm (3/4-inch)	100	85 - 100
12.5 mm (1/2-inch)	95 - 100	35 - 68
9.5 mm (3/8-inch)	70 - 100	
4.75 mm (No. 4)	20 - 40	10 - 25
2.36 mm (No. 8)	10 - 20	5 - 15
75 µm (No. 200)	0 - 4	0 - 4
Bitumen Content	5.5% - 7.0%	3.0% - 5.0%

TABLE B
Mixture Composition

Gyrations	$N_{initial}$	N/A
	N_{design}	50
	$N_{maximum}$	N/A
Air Voids	ASTM D 6752	16.0% - 20.0%
	AASHTO T 275	18.0% - 22.0%
	AASHTO T 269*	18.0% - 22.0%
Draindown	AASHTO T 305	$\leq$ 0.3%

*When using AASHTO T 269 the height of the specimen will be determined by the gyratory compactor reading at N_{design}.

2. QC Plan. Prepare and submit a QC Plan, as specified in Section 106. Provide the QC plan to the Representative at the start of the project. Do not begin production until receiving approval of the QC Plan from the Representative.

3. Production. Perform QC Tests in accordance with Table C.

TABLE C
Production Testing

Property	Frequency	Range
Asphalt content	Daily	± 0.7%
Gradation	Daily	Table A
Air Voids	Daily	Table B
Draindown	Daily	≤ 0.3% at design compaction temperature

4. Acceptance of the Mixture. Obtain material certifications from the material producer using the results of QC tests for bitumen content, gradation, and air voids. Provide copies of the certifications to the Inspector-in-Charge within 1 working day after performing QC tests.

420.3 CONSTRUCTION—

(a) Test Sections. Produce two test sections using the approved JMF and placement and finishing operations to be used in production and construct at the project site on a prepared subgrade and base, using the material and construction requirements used in production. Each section must have an area of at least 225 square feet. Perform infiltration on both test sections in accordance with ASTM C 1701. The average of both infiltration values must exceed 200 inches per hour. Compacted thickness cannot be more than 1/4-inch less than the design thickness.

(b) Subgrade Preparation. Excavate subgrade to undisturbed soil without compaction, allowing the subgrade to be left as permeable as possible. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, remove the accumulated material using light equipment and scarify the underlying soil to a minimum depth of 6 inches using a spring tooth rake or equivalent and a light tractor. Avoid driving haul trucks or other heavy equipment through the installation area. Repair damaged areas to the satisfaction of the Representative. Do not compact or otherwise subject the existing subgrade under pavement areas to excessive construction equipment traffic before geotextile and stone bed placement. Satisfactorily correct and repair any damaged or compacted areas to the satisfaction of the Representative. Notify the Representative upon completion of subgrade work for final inspection and acceptance before proceeding with basin and choker course installation.

(c) Detention Basin. Prevent sediment from washing into beds during site development. Cover the bottom of the detention base with a minimum of 2 inches of fine aggregate to prevent soils from migrating into the storm water storage area. Wrap basin sides with a non-woven geotextile fabric. Install detention basin coarse aggregate in 8 inch maximum lifts. Compact the course in as specified in Section 360.3. Install aggregates to grades indicated on drawings. Place the specified depth(s) of coarse aggregate on top of the fine aggregate and roll as specified in Section 420.3(f). Remove temporary sediment control materials when the site is fully stabilized.

(d) Asphalt Treated Permeable Base Course. Section 360.3, where required for buses or light trucks.

(e) Weather Limitations. Do not place pervious pavement mixtures when the air or surface temperature is lower than 50F.

(f) Rollers. Use smooth steel-wheeled rollers in the static mode and seat with one to four passes. Do not use pneumatic tire rollers.

(g) Conditioning of Existing Surface. Before placing a wearing course, correct irregularities in the binder course. If practical, do not allow traffic on the binder course to prevent contamination. Remove and replace binder course that cannot be cleaned to the Representative's satisfaction.

Coat existing vertical surfaces of curbs, structures, gutters, and pavements that will be in contact with bituminous mixtures with a thin, uniform coating of bituminous material (AASHTO SS-1, CSS-1, SS-1h, CSS-1h, or AET) applied in two or more applications, or of the class and type designated for the bituminous course.

Do not use a tack coat between lifts of any pervious asphalt. Place the wearing course as soon as practical after the placement of the binder course.

(h) Spreading and Finishing. Use a track paver, as specified in Section 409.3(e), or a mechanical spreader. Spread or strike off the entire for the entire lane width or as much lane as practical. Place the mixture in maximum 4-inch compacted lifts. Adjust screed assemblies to provide the cross section and depth indicated. Construct the profile to the design grade line. Use fully automatic sensors to control profile and transverse grade. Allow the mixture to cool to 100F before placing subsequent layers or pavement courses. Perform handwork at locations directed by the Representative. For multiple lift construction, second lift may be placed and rolled perpendicular to the direction of placement and rolling of the first lift.

Do not use pervious pavement beds for storage of equipment, materials, or soils during construction.

(i) Compaction. Compact the pervious asphalt pavement when the surface is cool enough to resist a 10-ton steel-wheeled static roller or vibratory roller operated in the static mode. Limit compaction to not more than four passes to preclude a reduction in the surface porosity. One roller pass is defined as one trip of the roller in one direction over any one spot. Do not over compact the material to the point that it is not free draining or the aggregate is crushed.

(j) Joints.

1. Longitudinal Joints. Spread the pervious paving course to overlap the edge of the lane previously placed by 1 inch to 2 inches. Maintain the uniform un-compacted depth adjacent to a compacted lane necessary to provide a smooth joint after compaction.

2. Transverse Joints. At the end of each day's work and when more than a 30 minute interruption occurs in pervious paving operations, install a temporary vertical bulkhead to form a straight transverse construction joint. The joint must be the full depth and width of the pervious paving course. In lieu of a temporary bulkhead, a full depth transverse joint may be sawed before resuming paving.

(k) Surface Tolerance. Test the finished surface at locations the Representative suspects are irregular and at transverse joints and paving notches. Test the surface in stages using a 10-foot straightedge. At each stage, hold the straightedge in contact with the surface and parallel to the road centerline and, in successive positions, test the pavement surface from one side to the other. Advance the test location to the next stage by moving the straightedge along the pavement centerline by not more than 5 feet.

Immediately correct irregularities of more than 3/8-inch by loosening surface mixture and removing or adding pervious paving course. For irregularities exceeding 3/8-inch that develop after compaction is completed, correct the irregularity by a method that does not produce contaminating fines or damage the base. Do not grind or mill the pervious paving course. The area is defective if irregularities or defects remain after final compaction. Remove and replace defective areas. If allowed, submit a corrective action plan to the representative for approval.

(l) Tests for Depth: Binder and Wearing Courses. Carefully dig or drill one 6-inch diameter test hole to the full depth of the pervious course for each 3,000 square yards or less of completed base course. The Representative may require additional test holes in areas the Representative suspects are deficient in depth. The Representative will measure the depth of the pervious course. Using material acceptable to the Representative, backfill the test holes and compact the material to fill the test hole flush with the completed course.

Remove and replace sections deficient in depth by 1/2-inch or more. Start correction at the point of determined deficiency and continue correction longitudinally and transversely until the depth is within 1/2-inch of the indicated depth.

(m) Infiltration Testing. Perform infiltration testing on three areas selected in accordance with PTM No. 1 for every 10,000 square feet of pervious asphalt pavement placed in accordance with ASTM C 1701. Remove and replace pervious asphalt pavement not meeting or exceeding a minimum average infiltration rate of 200 inches per hour. Document the average infiltration value from testing for use in future maintenance activities.

(n) Defective Work. Unless otherwise directed in writing by the District Executive, remove and replace pervious asphalt that is deficient in surface tolerance, depth, asphalt content, percent of coated aggregate particles is less than 95%, or when percent passing the 4% maximum for the No. 200 sieve for the composite mixture is exceeded.

Pervious courses are also considered defective if the ASTM C 1701 infiltration rate is less than 200 inches per hour.

With written permission from the District Executive, low areas may be filled during construction of the next pavement course.

420.4 MEASUREMENT AND PAYMENT—

(a) Pervious Bituminous Pavement System. Square Yard or Ton

1. Pervious Wearing Course. Square Yard or Ton

2. Pervious Binder Course. Square Yard or Ton

(b) Asphalt Treated Permeable Base Course. Section 360.4

SECTION 483—POLYMER-MODIFIED EMULSIFIED ASPHALT PAVING SYSTEM (MICRO SURFACING)

483.1 DESCRIPTION—This work is the construction of a polymer-modified emulsified asphalt paving system, commonly known as micro-surfacing, to fill ruts and/or resurface existing pavements.

Micro-surfacing material is classified into three mix types as follows:

(a) Type A. Used to seal cracks, fill voids and shallow (less than 1/2 inch) ruts, and provide a scratch course or surface seal. Use a double application, when specified, to meet total design pounds per square yard for surface courses.

(b) Type B. Used to fill moderate (1/2 inch to 1 1/4 inch) ruts; and provide a scratch course, a leveling course, a seal coat, or a surface treatment. Use a double application, when specified, to meet total design pounds per square yard for surface courses.

(c) Type Rut Fill (RF). Used to fill deep (2 inch) ruts in a single pass.

483.2 MATERIAL—

(a) Bituminous Material. Class CQS-1hPM as specified in Bulletin 25. Obtain material from an approved producer and source listed in Bulletin 15 and provide quality control testing and certification as specified in Sections 106.03(b) and 702.1(b)1.

1. Polymer Modifier. Provide a latex based modifier capable of making a micro-surfacing mix which cures fast enough to allow traffic to be placed on the pavement within 1 hour, without damaging the surface.

(b) Aggregate. Provide coarse or fine aggregates from sources listed in Bulletin 14. Provide fine aggregate Type B or better meeting the quality requirements of Table A, Section 703.1(c) and coarse aggregates meeting the quality requirements of Table B, Section 703.2(a). The final gradation must meet the final gradation specified in Table A of this specification. For wearing courses, provide aggregate with at least the SRL designation specified. To achieve the specified SRL, the Contractor may provide a blend of two aggregates if the blend has an SRL designation equal to or better than that specified. Blends are 50% by weight of each aggregate. Blend the aggregates using an approved method.

(c) Filler. Supply filler, when required to maintain the percent by weight passing the 75 µm (No. 200) sieve, as specified in Section 703.1(c)1 consisting of any approved, non-air entrained, Type 1, Portland cement free of lumps or hydrated lime as specified in Section 723.1.

(d) Water. Section 720.2 and free of harmful soluble salts.

(e) Other Additives. Supplied by the manufacturer to control mix set time in the field due to varying ambient environmental conditions.

(f) Mixture Composition. Size, uniformly grade, and combine aggregate fractions in such proportions that the total aggregate and filler in the JMF conform to the composition by weight percentages specified in Table A. Perform the tests identified in Table B for each mix design and provide the test results to document each mix design's characteristics.

Submit a certified mix design(s) using a Micro-Surfacing Mix Design and Materials Analysis Form TR-483 to the DME/DMM at least 2 weeks before its use in the work. Clearly show for each mix design the proportions of aggregate, filler, percent polymer-modified emulsified asphalt and asphalt residue, based on the dry weight of the aggregate, and the design cure time. Ensure that all of the materials used in the mix design represent the materials proposed for use on the project. If minor adjustments are required during construction, based on field conditions, provide the changes in writing to the Representative.

1. QC Plan and JMF. Prepare a QC Plan, as specified in Section 106, and submit it for review at the start of the project and at least annually thereafter. Include the number of applications and the mix design used with each

application in the QC Plan. Do not start work until the QC Plan has been reviewed and the JMF has been submitted.

When unsatisfactory results or other conditions make it necessary, a new JMF may be required. If a change in sources of materials is made, submit a revised JMF to the DME/DMM before using any new material.

2. Uniformity. Produce each mix type within the ranges specified in Table C.

TABLE A

SIEVE SIZE	COMPOSITION, TOTAL PERCENT BY MASS (WEIGHT PASSING)		
	TYPE A	TYPE B	TYPE RF
12.5 mm (1/2 inch)	100	100	100
9.5 mm (3/8 inch)	100	95 - 100	90 - 100
4.75 mm (No. 4)	85 - 100	65 - 85	55 - 75
2.36 mm (No. 8)	50 - 75	46 - 65	40 - 55
1.18 mm (No. 16)	40 - 65	28 - 45	24 - 40
600 µm (No. 30)	25 - 45	19 - 34	19 - 34
300 µm (No. 50)	13 - 25	10 - 23	10 - 20
75 µm (No. 200)	5 - 15	5 - 15	5 - 15
Note: Material finer than the 75 µm (No. 200) sieve will be determined as per PTM No. 100.			

TABLE B

MICRO-SURFACING MIX DESIGN PROPERTIES		
Property	**Test Method**	**Test Requirements**
Wet Cohesion:	ISSA TB 139 30 Minutes ISSA TB 139 60 Minutes	12 kg-cm min 20 kg-cm min or near spin
Wet Track Abrasion Loss:	ISSA TB 100 1 Hour Soak ISSA TB 100 6 Day Soak	50 g/ft^2 max 75 g/ft^2 max
Mix Time:	ISSA TB 113	120 seconds min
Classification of Compatibility:	ISSA TB 144	11 grade points min
Wet Stripping:	ISSA TB 114	Pass (90% min)
Loaded Wheel Test:	ISSA TB 147	Vertical 10% max, Lateral 5% max
Note: Provide aggregate with a minimum sand equivalency of 65 as determined by AASHTO T 176. If the sand equivalency is < 65, the aggregate may be approved as long as the Plasticity Index (PI) is zero. Test the PI as per AASHTO T 89 and AASHTO T 90 and meets the methyl blue test.		

TABLE C

MIX TYPE	MINIMUM SURFACING APPLICATION THICKNESS (inch)	ASPHALT RESIDUE (% by Weight of Aggregate)	SINGLE APPLICATION RATE (Pounds per Square Yard)	DOUBLE APPLICATION RATE (Pounds per Square Yard)
A	1/4	6.0 - 8.5	25-30	35-40
B	3/8	5.5 - 7.5	35- 40	40- 55
RF	N/A	5.5-7.5	22-38	
Note A: Provide mix set additive for each mix type as required. Note B: Filler for each mix type to be from 1% to 2%± 0.5% by weight of dry aggregate depending on weather conditions. Note C: It is permissible to increase asphalt content for slag and other absorptive aggregates at the discretion of the DME/DMM.				

(g) Mixture Acceptance. Provide a certified calibration sheet for the mixing equipment for each mix design to be used within 60 days before its use on the project. Record mixing equipment meter readings of material control devices

on a Run Sheet, daily, for each mix design. Calculate the percent cement or hydrated lime, total emulsion, asphalt residue based on the dry weight of the aggregate, and the yield square yard.

Certify the mixture composition and application rate based on quality control tests and Run Sheet calculations. Send certifications to the Inspector-In-Charge within 1 working day following any quality control testing. Certify mixtures and each shipment of material delivered to the job site as specified in Section 106.03(b)3.

(h) Bituminous Tack Coat. Section 460.2

(i) Certification. Section 106.03(b)3.

Certify each shipment of material delivered to the job site.

483.3 CONSTRUCTION—

(a) Preplacement Meeting. Hold a preplacement meeting on site or at a location that is acceptable to the Representative with both Contractor and PennDOT personnel present before placing any material on the project. Identify any areas of concern in the pavement that may show any signs of fatigue or excessive rutting at the pre-placement meeting. Also review the Specification, QC Plan, source of supply list, and the Aggregate Delivery Plan. It may be necessary to hold more than one preplacement meeting on larger projects with multiple State Routes.

(b) Weather Limitations. Apply when entire surface is in a condition to allow satisfactory penetration and adhesion and the atmospheric temperature is 50F minimum during the entire placement. Under no circumstances will the 50F minimum temperature requirement to be waived even for night work. Do not apply mixture if rain is imminent or if freezing temperatures are expected within 24 hours after application. Remove and replace rained on mixture before it sets. Do not apply from September 16 to April 30 in Districts 1-0, 2-0, 3-0, 4-0, 10-0, and 5-0 (Monroe, Carbon, and Schuylkill Counties only) and from October 1 to April 30 in Districts 6-0, 8-0, 9-0, 11-0, 12-0, and 5-0 (Berks, Lehigh, and Northampton Counties only). No exceptions to weather limitations will be allowed, unless directed in writing by the District Executive.

(c) Aggregate Delivery Plan. Before the start of work, submit an Aggregate Delivery Plan to the DME/DMM for approval. Include in the plan the number of trucks that will be used to haul aggregates to the micro-surfacing machine in order to keep it moving continuously to limit starting and stopping.

All aggregates being delivered to the micro-surfacing machine must be screened directly into the truck.

All screening plants must be equipped with a scalping screen with a 3/8 inch maximum square opening for Type A and with a 1/2 inch maximum square opening for Type B and Type RF.

(d) Mixing Equipment. Produce mixture in a self-propelled, front feed, continuous-loading mixing machine equipped with a chain-dragged conveyor belt aggregate delivery system interconnected with a positive displacement, water-jacketed gear pump to accurately proportion ingredients. Truck mounted units may be allowed on projects less than 20,000 square yards except for limited access highways and for all municipal projects. Locate filler feed so that the proper amount of cement is coating the aggregate before charging into the mixer. Provide a spray bar to completely wet the aggregate dropping down into the pug mill with additive and water.

Provide a continuous-flow, twin shafted, multi-bladed pug mill at least 50 inches long. Introduce polymer-modified emulsified asphalt beyond the first quarter point of the mixer to ensure thorough mixing of aggregate, cement, additive, and water before polymer-modified emulsified asphalt is added. Meet manufacturer's recommendations for blade size and side clearance. Provide readily accessible material control devices, placed so that the Inspector is able to determine the amount of each material being used at any time. Calibrate each material control device before production of each mix type. Equip the machine with a water pressure system and nozzle spray bar to provide a water spray ahead of and outside the spreader box, when required.

(e) Spreading Equipment. Spread the mixture uniformly by means of a mechanical type squeegee box attached to the mixer and equipped with paddles mounted on adjustable shafts to continually agitate and distribute the material throughout the box. Provide sufficient turbulence to prevent the mix from setting up in the box, forming excessive side build-up, or forming lumps. Attach flexible front and rear seals, in contact with the road, to prevent loss of mixture from the box. Furnish rut filling equipment with movable steel strike-off bar. Operate spreading equipment to prevent loss of the mixture on super elevated curves and to leave a uniform, skid-resistant application of aggregate and asphalt on the surface. Operate spreading equipment to achieve a uniform consistency without skips, lumps, or

tears in the finished surface.

(f) Conditioning of Existing Surface. Section 409.3(g)1 and as follows:

Immediately before placing mixture, clean the surface of vegetation, loose materials, dirt, mud, and other objectionable items. Ensure all pavement markings and legends are completely removed before placing any mixture. Before placing mixture on existing concrete surfaces, apply tack coat over the entire area as specified in Section 460. Do not apply tack coat on existing asphalt surfaces. Apply water to dampen entire surface immediately before placing mixture.

(g) Spreading and Finishing. Section 409.3(h) and as follows:

Spread the mixture to seal cracks, fill voids, and to leave a uniform surface. When filling ruts, take care to restore the designed profile of the pavement cross section. Avoid excess crowning (over filling) of rutted areas. Use squeegees and lutes in areas inaccessible to the spreader box.

Carry a sufficient amount of material at all times, in all parts of the spreader box, to obtain complete coverage. Water may be sprayed into the spreader box, to facilitate spreading, without harming the mix. Lumps, balls, or unmixed aggregate in the finished surface is not allowed.

Adjustments to the additive may be required to slow mixture set time where hand spreading is needed. When hand spreading, pour mixture in a small windrow along one edge of the surface to be covered and spread uniformly by hand squeegee or lute.

Make a neat seam where two passes join. Immediately remove excess material from the ends of each run.

1. General Requirements. Ensure mixture properly sets within one hour of placement. If mixture takes longer than one hour to properly set, the Representative will give the Contractor a warning and an opportunity to immediately correct mixture application and set time. If the mixture takes longer than one hour and twenty minutes to properly set, stop placement operations immediately.

2. Mixture Set Time. Remove and replace mixture if mixture set time takes longer than one hour and twenty minutes.

(h) Compaction. Before opening to traffic, compact using a pneumatic-tire roller as specified in Section 108.05(c)3.f, except having tire pressures of 40 pounds per square inch to 60 pounds per square inch. Roll the entire surface area of the placed mixture. On a double application, roll the entire surface area of the placed mixture for each application.

(i) Sampling and Testing. At least 2 weeks before the start of work, under the direction and supervision of the Representative, obtain samples of the aggregates from stockpiles designated and constructed for each mixture type and each project. Obtain a minimum sample size of 3 pounds using guidelines for stockpile sampling specified in PTM No. 607. Immediately deliver the samples to the Representative for testing. Passing aggregate acceptance test results are required before placement of the mixture. All acceptance samples will be obtained and all acceptance tests will be performed by the Representative in accordance with PTM No. 616 and PTM No. 100 using the following frequency:

- **When the projected quantity of aggregate for the specified mixture type is less than 500 tons.** The entire quantity will be designated as one lot and divided into three equal sublots for sampling. Under the direction and supervision of the Representative obtain a sample from each sublot and immediately deliver the samples to the Representative for testing. One of the three sublot samples will be randomly selected and tested in accordance with PTM No. 1 by the Representative and tested for compliance with Table A. If the sample tested meets the specification, the entire lot will be considered acceptable for delivery to the designed project. If the sample fails, the remaining two samples will be tested and the Representative will determine the percent within limits (PWL) according to Section 106.03(a)3. If results indicate a PWL for the material less than 90, the Representative will reject the stockpile. After the entire rejected lot has been blended, screened, or replaced, retesting for acceptance of the aggregate will be performed. When retesting is performed, all sublot samples will be tested in accordance to Section 703.5(b)2. All acceptance testing will be performed by the Representative. All test results will be recorded on a TR-4126A aggregate report form.

- **When the projected quantity of aggregate for the specified mixture type is 500 tons or greater.** The aggregates will be divided into equal lots at the discretion of the aggregate supplier, but in no case will the lot exceed 1000 tons. Each lot will be divided into three equal sublots. Under the direction and supervision of the Representative obtain a sample for each sublot. All three samples for each lot will be tested and the Representative will determine the percent within limits (PWL) according to Section 106.03(a)3. If results indicate a PWL for the material less than 90, the Representative will reject the stockpile. If the test results for each lot meets the specification and are in compliance with Table A, the entire lot is acceptable for shipment to the project. If the test results fail to meet the specifications, the lot will be rejected. Retesting for lot acceptance will be performed as described above. All acceptance testing will be performed by the Representative. All test results will be recorded on a TR-4126A aggregate report form.

(j) Blending Aggregates on the Project. Requests to blend aggregates on the project to meet gradation requirements from Table A and the method of blending must be approved in writing by the DME/DMM before the start of work. Include on the QC Plan a detailed description of equipment used to blend aggregates, a list of supplier codes for aggregates being blended, and the percentages of each aggregate being blended. Set up a portable laboratory at the blending site equipped to perform PTM No. 616 and PTM No. 100 tests for acceptance of aggregates on the project. The Contractor's aggregate technician must be a PennDOT certified aggregate technician before performing any aggregate testing at the staging area in the presence and direction of the Representative. Aggregates will be accepted as specified in Section 483.3(i). Provide aggregate for use in all mixture Types including each application of a double application of a mixture Type having the SRL designation indicated in the bid proposal. An aggregate designation or blends, equal to or better than that specified, may be supplied.

(k) Test Strip. On the first day of work the Representative will identify a location to perform the test strip. The test strip will be prohibited on a limited access highway. Construct a test strip to demonstrate the mixture's ability to be laid in multiple stone thicknesses and to be opened to traffic within one hour after placement. Construct the test strip in the same manner and condition as required on the project. Construct the test strip over one-full lane width and between 100 feet and 550 feet long. Apply the mixture at an application rate representative of the application rate for the project. Test the mixture in accordance with ISSA Test Method TB 102 in the presence of the Representative. The Representative will evaluate and approve the test strip based on its ability to be opened to traffic within one hour and on its ability to have a set time of 10 minutes, maximum, as determined by ISSA Test Method TB 102.

Do not continue with work until the Representative has approved the test strip. The Representative does not have the authority to waive or eliminate the test strip requirement. If this work is to be performed a test strip is mandatory. The test strip will be payable in accordance with Section 483.4.

(l) Defective Work. As specified in Section 105.12 and as follows:

Unless otherwise directed in writing by the District Executive, satisfactorily correct pavement not meeting the following criteria:

1. Application Rate. Calculate yield at the end of each day's application. Areas where application rates deviate from the acceptable ranges in Table C will be considered defective work. Failure to meet the acceptable ranges in Table C will require an additional minimum 15 pounds per square yard application or the District Executive, with the concurrence of the Director of the Bureau of Project Delivery, may allow the Contractor to leave the defective lot in place. The Department will pay for the defective lot at 50% of the contract unit price.

2. Finished Surface. Provide a finished, uniform surface texture meeting the following requirements**:**

- No areas of excess asphalt (flushing) greater than 5% of the finished surface area. Areas of excess asphalt are characterized by a smooth, shiny surface that may be tacky to the touch. Bleeding at joints is not allowed.

- No tear and/or drag marks greater than 1 inch wide and 3 inches long.

- No more than 12 tear and/or drag marks greater than 1/2 inch wide and 4 inches long per 10 feet of a lane.

- No clumps and/or other foreign objects greater than 1 1/2 inch in diameter.

- No completed sections of micro-surfacing which exhibit washboard or ripple patterns exceeding 100 linear feet. If these areas exist they will be considered defective work, as determined by the Representative, and will require surface correction.

- No longitudinal streaks with greater than a 1/4 inch ridge, bump or depression, as measured with a 10 foot long straightedge.

3. Longitudinal Joints. Make a neat seam where two longitudinal passes join with no greater than a 1/4 inch bump, ridge, or depression as measured with a 10 foot straightedge. Do not overlap longitudinal joints more than 4 inches, except on irregular roadway widths when approved by the Representative.

4. Longitudinal Edges. Place material to the final widths specified. Make a neat longitudinal edge along the roadway lane, shoulder, and/or curb lines. Place edges flush with curbs. Place edges with no more than ±3 inches horizontal variance in any 100 feet of roadway.

5. Transverse Profile. Fill ruts to have no depressions as measured with a 10 foot long straightedge.

(m) Opening to Traffic. Do not allow traffic on newly completed surface course until mix has set sufficiently to prevent pick-up and until directed by the Representative.

483.4 MEASUREMENT AND PAYMENT—

(a) Micro-Surfacing.

1. Area Basis. Square Yard

2. Weight Basis. Ton

Under the direction and supervision of the Representative complete measurements based on the combined tonnages of aggregate, filler, and polymer-modified emulsified asphalt actually used; computed as follows:

- **Aggregate.** Measure aggregate quantity using the calibrated, dry weight from the aggregate control device. Make a deduction for moisture naturally occurring in the aggregate by using PTM No. 513.

- **Filler.** Compute filler quantity from the fines feeder control device.

- **Polymer-modified emulsified asphalt.** Compute polymer-modified emulsified asphalt quantity by weight used.

(b) Bituminous Tack Coat. Section 460.4

SECTION 489—ULTRA-THIN BONDED WEARING COURSE

489.1 DESCRIPTION—This work is the construction of a polymer-modified emulsified asphalt membrane (UTWCEM) immediately overlaid with an ultra-thin bonded wearing course of hot-mix asphalt concrete (UTWC) in one pass of a single paving machine.

489.2 MATERIAL—

(a) Bituminous Material.

1. Asphalt Binder. Provide material as specified meeting the requirements of the Standard Specification for Performance-Graded Asphalt Binder, AASHTO M 320, except as revised in Bulletin 25. Obtain material from an approved producer and source listed in Bulletin 15 for the specified grade and provide quality control testing and certification as specified in Sections 106.03(b) and 702.1(b)1.

2. Emulsified Asphalt. Class UTWCEM as specified in Bulletin 25. Obtain material from an approved producer and source listed in Bulletin 15 and provide quality control testing and certification as specified in Sections 106.03(b) and 702.1(b)1.

(b) Aggregate.

1. Fine Aggregate. Manufactured sand from an approved source, listed in Bulletin 14 and meeting the requirements in Table A.

TABLE A

FINE AGGREGATE PROPERTIES			
TEST	**TEST METHOD**	**MINIMUM**	**MAXIMUM**
Sand Equivalent	AASHTO T 176	45	-
Methylene Blue	AASHTO T 330	-	10
Uncompacted Void Content	AASHTO T 304	40	-

2. Coarse Aggregate. Coarse aggregate from an approved source, listed in Bulletin 14 and meeting the requirements in Table B.

TABLE B

COARSE AGGREGATE PROPERTIES				
TEST	**TEST METHOD**	**AVERAGE DAILY TRAFFIC (ADT)**		
		< 5,000	**5,000 < 20,000**	**> 20,000**
Abrasion Max. %	AASHTO T 96	35	30	30
Micro-Deval (MD)* Max. %	AASHTO T 327	18	18	18
Skid Resistance Level (SRL) Min. %	Bulletin 14	G or higher	H or higher	E
Absorption Max. %	AASHTO T 85	2	2	2
Thin And Elongated Pieces Max. %	ASTM D 4791	10	10	10
Soundness Max. %	PTM No. 510	10	10	10
% Crushed, 1 Face	ASTM D 5821	95	95	100
% Crushed, 2 Face	ASTM D 5821	85	85	85
*MD > 18, requires approval of DME/DMM.				

(c) Filler. Do not use flyash if the design traffic is greater than or equal to 3 million Equivalent Single Axle Loads (ESALs).

(d) Mixture Composition. Provide a wearing course of plant mixed hot bituminous concrete consisting of fine aggregate, coarse aggregate, filler, and asphalt cement. Size, uniformly grade, and combine aggregate fractions in such proportions that the total aggregate and the bitumen in the JMF conform to the composition specified in Table C, and meet the mixture characteristics of Table D.

TABLE C

COMPOSITION, TOTAL PERCENT BY MASS (WEIGHT) PASSING			
SIEVE SIZE	**TYPE A**	**TYPE B**	**TYPE C**
19.0 mm (3/4 inch)	100	100	100
12.5 mm (1/2 inch)	100	100	85 - 100
9.5 mm (3/8 inch)	100	75 - 100	65 - 85
6.3 mm (1/4 inch)	75 - 100	28 - 45	28 - 45
4.75 mm (No. 4)	40 - 60	23 - 37	23 - 37
2.36 mm (No. 8)	15 - 30	21 - 31	21 - 31
1.18 mm (No. 16)	12 - 20	15 - 23	15 - 23
600 µm (No. 30)	8 - 15	10 - 18	10 - 18
300 µm (No. 50)	6 - 12	8 - 14	8 - 14
150 µm (No. 100)	5 - 10	5 - 10	6 - 10
75 µm (No. 200)	4.0 – 6.5	4.0 – 6.5	4.0 – 6.5
Asphalt % by mass (weight)	4.5 - 5.8	4.5 - 5.7	4.5 - 5.7
Note: Material finer than the 75 µm (No. 200) sieve will be determined as per PTM No. 100.			

TABLE D

MIXTURE CHARACTERISTICS			
MIXTURE CHARACTERISTIC	**TEST METHOD**	**MINIMUM**	**MAXIMUM**
Moisture sensitivity, % TSR	AASHTO T 283*	80	-
Draindown, % mass	AASHTO T 305	-	0.1
Apparent Asphalt Film Thickness, microns	Bul. 27, Sec 12.4.1	10.0	-

*Prepare specimens in accordance with the Department's modified procedures for Superpave Mix Design, detailed in Bulletin 27, Chapter 2A referencing AASHTO R 35 Section 11, with the following exceptions:

1. Condition the mixture in accordance with Bulletin 27.
2. Compact to 100 gyrations.
3. Extrude as soon as possible without damage to the sample.
4. Use AASHTO T 269 to determine void content.
5. Record the void content of the specimens.
6. Condition specimens, compute the Tensile Strength Ratio, and evaluate the specimens in accordance with Bulletin 27.
7. Visual stripping will require modification and/or readjustments as directed by the Representative.

1. Producer QC Plan and JMF. Prepare a QC Plan, as specified in Section 106, and submit it for review at the start of the project and at least annually thereafter. Do not start work until the QC Plan has been reviewed and the JMF has been submitted.

When unsatisfactory results or other conditions make it necessary, a new JMF may be required. If a change in sources of materials is made, submit a revised JMF to the DME/DMM before using any new material.

2. Uniformity. Produce the bituminous mixture to meet the requirements as specified in Table C. Produce the mixture within the JMF tolerances specified in Table E.

TABLE E

JMF TOLERANCE REQUIREMENTS OF COMPLETED MIX (n≥1)	
Passing 9.5 mm (3/8 inch) and larger sieves	±5%

Passing 6.3 mm (1/4 inch) to 2.36 (No. 8) sieves		±4%	
Passing 1.18 mm (No. 16) to 0.3 mm (No. 50) sieves		±3%	
Passing 0.15 mm (No. 100) sieve		±2%	
Passing 75µ (No. 200) sieve		±1.5%	
Asphalt % by mass		±0.5%	
TEMPERATURE OF MIXTURE (F)			
CLASS OF MATERIAL	**TYPE OF MATERIAL**	**MINIMUM**	**MAXIMUM**
PG 64-22	Asphalt Cement	285	330
PG 76-22	Asphalt Cement	295	340

(e) Mixture Acceptance. Obtain material certification from the material producer. Send certification to the Inspector-In-Charge within 1 working day following any QC tests for bitumen determination and sieve analysis of the mixture.

The mixture will be accepted by certification at the plant when quality control tests conform to the JMF within the tolerances specified in Table E. Acceptance by certification may be suspended if QC tests or QA samples obtained by QA Teams from the BOPD deviate from the tolerances in Table E for acceptance values. The acceptance values are:

- Asphalt percent passing by mass (weight),
- Percent passing the 75µ (No. 200) sieve,
- Percent passing the 2.36 mm (No. 8) sieve, and
- Percent passing the 6.3 mm (1/4 inch) sieve.

If at any time during the course of the work any acceptance values deviate from the tolerances in Table E in consecutive tests, immediately make necessary changes to comply with the JMF. If the material cannot be brought into compliance within 150 tons of production, suspend operations and notify the Inspector-In-Charge. Do not resume production for the project until the Representative has reviewed any corrective action.

If the asphalt content or the percent passing the 75µ (No. 200) sieve deviates from the tolerances specified in Table E, the material represented will be considered defective and acceptance will be determined as specified in Section 409.3(o).

(f) Certification. Section 106.03(b)3.

Certify each day's shipment of material delivered to the job site.

489.3 CONSTRUCTION—Section 409.3 with additions and modifications as follows:

(b) Weather Limitations. Replace with the following:

Do not place bituminous paving mixtures from November 1 to March 31, unless allowed in writing by the District Executive. Do not place bituminous paving mixtures when the surfaces are wet or when the air or surface temperature is below 50F. If work is halted because of weather conditions, the Representative may allow the Contractor to place limited quantities of mixture that are en route to the project.

(e) Paving Equipment.

1. Bituminous Pavers. Add the following:

Use pavers that include a built-in spray bar placed in front of the variable-width heated screed unit, so that the operations of spreading UTWCEM and the UTWC are performed in succession, within a period of less than 5 seconds.

(g) Preparation of Existing Surface.

1. Conditioning of Existing Surface. Replace with the following:

At least 24 hours before paving operations, seal longitudinal and transverse joints and cracks 1/4-inch and wider as specified in Section 469. Use rubberized sealant as specified in Section 469 and minimize the sealant over-band

thickness and width. Do not exceed Section 469 over-band tolerances. Remove thermoplastic and tape traffic markings greater than 0.2 inches thick. Thoroughly clean pavements impregnated with grease, oil, or fuel. Immediately prior to applying the UTWCEM and the UTWC, clean the surface by sweeping or other means necessary to remove all loose particles and unsuitable material.

(h) Spreading and Finishing.

1.b Spreading and Finishing. Replace with the following:

Apply UTWCEM with a metered mechanical pressure sprayer, at a temperature of 120F to 180F. Continuously monitor the rate of spray, ensuring a uniform application rate over the entire width to be overlaid. Determine the spray rate given the existing pavement porosity, and apply between 0.15 and 0.25 gallons per square yard. Do not allow wheels or other parts of the paving machine to come in contact with the UTWCEM before the UTWC is applied. Within 5 seconds of applying the UTWCEM, lay the UTWC within the temperature range specified in Table E for the class and type of material used, and at the placement rate specified in Table F.

Continuously adjust operations to obtain a quality surface free from drags marks, open areas or suspect quality. If adjustments do not obtain a quality surface the Representative may direct work to stop. Do not begin spreading and finishing until the Representative is satisfied with proposed corrective actions to provide a satisfactory surface.

TABLE F

GRADATION		
TYPE	**NMAS**	**PLACEMENT RATES FOR UTWC**
A	6.33 mm (1/4 inch)	45 to 65 pounds per square yard
B	9.5 mm (3/8 inch)	55 to 80 pounds per square yard
C	12.5 mm (1/2 inch)	60 to 85 pounds per square yard
Note: Placement rates are intended as a guide and additional material may be required to obtain a quality surface. In no case should material yield be below the lower limits of the placement rate range.		

(i) Compaction. Replace with the following:

Roll the UTWC immediately after placement and before the material temperature has fallen below 185F. Roll using a minimum of two passes with a steel double-drum asphalt roller having a mass of not less than 8 tons. Do not allow roller(s) to remain stationary on the freshly placed UTWC. Maintain roller(s) in reliable operating condition and equipped with functioning water system and scrapers to prevent adhesion of the fresh mix onto the roller drums. A release agent (added to the water system) may be required. Compact in the static mode, with the exception of joints where vibration may be necessary. A pneumatic-tire roller may be used to prevent the "bridging" effect of the steel drum roller.

(j) Mat Density Acceptance. Density testing is not required.

(k) Joints. Replace with the following:

1. Longitudinal Joints. Form butt joints only and compact with rollers.

2. Transverse Joints. Minimize the number of transverse joints. Maintain continuous forward paving wherever possible. Construct joints perpendicular to the direction of traffic and compact.

(m) Tests for Depth. Loose depth or compacted depth tests are not required. However, control the depth of courses by the weight per square yard.

489.4 MEASUREMENT AND PAYMENT—

(a) Ultra-thin Bonded Wearing Course. Square Yard.
For the type indicated.

(b) Crack Filling and Sealing. Section 469.4

SECTION 496—ASPHALT CONCRETE PAVEMENT, 60-MONTH WARRANTY

496.1. DESCRIPTION—This work is construction of a plant-mixed, asphalt concrete pavement on a prepared surface with a 60 month warranty and includes the furnishing of a warranty bond. Acceptability of this work will be determined by construction end-result and the warranty performance criteria.

496.2. MATERIAL—Provide material which ensures that the asphalt concrete pavement meets the warranty performance criteria. Select the type and class of bituminous material, type of aggregate, and, when necessary, type of filler to be used in the constructed pavement. For wearing courses, use aggregate, having the specified SRL designation, from a source listed in Bulletin 14. An aggregate designation or blends, equal to or better than that specified, may be supplied. Blends are 50% by weight.

(a) Composition of Mixtures. Establish the JMF(s) using a volumetric mix design procedure with the Superpave Gyratory Compactor (SGC).

Submit mix design(s) on the most current version of the TR-448A form, signed by a Certified Bituminous Level 2 Plant Technician, to the DME/DMM at least 7 calendar days before its use in the work. The submitted mix design(s) will be used for information only and will become part of the as-built project files. Submission of the mix design(s) will not relieve the Contractor from responsibility for meeting the specified construction end-result or warranty performance criteria. Stone Matrix Asphalt (SMA) wearing course mixes may be submitted for consideration. For each mix design, provide the following information:

- Date of Submission
- Project S.R., Section, and County
- Project Contract No.
- Bituminous Concrete Producer: Name and Location
- Bituminous Plant Type
- Aggregate Producer: Supplier Code, Material Code/Class, Percent in Mix, Bulk Specific Gravity and Percent Absorption
- Asphalt Cement Producer: Supplier Code, Material Code/Class, Percent in Mix and Bulk Specific Gravity
- Volumetric Mix Design Method
- Other JMF Materials: Source, Material Code/Class, Percent in Mix, Bulk Specific Gravity and % Absorption (if applicable)
- JMF: Design and Upper and Lower Tolerances for production control
- SGC Gyrations at Nini, Ndes, and Nmax
- Combined Aggregate Bulk Specific Gravity (Gsb)
- Theoretical Maximum Specific Gravity (Gmm) or Density
- Laboratory Specific Gravity at Ndes (Gmb) or Density
- Voids in Mineral Aggregate (VMA), percent by volume
- Voids in Total Mixture (VTM), percent by volume
- Voids Filled with Asphalt (VFA), percent by volume
- Ignition Furnace Correction Factors for Asphalt Binder and 0.75 µm (No. 200) Sieve
- Moisture Sensitivity Data (Tensile Strengths, Tensile Strength Ratio, Date Performed) or (Hamburg Wheel Tracking Results)
- Combined Aggregate Consensus Properties (Sand Equivalency, Fine Aggregate Angularity, Coarse Aggregate Angularity, Flat & Elongated Pieces)
- Gradation Chart (FHWA 0.45 Power Type) with JMF plotted
- Types and results of additional mixture testing, if performed
- Designer's signature

Ensure that all component materials shown in the mix design are representative of the materials that will be used on the project. If, for any reason, a change in material source or other adjustments are necessary during construction, before using any new material notify the DME/DMM in writing, explaining the need for the change. Submit a copy of the revised JMF with the written notification.

1. QC Plan. Prepare a QC plan, as specified in Section 106, and submit it at the start of the project. Do not start work until the QC plan and the JMF have been submitted. The submitted QC plan will be used for information only and will become part of the as-built project files.

Provide certified results of QC testing to the Representative within 48 hours of material sampling. The submitted test results will be used for information only and will become part of the as-built project files.

(b) Warranty Bond and Liability Insurance. When awarded the contract, in addition to the required bonds specified in Section 103.04, furnish a Warranty Bond, with sufficient surety or sureties, in an amount equal to 50% of the total contract amount for all pavements to be constructed under the pavement warranty item(s). Have the bond specify that remediation work will be completed in a manner satisfactory to the Secretary. Have the bond state that the State is to be saved harmless from any expense or damage incurred through the failure of the Contractor to complete remediation work, as specified, or from any damages growing out of the carelessness of the Contractor, the Contractor's employees, or subcontractors in performing remediation work.

Have a corporate surety, legally authorized to transact business in the State and satisfactory to the Secretary, execute the bond. If the Secretary decides the bond surety is unsatisfactory, promptly furnish any additional required security to protect the State's interests and the interests of all persons, firms, or corporations who/which have furnished material, provided equipment on rental, or supplied/performed labor services on, or in connection with, the performance of the remediation work for this contract.

The Warranty Bond is to be effective beginning on the date of physical work completion, established by the Representative for the whole project or any substantial project section, as specified in Section 110.08(a). The Warranty bond is to remain in effect for a period of 60 months from the effective date or until completion of all remediation work identified in the final annual performance surveys, whichever is later. If a substantial section of the project is completed in advance of the whole, the Contractor may request that a final inspection of that section be conducted. If the Department accepts the work on the section of the project, in writing, and the section is opened to normal traffic, the warranty period for that section will start in advance of the date of physical work completion for the entire project. The Warranty Bond, however, must remain in effect until all criteria established in Section 496.3(c)6 are satisfied, and the Warranty Acceptance Notification has been issued. The amount of the warranty bond will be reduced proportionately if the warranty period for a portion of the work expires in advance of the warranty period for the remainder of the work.

Maintain insurance to indemnify and save harmless the Commonwealth, the Department, and all of its officers and employees from all suits, actions, or claims of any character, name, and description, brought for or on account of any injuries or damages received or sustained by any person, persons, or property related to the performance of any work by the Contractor, these pavement items, or to remedial actions taken throughout the warranty period, whether the same is due to the use of defective material, defective workmanship, neglect in safeguarding the work or public interests, or by or on account of any act, omission, neglect or misconduct of the Contractor.

496.3. CONSTRUCTION—Provide an asphalt concrete pavement meeting the requirements specified herein and capable of meeting the warranty performance based criteria specified herein.

Construct the pavement as a combination of two or more different asphalt concrete pavement courses to achieve the total depth indicated.

(a) Tests for Depth of Binder and Wearing Courses. Within 24 hours after final compaction, in the presence of the Inspector, drill one, 4-inch diameter or larger core through all lifts and courses placed under this item of work to the top of the existing pavement or base, for each 2,000 linear feet of pavement lane. The Inspector will determine core locations using PTM No. 1, excluding any transitional areas indicated.

The Inspector will measure the depth of each core according to PTM No. 737. When any one core depth measurement indicates the pavement is deficient in depth by more than 1/4 inch, which cannot be satisfactorily corrected, the affected pavement area will be considered defective work. When core depth measurements indicate that the pavement is uniformly deficient in depth by more than 1/8 inch in any three consecutive core locations and the deficiency cannot be satisfactorily corrected, the affected pavement area will be considered defective work. After the Inspector completes depth measurements, backfill, compact, and seal core holes with mixture used to construct the wearing course. After depth measurement, the cores may be used for QC testing.

Immediately correct pavement that is deficient in depth starting at the point of the determined deficiency, and proceed longitudinally and transversely until the depth within the limits of the entire repair area is within 1/4 inch of the required depth. Drill additional cores as needed, both forward and back of the cores determined to have deficient

depth, to determine the actual starting and ending point of the deficiency. Coring operations will not exclude pavement from the warranty performance criteria.

(b) Information Samples for the Department. The Department reserves the right to direct the Contractor to obtain loose mixture box samples and/or pavement core samples at random locations selected by the Inspector according to PTM No. 1 for testing at the LTS for informational purposes only.

If directed and in the presence of the Inspector, obtain n=1 loose mixture box samples from directly behind the paver before the material is compacted. Immediately package loose mixture samples in individual cardboard boxes sized no larger than 240 cubic inches and identify each sample by number, location (lane, direction, and station), date of placement, mixture type, and as Information Samples (Sample Class IF). Immediately deliver the packaged loose mixture box samples to the Inspector.

If directed and in the presence of the Inspector, drill and obtain n=1 6-inch diameter pavement core samples for each 1,000 tons of material placed. Do not bend, compress, or distort samples during cutting, handling, transporting, and storing. If core samples are damaged, immediately obtain replacement samples, as directed by the Inspector, from within 12 inches of the original sample location. Obtain samples no later than 24 hours after placement. Identify the samples by number, location (lane, direction, and station), date of placement, mixture type, and as Information Samples (Sample Class IF). Immediately package and deliver the samples to the Inspector. Within 24 hours after coring, backfill the hole with mixture of the same JMF or with mixture used for subsequent courses and compact and seal the mixture.

(c) Warranty.

1. Performance Criteria. Performance results will be determined by automated surveys. These distresses will be identified, measured, and reported using the survey techniques, rating procedures, and extent estimation procedures in accordance with Publication 336. Surveys will be performed by the Department or a designee. Manual surveys, when necessary, will be performed according to Publication 336. Performance results for flushing and potholes will be determined by manual surveys.

For each Segment, or partial Segment, performance criteria limits for distresses are indicated in Table A. A segment is defined as a division of the State Route approximately one-half mile in length with termini designated by the Department typically beginning and ending at physical features. The segment beginning points will be designated on the plans.

If the last performance survey (year 5) determines that 30% of segment area has two or more distresses with low severity, then remedial action is required by microsurfacing, or other treatment approved by the Department.

TABLE A
Performance Criteria Distress Limits

PERFORMANCE CRITERION	THRESHOLD LEVEL	REMEDIAL ACTION
FATIGUE CRACKING	All medium or greater severity*	Remove and replace distressed layers full lane width to a depth necessary to correct observed distress but not to exceed warranted pavement and length not less than 10 feet beyond the distressed area.
CRACKING	All low to medium severity*	Crack seal as specified in Section 469.
(Transverse Cracking & Miscellaneous Cracking)	All high severity*	Remove and replace distressed layers full lane width to a depth necessary to correct observed distress but not to exceed warranted pavement and length not less than 10 feet beyond the distressed area.
RAVELING / WEATHERING	All medium or greater severity*	Remove and replace distressed layers full lane width to a depth necessary to correct observed distress but not to exceed warranted pavement and length not less than 10 feet beyond the distressed area.
RUTTING	> 3/8 inch	Remove and replace distressed layers full lane width to a depth necessary to correct observed distress but not to exceed warranted pavement and length not less than 10 feet beyond the distressed area.

FLUSHING	ALL	Remove and replace distressed layer full depth and full or half lane width (longitudinal joint at center of lane for half lane width) and a minimum of 24 inches beyond distressed pavement in all longitudinal directions.
POTHOLES (INCLUDING SLIPPAGE AREAS)	ALL	Remove and replace distressed layers full lane width to a depth necessary to correct observed distress but not to exceed warranted pavement and length not less than 10 feet beyond the distressed area.
LONGITUDINAL JOINT DETERIORATION	All medium severity*	Crack seal as specified in Section 469.
EDGE DETERIORATION (shoulder joint)	All high severity*	Remove and replace distressed layer one foot either side of the joint transversely and a minimum of 24 inches beyond distressed pavement in all longitudinal directions.
LONGITUDINAL JOINT DETERIORATION	All medium severity*	Crack seal as specified in Section 469.
LEFT EDGE JOINT (lane joints)	All high severity*	Remove and replace distressed layer one foot either side of the joint transversely and a minimum of 24 inches beyond distressed pavement in all longitudinal directions.

*The Threshold Level as defined in Publication 336.

NOTE: Should deviations beyond the threshold levels indicated in Table A in combination total a remedial action area greater than 20% of the surface area of any segment of pavement as defined herein, (except that, for this determination, a medium severity crack referenced above will be considered to be a deviation affecting 6 inches on either side of the crack for the entire length of the crack) remove and replace the entire segment.

Should the distance between repair areas be less than 100 feet, make one continuous repair.

All repairs must meet the surface tolerance as specified in Section 409.3 (l).

2. Remediation Work under the Pavement Warranty.

2.a Department's Responsibility. To determine compliance with specified performance criteria the Department will be responsible for conducting an annual performance analysis, the basis of which will be the distress criteria established in Table A.

The Department will schedule and perform annual surveys, and additional surveys if needed, of the warranted pavement for flushing and potholes. When needed, Rut Depth measurements will be verified using a 12 foot straight edge, across the lane width, to determine the severity and extent. Surveys will be conducted annually throughout the warranty period. The Contractor will be notified at least 14 calendar days in advance of all scheduled manual surveys. In addition, the Department will routinely schedule and perform traffic classification counts to confirm that Equivalent Single Axle Load (ESAL) estimates remain within the projected values included in the contract documents.

The Department reserves the right to schedule and perform additional or more frequent performance surveys if, at any time during the warranty period, evidence exists that performance criteria are not being met. The Department will provide the Contractor with access to the results of all performance surveys and traffic counts. Performance survey results will be reported for each individual State Route Segment as established under the Department's Location Reference System (LRS) or partial Segment within the limits of the warranty project. Within 14 calendar days after completion, the Department will notify the Contractor, in writing, of the results of performance surveys, identifying the Segment (location) and the performance criterion, and indicating whether specified distress limits have been met or exceeded. After performance surveys are completed, if the Department determines remedial action is necessary, the Contractor will be notified within 5 calendar days, from the date of that determination, that remediation work is required.

During the warranty period, the Department will not perform routine pavement maintenance, such as crack sealing and base repairs, on the warranted pavement. If the Department determines emergency repair work is necessary, the Contractor will be notified immediately of the emergency repair work that is required. The Contractor will be given 24 hours to review the emergency repair work that is needed and notify the Department if they will perform the required repairs. When the Contractor notifies the Department agreeing to make the required emergency repairs, they must begin repair work within 48 hours of the Department's initial notification. If the Contractor does not notify the Department within 24 hours or begin the repair work within 48 hours of the Department's initial notification, the Department reserves the right to make emergency repairs to the warranted pavement during the warranty period. If the pavement condition is determined to be potentially harmful or unsafe, the Department reserves the right to make immediate emergency repairs to the warranted pavement during the warranty period. The Department will then notify the Contractor of the location of all emergency repairs performed. The costs expended by the Department for any emergency repair work needed to correct deficiencies covered under the terms of this warranty specification will be the responsibility of the Contractor.

2.b Contractor's Responsibility. The Contractor's obligation to perform required remediation work shall survive acceptance of the work and final settlement of the Contract.

The Contractor may witness all manual performance surveys. Where survey results for a given Segment indicate that performance criteria distress limits for one or more distress types have been exceeded, perform the remediation work described in Table A. If proposing to utilize a method of testing, measurement, or remedial action other than that prescribed, submit a plan that includes a detailed description of the proposed testing, measurement, or remedial action to the Representative for review and approval. The Department will review and approve or disapprove the submitted testing, measurement, or remedial action plan within 5 calendar days of receipt of the submission.

Complete remediation work required as part of the pavement warranty, at the location(s) indicated, within 60 calendar days after receipt of the Department's written notification that remediation work is required. Perform remediation work to meet the material and performance criteria requirements contained herein. Notify the District Executive of the tentative start date for remediation work and submit a schedule for remedial repairs within 5 calendar days of that notification. If remediation work does not begin by the start of the 61st calendar day after the date of the Department's written notification, the Contractor will be responsible to pay an amount equivalent to the Construction Engineering Liquidated Damages as specified in Section 108.07. This cost will accrue until the required remedial work ends. In addition to the continuing cost equivalent to the Construction Engineering Liquidated Damages, costs equivalent to Road Users Liquidated Damages as specified in Section 108.07 will be assessed no sooner than the 61st calendar day after the date of the Department's written notification, for each calendar day that the roadway is not open to unrestricted traffic. If inclement weather prohibits quality repairs, the Contractor will be responsible for placing and maintaining temporary repairs until permanent remediation work can be properly completed. Charges equivalent to Road Users Liquidated Damages will not be assessed following temporary repair work, provided the temporary repairs are properly maintained. Permanent repairs are to be constructed as soon as weather permits. The Department will notify the Contractor in writing when weather conditions permit permanent repairs. Charges equivalent to Construction Engineering Liquidated Damages and Road Users Liquidated Damages will resume beginning 5 calendar days beyond this notification until permanent repairs are completed. In the final year of the warranty period, segments with distresses that cannot be repaired due to inclement weather will have the warranty period extended for these segments only until permanent repairs are satisfactorily completed. The warranty bond can be reduced proportionately to cover only the distressed segments. All charges equivalent to Liquidated Damages as referenced herein will be determined from original contract documents.

Furnish all materials, equipment, and labor needed to perform remediation work required as part of the pavement warranty, including traffic control, at no cost to the Department. When the remedial action specified in Table A calls for removal and replacement, use only plant-mixed, asphalt concrete unless other materials are accepted, in writing, by the District Executive. Under adverse weather conditions**,** temporary repair methods and materials may be used in remediation work, provided traffic safety and normal traffic patterns are maintained**.** Remove temporary repairs and perform permanent remediation work as soon as weather conditions permit.

The Department's notice to perform required remediation work, or the Department's approval of the Contractor's written proposal to perform elective or preventative maintenance work, shall serve as a right-of-entry that authorizes the work to be done, subject to time and location limitations contained in that notification, or those agreed to by the Contractor and the Department. Perform remediation work, including replacements, to meet the specified performance criteria indicated in Table A. Restore, according to Department specifications, all features removed and/or damaged during remediation work.

Except for allowable crack sealing, as indicated in Table A, repair distress areas to the limits specified with square or rectangular patches using materials meeting the requirements of this specification and constructed to meet the construction end-result and performance criteria of this specification.

Provide and maintain traffic control for operations involved in remediation work performed as part of the pavement warranty. Use the traffic control plan (TCP) provided in the original contract for remediation work, or submit an alternate TCP to the District Executive for approval. Submit alternate TCPs at least 14 calendar days before the start of remediation work. Alternate TCPs are to comply with the provisions of Publications 212 and 213, the MUTCD, and the contract special provisions.

If the Department's written notification indicates that remedial action is required as part of the pavement warranty and the Department's performance survey results are disputed, notify the Department, in writing, within 30 calendar days from the date of the Department's written notification. Base disputes on appraisals of the performance survey results supplied by the Department. The Contractor may base a dispute on a third party appraisal of the performance results. If the Department and Contractor cannot resolve a dispute over remediation work within 14 calendar days from the date of the Contractor's written notification, the dispute will be submitted to the Conflict Resolution Team identified in Section 496.3(c)3.

Remove material placed by the Department, during emergency repair work within warranted pavement areas and perform required remediation work if it is determined that the emergency repair was required due to faulty workmanship or construction.

The Contractor may monitor or test warranted pavement course(s), using nondestructive methods, at any time during the warranty period. Notify the District Executive at least 7 calendar days in advance of any nondestructive testing. Provide all nondestructive test results to the Department for information. Obtain written authorization from the Department before conducting nondestructive Testing.

Do not perform any remediation work without prior written notification from the Department. Submit a written proposal, to the District Executive, setting forth the reason(s) for performing elective or preventative remediation work not directed by the Department. The Department will review and approve or disapprove elective or preventative remediation work initiated by the Contractor within 5 calendar days from receipt of the written proposal.

3. Conflict Resolution Team. The Conflict Resolution Team (Team) will consist of two representatives selected by the Contractor, two representatives selected by the Department (District and Bureau of Project Delivery), and a fifth person mutually agreed upon by both the Department and the Contractor. Any costs incurred for the fifth Team member will be shared equally by the Department and the Contractor. The Team members, who will be identified at the pre-construction meeting, must be knowledgeable in the terms and conditions of the warranty specification and the methods used in the measurement and calculation of pavement distress. Each Team member will have an equal vote and the decision of the majority will be final. If a change in the team is required the same selection procedure will be used as stated above.

The Team will resolve disputes concerning defective work, warranted pavement performance, survey results, required remediation work, proposed alternate repair methods and material selection, and disputes over probable causes.

The Team will meet and resolve disputes within 30 calendar days from the date of submission.

4. Probable Cause. The Department will furnish the Contractor with the results of performance surveys and traffic counts, noting those distresses considered to be caused by factors beyond the control of the Contractor. The Contractor will not be held responsible for meeting specified performance criteria or performing remediation work within these distress areas, which will be calculated by multiplying the maximum transverse width of the distress by the maximum longitudinal length. The area of non-responsibility will be defined as a square or rectangular area centered over and equal to 150% of the distress area, but extending no more than 10 feet on either side of the distress area.

The Department may repair distresses determined to be caused by factors beyond the control of the Contractor using routine repair techniques.

Factors beyond the control of the Contractor include the following:

4.a Base Condition. If performance surveys detect fatigue cracking or other distresses which might indicate an unacceptable base condition, a series of 6-inch diameter cores will be drilled within the distress area, as necessary, at locations directed by the Department. The Inspector will measure the depth of each core. The cores will be tested according to PTM No. 715 and AASHTO T-209 to determine the percent of unfilled voids, PTM No. 702 or other approved test methods to determine the percent bitumen, and PTM No. 739 to determine gradation. Have a Representative witness the testing. Test results will be provided to the DME/DMM. If the warranted pavement meets

the specified minimum thickness, the density is $\geq$ 92% of theoretical maximum density and test results for percent bitumen and gradation are within the tolerances indicated in the Contractor's mix design(s), or if field evaluation clearly indicates base failure beyond the Contractor's control, the Contractor will not be held responsible for repair of the distress and will be reimbursed, by the Department, the total cost of the testing. Should these criteria not be achieved, further investigation may be necessary to determine the cause of the distress.

4.b Traffic Loadings. If, during the warranty period, the Department's traffic counts indicate that estimated cumulative ESALs have exceeded 100% of the estimated 20-year design life ESALs or if the ESAL's increase enough to warrant a change in the mix design in the number of gyrations, the Contractor will not be held responsible for repair of rutting or base condition distresses for the remainder of the warranty period.

4.c Routine Maintenance by the Department. During the warranty period, the Department will perform routine maintenance such as snow removal, application of anti-skid material and/or de-icing chemicals, repairs to safety appurtenances, application and maintenance of pavement markings, mowing, and sign maintenance. Routine pavement maintenance activities, such as crack sealing, pothole patching, or milling, will not be performed by the Department during the warranty period.

4.d Destructive Procedures by the Department. The Contractor will not be held responsible for repair of distresses caused by coring, milling or other destructive procedures performed by the Department.

4.e Uncontrolled Forces of Nature. The Contractor will not be held responsible for repair of distresses caused by floods, earthquakes, tornadoes, brush or forest fires, landslides, sinkholes, or other natural disasters.

4.f Traffic Accidents. The Contractor will not be held responsible for repair of distresses caused by traffic accident-related fuel or chemical spills, vehicle fires, and/or gouging or goring of the pavement surface unless the Contractor or its representative is the cause of the distress.

5. Final Warranty Inspection. At the end of the warranty period, and when any remediation work, if required, is substantially complete (at least 90%), make arrangements for a mutual final warranty inspection. At the time of final warranty inspection, the Representative, along with the Contractor, will establish the following:

- The list of all physical work items requiring completion and/or correction; and
- A list of all documents requiring submission, completion, and/or correction.

As established during the final warranty inspection, perform work as necessary for required correction or completion of all physical work items, and complete, correct, and submit all outstanding documents.

6. Release from Warranty. To be released from warranty responsibility, satisfy all of the following:

- Meet minimum requirements for each of the specified performance criteria through the end of the warranty period,
- Complete all required remediation work identified during the warranty period at no additional cost to and to the satisfaction of the Department, and
- Submit all required warranty documents.

When the warranty period has expired, all physical remediation work has been satisfactorily completed, and all required warranty release criteria have been met, the Representative will establish the date of physical warranty work completion; the date on which the Contractor will be relieved of responsibility for further physical remediation work and maintenance on the project or any substantial project section.

Upon receipt and verification, the Representative will establish the date that all required warranty documents are satisfactorily furnished.

When all physical remediation work has been satisfactorily completed and all contractually required warranty documents have been properly furnished, the date of warranty project acceptance will be established.

If the warranty period for a substantial project section expires in advance of the whole, a final warranty inspection will be made of that section, as specified for the entire project, and the Contractor notified, in writing, that the warranty terms for the specific section of the project have been satisfied. No further remediation work will be required on the

section as specified in Section 108.04(b). The Contractor will then be allowed to reduce their warranty bond proportionately.

7. Warranty Acceptance Notification. Upon completion of the requirements of Section 496.3(c)6, a Warranty Acceptance Notification will be issued indicating that the project warranty has been satisfactorily completed and certifying that the project is accepted as of that date.

8. Warranty Default and Termination of Contract. As specified in Section 108.08 and as follows:

- Failure of the Contractor to perform remediation work within the time specified.

496.4. MEASUREMENT AND PAYMENT—

(a) Asphalt Concrete Pavement, 60-Month Warranty. Square Yard

Payment will be made, as specified in Section 110.05, as work progresses, based on the quantity of each separate pavement course placed meeting specified construction criteria.

The Inspector will measure the quantity of each pavement course placed, on a daily basis, and compute the payable quantity by multiplying the measured area by a factor equal to the depth of the pavement course being placed divided by the total, indicated pavement depth. The placement depth will be determined as indicated in Section 496.3(a). No additional payment will be made for pavement depths in excess of the total, indicated depth.

(b) Asphalt Concrete Pavement, 60-Month Warranty, Warranty Bond and Liability Insurance. Lump Sum

LABORATORY TESTING SECTION

Method of Test for

PROBABILITY SAMPLING

1. SCOPE

1.1 This method of test outlines the procedures for selecting sampling sites in accordance with accepted probability sampling techniques. It is intended that all Department samples, regardless of size, type or purpose shall be selected in an unbiased manner, based entirely on chance.

2. SECURING SAMPLES

2.1 Department samples shall be taken as directed by the engineer or their authorized representative.

2.2 Sample location and sampling procedure are as important as testing. It is essential that the sample location be chosen in an unbiased manner and the sample taken precisely as directed by the appropriate PTM.

3. RANDOM NUMBER TABLE

3.1 For test results or measurements to be meaningful, it is necessary that the SUBLOTS to be sampled or measured be selected at random, which means using a table of random numbers. The following table of random numbers has been devised for this purpose. To use the table in selecting sample locations, proceed as follows.

3.2 Determine the LOT size and the number of SUBLOTS Per LOT by referring to the PTM for the material being sampled.

3.3 For each LOT, use five consecutive two-digit random numbers from Table I. For example, if the PTM for a particular material specifies five sublots per LOT and the number 15 is randomly selected as the starting point from Column X (or Column Y) for the first LOT, numbers 15-19 would be the five consecutive two-digit random numbers. For the second LOT, another random starting point, number 91 for example, is selected and the numbers 91 through 95 are used for the five consecutive two-digit random numbers. The same procedure is used for additional LOTS.

3.4 For samples taken from the roadway, use the decimal values in Column X and Column Y to determine the coordinates of the sample locations as specified in the appropriate PTM.

3.5 In situations where coordinate locations do not apply (i.e., plant samples, stockpile samples, etc.), use only those decimal values from Column X or Column Y as specified in the appropriate PTM.

4. SAMPLING PROCEDURE

4.1 After the appropriate number of random locations has been determined, refer to the proper PTM for special sampling procedure instructions and examples.

5. DEFINITION OF TERMS

5.1 LOT - an isolated quantity of a specified material from a single source or a measured amount of specified construction assumed to be produced by the same process. The LOT size is specified in the PTM for the material being sampled.

5.2 SUBLOT - a portion of a LOT; the actual location from which a sample is taken. The size of the sublot and the number of sublots per LOT are specified in the PTM for the material being sampled.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
TABLE I
RANDOM POSITIONS IN DECIMAL FRACTIONS (2 PLACES)

	X		Y		X		Y		X		Y
1.	0.29	R	0.66	34.	0.61	L	0.87	67.	0.93	R	0.17
2.	0.74	R	0.49	35.	0.76	R	0.16	68.	0.40	R	0.50
3.	0.89	L	0.79	36.	0.87	L	0.10	69.	0.44	R	0.15
4.	0.60	R	0.39	37.	0.41	L	0.10	70.	0.03	L	0.60
5.	0.88	R	0.31	38.	0.28	R	0.23	71.	0.19	L	0.37
6.	0.72	L	0.54	39.	0.22	L	0.18	72.	0.92	L	0.45
7.	0.12	R	0.08	40.	0.21	L	0.94	73.	0.20	L	0.85
8.	0.09	L	0.94	41.	0.27	L	0.52	74.	0.05	R	0.56
9.	0.62	L	0.11	42.	0.39	R	0.91	75.	0.46	R	0.58
10.	0.71	R	0.59	43.	0.57	L	0.10	76.	0.43	R	0.91
11.	0.36	L	0.38	44.	0.82	L	0.12	77.	0.97	L	0.55
12.	0.57	R	0.49	45.	0.14	L	0.94	78.	0.06	R	0.51
13.	0.35	R	0.90	46.	0.50	R	0.58	79.	0.72	L	0.78
14.	0.69	L	0.63	47.	0.93	L	0.03	80.	0.95	L	0.36
15.	0.59	R	0.68	48.	0.43	L	0.29	81.	0.16	L	0.61
16.	0.06	L	0.03	49.	0.99	L	0.36	82.	0.29	R	0.47
17.	0.08	L	0.70	50.	0.61	R	0.25	83.	0.48	R	0.15
18.	0.67	L	0.68	51.	0.87	L	0.36	84.	0.73	R	0.64
19.	0.83	R	0.97	52.	0.34	L	0.19	85.	0.05	L	0.94
20.	0.54	R	0.58	53.	0.37	R	0.33	86.	0.43	L	0.05
21.	0.82	R	0.50	54.	0.97	L	0.79	87.	0.87	R	0.98
22.	0.66	R	0.73	55.	0.13	R	0.56	88.	0.37	L	0.71
23.	0.06	L	0.27	56.	0.85	R	0.64	89.	0.94	L	0.26
24.	0.03	L	0.13	57.	0.14	L	0.04	90.	0.57	L	0.63
25.	0.55	L	0.29	58.	0.99	R	0.74	91.	0.26	R	0.80
26.	0.64	L	0.77	59.	0.40	L	0.76	92.	0.01	L	0.79
27.	0.30	R	0.57	60.	0.37	L	0.09	93.	0.83	R	0.59
28.	0.51	R	0.67	61.	0.90	R	0.74	94.	0.71	L	0.21
29.	0.29	R	0.09	62.	0.09	L	0.70	95.	0.65	L	0.63
30.	0.63	R	0.82	63.	0.66	L	0.97	96.	0.65	L	0.87
31.	0.53	L	0.86	64.	0.89	L	0.55	97.	0.72	R	0.92
32.	0.99	R	0.22	65.	0.67	L	0.44	98.	0.85	L	0.78
33.	0.02	R	0.89	66.	0.02	R	0.65	99.	0.04	L	0.46
								100.	0.29	L	0.95

X = Decimal fraction of the total length measured along the road from the starting point.
Y = Decimal fraction measured across the road from either outside edge towards the centerline of the paved lane.
R = Indicates measurement from the right edge of the paved lane.
L = Indicates measurement from the left edge of the paved lane.

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PA Test Method No. 510
October 2013
12 Pages

LABORATORY TESTING SECTION

Method of Test for

SOUNDNESS OF AGGREGATE BY USE OF SODIUM SULFATE

1. SCOPE

1.1 This method of test, which is based on AASHTO T-104, covers the procedure to be followed in testing aggregates to determine their resistance to disintegration by saturated solutions of sodium sulfate. This is accomplished by repeated immersion in saturated solutions of sodium sulfate followed by oven drying to partially or completely dehydrate the salt precipitated in permeable pore spaces. The internal expansive force, derived from the re-hydration of the salt upon re-immersion, simulates the expansion of water on freezing. This test method furnishes information helpful in judging the soundness of aggregates subject to weathering action, particularly when adequate information is not available from service records of the material exposed to actual weathering conditions.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

- M-92, Wire-Cloth Sieves for Testing Purposes
- R-16, Regulatory Information for Chemicals Used in AASHTO Tests
- T-27, Sieve Analysis of Fine and Coarse Aggregate

2.2 ASTM Standards:

- C 670, Practice for Preparing Precision Statements for Test Methods for Construction Materials
- E 100, Specification for ASTM Hydrometers

3. APPARATUS

3.1 Sieves- With square openings of the following sizes conforming to AASHTO M-92, for sieving the samples in accordance with Sections 5, 6, and 8:

4.75 mm	(No. 4)	63 mm	(2½")
4.00 mm	(No. 5)	50 mm	(2")
2.36 mm	(No. 8)	37.5 mm	(1½")
1.18 mm	(No. 16)	31.5 mm	(1¼")
600 μm	(No. 30)	25.0 mm	(1")
300 μm	(No. 50)	19.0 mm	(¾")
150 μm	(No. 100)	16.0 mm	(⅝")
		12.5 mm	(½")
		9.5 mm	(⅜")
		8.0 mm	(5/16")

3.2 Mechanical Sieving Device- A mechanical sieving device shall provide the motion specified in PTM 616, Sieve Analysis of Coarse and Fine Aggregate (Note 1).

> NOTE 1- A mechanical sieving device is required for the testing of fine aggregate by this method. Its use is not permitted in the testing of coarse aggregate larger than 9.5 mm (3/8”), except for making a rough separation of material prior to washing the sample.

3.3 Containers- Containers for immersing the samples of aggregate in the sodium sulfate solution.

3.3.1 For Fine Aggregates- Stainless steel pots or pans, approximately 105 mm (4⅛") in diameter and not less than 76 mm (3") deep are satisfactory containers for the samples.

3.3.2 For Coarse Aggregates- Stainless steel or aluminum pans, approximately 203 mm (8") in diameter and not less than 76 mm (3") deep are satisfactory containers for the samples.

3.4 Temperature Regulation- Suitable means for regulating the temperature of the samples during immersion in the sodium sulfate solution shall be provided.

3.5 Thermometer- A thermometer covering the recommended temperature range for solutions during the test and readable to 0.1°C (0.2°F).

3.6 Balance- A balance conforming to the requirements of AASHTO M-231, Class G2.

3.7 Drying Oven- The oven shall be capable of being heated continuously at 110 ± 5°C (230 ± 9°F) and the rate of evaporation, at this range of temperature, shall be at least 25 g/h for 4 hours, during which period the doors of the oven shall be kept closed. This rate of evaporation shall be determined by the loss of water from 1-liter Griffin low-form beakers, each initially containing 500 g of water at a temperature of 21 ± 2°C (70 ± 3°F), placed at each corner and at the center of each shelf of the oven. The evaporation requirement is to apply to all test locations when the oven is empty except for the beakers of water.

3.8 Specific Gravity Measurement- Hydrometers conforming to the requirements of ASTM E100, capable of measuring the solution specific gravity within ±0.001.

4. SODIUM SULFATE SOLUTION

4.1 Prepare the sodium sulfate solution, for immersion of the test samples, in accordance with Section 4.1.1 (Note 2).

> NOTE 2-Some aggregates containing carbonates of calcium are attacked chemically by fresh sulfate solution, resulting in erroneously high measured losses. If this condition is encountered or is suspected, repeat the test using a filtered solution that has been used previously to test the same type of carbonate rock, provided that the solution meets the requirements of Sections 4.1.1 for specific gravity.

4.1.1 Sodium Sulfate Solution- Prepare a saturated solution of sodium sulfate by dissolving a reagent grade of the salt in water (Note 4) at a temperature of 25°C (77°F) minimum. Add sufficient salt (Note 3) of the anhydrous (NA_2SO_4) form to ensure not only saturation but also the presence of excess crystals when the solution is ready for use in the tests. Thoroughly stir the mixture during the addition of the salt and stir the solution at frequent intervals until used. To reduce evaporation and prevent contamination, keep the solution covered at all times when access is not needed. Allow the solution to cool to 20.3 to 21.9°C (68.5 to 71.5°F). Again stir, and allow the solution to remain at the designated temperature for at least 48 hours before use. Prior to each use, break up the salt cake, if any, in the container, stir the solution thoroughly and determine the specific gravity of the solution. When used, the solution shall have a specific gravity of not less than 1.154 nor more than 1.171. The solution shall be reused until completion of the required 5 cycles of soaking and drying, after which it shall be discarded.

> NOTE 3- 215 g of anhydrous salt per liter of water is sufficient for saturation of the sodium sulfate solution at 22°C (71.6°F). However, since this salt is not completely stable and since it is desirable that an excess of crystals be present, the use of not less than 225 g of the anhydrous salt per liter of water is recommended.

> NOTE 4- Distilled water shall be used in referee or comparison testing.

4.2 Barium Chloride Solution- A 0.2 molar solution of barium chloride is used (41.6 g of $BaCl_2$ per liter of solution) to determine the presence of sodium sulfate in the wash water.

5. SAMPLES

5.1 Fine Aggregate- Fine aggregate for the test shall be passed through a 9.5 mm (3/8") sieve. The sample shall be of such a size that it will yield not less than 100 g of each of the following sizes, expressed in terms of the following sieves:

Passing Sieve	Retained on Sieve
9.5 mm (⅜")	4.75 mm (No. 4)
4.75 mm (No. 4)	2.36 mm (No. 8)
2.36 mm (No. 8)	1.18 mm (No. 16)
1.18 mm (No. 16)	600 μm (No. 30)
600 μm (No. 30)	300 μm (No. 50)

5.1.1 Should the sample contain less than 5 percent of any of the sizes specified in Section 5.1, that size shall not be tested.

5.2 Coarse Aggregate- Coarse aggregate for the test shall consist of material from which the sizes finer than the 4.75 mm (No. 4) sieve have been removed. The sample shall be of such a size that it will yield the amounts indicated in Table 1.

Table 1 - Coarse Aggregate Sample

Sieve Size	Mass, g
63 mm to 37.5 mm (2½" to 1½")	5000 ± 300
Consisting of:	
50 mm to 37.5 mm (2" to 1½") material	2000 ± 200
63 mm to 50 mm (2½" to 2") material	3000 ± 300
37.5 mm to 19.0 mm (1½" to ¾")	1500 ± 50
Consisting of:	
25.0 mm to 19.0 mm (1" to ¾") material	500 ± 30
37.5 mm to 25.0 mm (1½" to 1") material	1000 ± 50
19.0 mm to 9.5 mm (¾" to ⅜")	1000 ± 10
Consisting of:	
12.5 mm to 9.5 mm (½" to ⅜") material	330 ± 5
19.0 mm to 12.5 mm (¾" to ½") material	670 ± 10
9.5 mm to 4.75 mm (⅜" to No. 4)	300 ± 5

NOTE 5- The sample size for AASHTO No. 8's shall be 300 ± 5 g passing the 3/8" sieve retained on the No. 4 sieve only.

5.2.1 Should the sample contain less than 5 percent of any of the sizes specified in Section 5.2, that size shall not be tested. When a combination of sizes is specified for the test portion and one of the sizes specified is less than 5 percent of the sample, reduce the test portion by the applicable mass specified in Section 5.2 for the size not available.

5.2.2 When testing large rock (broken stone, ledge rock, cobbles, and boulders for use as riprap, channel lining, etc.), obtain the test portion by crushing, splitting, or sawing the larger sample pieces. Test only those pieces in the 37.5 to 19.0 mm (1½ to ¾") and 63 to 37.5 mm (2½ to 1½") size fractions when size reduction is by crushing or splitting.

5.2.3 When testing large rock (to evaluate a potential source) that will be subsequently crushed to produce aggregate, obtain the test portion by crushing the larger sample pieces. Test pieces only in those sizes that will be included in the produced aggregate, but ignoring any material finer than 4.75 mm (No. 4) sieve or coarser than 63 mm (2½") sieve.

5.2.4 When the finished aggregate material will contain particles coarser than 63 mm (2½"), such as aggregate for use in mass concrete, crush the material coarser than 63 mm (2½") and distribute the material among that in the range of 63 mm (2½") to 4.75 mm (No. 4) sieves. Discard material finer than 4.75 mm (No. 4) sieve.

6. PREPARATION OF TEST SAMPLE

6.1 Fine Aggregate- Thoroughly wash the sample of fine aggregate on a 300 μm (No. 50) sieve, dry to constant mass at 110 ± 5°C (230 ± 9°F), and separate into the different sizes by sieving, as follows: Make a rough separation of the graded sample by means of a nest of the standard sieves specified in Section 5.1. From the fractions obtained in this manner, select samples of sufficient size to yield 100 g after sieving to refusal (In general, a 110 g sample will be sufficient). Do not use fine aggregate sticking in the meshes of the sieves in preparing the samples. Weigh samples consisting of 100 ± 0.1 g out of each of the separated fractions after final sieving, record the masses of the test samples, and place in separate containers for the test.

6.2 Coarse Aggregate- Thoroughly wash and dry the sample of coarse aggregate to constant mass at 110 ± 5°C (230 ± 9°F) and separate it into the different sizes shown in Section 5.2 by sieving to refusal. Weigh out quantities of the different sizes within the tolerances of Section 5.2 and combine them to the designated total mass (Note 6). Record the masses of the test samples and their fractional components. In the case of sizes larger than 19.0 mm (3/4"), record the number of particles in the test samples.

Note 6- The fractional components of each sample may be placed in separate containers if so desired but it is not required. If separate containers are used, the two sizes must be combined for the calculations under Section 8.1.2 (Table 2).

Table 2 - Suggested Form for Recording Test Data (with Illustrative Test Values)

Sieve Size			Grading of Original Sample, Percent Retained	Mass of Test Fractions Before Test, g	Percentage Passing Designated Sieve After Test	Weighted Percentage Loss
Soundness Test of Fine Aggregate						
Minus 150 μm			5			
300 μm to 150 μm			12			
600 μm to 300 μm			26	100	4.20	1.09
1.18 mm to 600 μm			25	100	4.80	1.20
2.36 mm to 1.18 mm			17	100	8.00	1.36
4.75 mm to 2.36 mm			11	100	11.20	1.23
9.5 mm to 4.75 mm			4		11.20[a]	0.45
Totals			100			5.33
Soundness Test of Coarse Aggregate						
63 mm to 50 mm 50 mm to 37.5 mm	2825 g 1958 g	63 to 37.5 mm	20	4783	4.80	0.96
37.5 mm to 25.0 mm 25.0 mm to 19.0 mm	1012 g 513 g	37.5 to 19.0 mm	45	1525	8.00	3.60
19.0 mm to 12.5 mm 12.5 mm to 9.5 mm	675 g 333 g	19.0 to 9.5 mm	23	1008	9.60	2.21
9.5 mm to 4.75 mm			12	298	11.20	1.34
Totals			100			8.11

[a] The percentage loss (11.20 percent) of the next smaller size is used as the percentage loss for this size, since this size contains less than 5 percent of the original sample as received. Section 10.1.3.2.

NOTE 7- Calculate the percentage loss and weighted percentage loss for each size fraction and the weighted average percentage loss to the nearest 0.01%. Record the soundness loss for the appropriate gradation to the nearest 0.01%.

6.3 For 2A, OGS, #57, #67, the standard grading is as follows:

Table 3 - AASHTO 2A OGS, #57, #67 Gradation

Sieve Size		Standard Grading %
Passing	Ret. On	
7.5 mm (1½")	19.0 mm (¾")	36.8
9.0 mm (¾")	9.5 mm (⅜")	36.9
9.5 mm (⅜")	4.75 mm (No. 4)	26.3

7. PROCEDURE

7.1 Storage of Samples in Solution- Pour the prepared solution of sodium sulfate into the sample containers in such a manner that the solution covers them to a depth of at least 12.5 mm (1/2"), for not less than 16 nor more than 18 hours. Cover the containers to reduce evaporation and prevent the accidental addition of extraneous substances. Maintain the samples immersed in the solution at a temperature of 20.3 to 21.9°C (68.5 to 71.5°F) for the immersion period.

7.2 Drying Samples After Immersion- After the immersion period, carefully drain the solution from the sample container and return the solution to a common container for reuse. Then place the sample containers in a drying oven maintained at a temperature of 110 ± 5°C (230 ± 9°F). Dry the samples at the specified temperature until constant mass has been achieved. Establish the time required to attain constant mass as follows: with the oven containing the maximum sample load expected, check the mass losses of test samples by removing and weighing them without cooling, at intervals of 2 to 4 hours. Check to establish the required drying time for the least favorable oven location (Section 3.7) and sample condition (Note 8). Constant mass will be achieved when the mass loss is less than 0.1 percent of sample mass in 4 hours of drying. After constant mass has been achieved, allow the samples to cool to 20 to 25°C (68 to 77°F) (Note 9), when they shall again be placed in the prepared solution and tested as described in Section 7.1. Cooling may be aided by the use of an air conditioner or fan. The temperature of the material shall be checked by thermometer or other acceptable means before placing the material in the soaking solution.

> NOTE 8- Drying time required to reach constant mass may vary considerably for several reasons. Efficiency of drying will be reduced as cycles accumulate because of salt adhering to particles and in some cases, because of increase in the surface area due to breakdown. The different size fractions of aggregate will have differing drying rates. The smaller sizes will tend to dry more slowly because of their larger surface area and restricted interparticle voids, but this tendency may be altered by the effects of container size and shape.

NOTE 9- Experience has shown that sample temperatures significantly different than the solution temperature of 21.1°C (70.0°F) may change the temperature of the solution temporarily, thereby causing a change in salt saturation even though the solution returns to 21.1°C (70.0°F) for most of the soaking period. This may cause erroneous results.

7.3 Number of Cycles- Repeat the process of alternate immersion and drying until five cycles are completed.

8. QUANTITATIVE EXAMINATION

8.1 Make the quantitative examination as follows:

8.1.1 After completion of the final cycle and after the sample has cooled, wash the sample free from the sodium sulfate. Wash by circulating water at 43 ± 6°C (110 ± 10°F) through the samples in their containers by introducing hot water near the bottom and allowing the water to pass through the samples and overflow out of the container. The thoroughness of washing shall be checked by obtaining a sample of rinse water after it has passed through the samples and checked with 0.2 molar barium chloride. Further washing is required if the sample becomes cloudy upon addition of the barium chloride solution. In areas where the water gives a reaction with barium chloride other analytical means shall be used to assure thoroughness of washing. In the washing operation, the samples shall not be subjected to impact or abrasion that may tend to break up particles.

8.1.2 After the sodium sulfate has been removed, dry each fraction of the sample to constant mass at 110 ± 5°C (230 ± 9°F). Sieve the fine aggregate over the same sieve on which it was retained before the test, and sieve the coarse aggregate over the sieve shown below for the appropriate size of particle. For fine aggregate, the method and duration of sieving shall be the same as were used in preparing the test samples. For coarse aggregate, sieving shall be by hand, with agitation sufficient only to assure that all undersize material passes the designated sieve. No extra manipulation shall be employed to break up particles or cause them to pass the sieves. Determine the mass of the material retained on each sieve and record each amount. The difference between each of these amounts and the initial mass of the fraction of the sample tested is the loss in the test and is to be expressed as a percentage of the initial mass for use in Table 2.

Size of Aggregate	Sieve Used to Determine Loss
63 mm to 37.5 mm (2½ to 1½")	31.5 mm (1¼")
37.5 mm to 19.0 mm (1½ to ¾")	16.0 mm (⅝")
19.0 mm to 9.5 mm (¾ to ⅜")	8.0 mm (5/16")
9.5 mm to 4.75 mm (⅜" to No. 4)	4.0 mm (No. 5)

9. QUALITATIVE EXAMINATION

9.1 Make a qualitative examination of test samples coarser than 19.0 mm (3/4") as follows (Note 10):

9.1.1 Separate the particles of each test sample into groups according to the action produced by the test (Note 10).

9.1.2 Record the number of particles showing each type of distress.

NOTE 10- Many types of action may be expected. In general, they may be classified as disintegration, splitting, crumbling, cracking, flaking, etc. While only particles larger than 19.0 mm (3/4") in size are required to be examined qualitatively, it is recommended that examination of the smaller sizes be made in order to determine whether there is any evidence of excessive splitting.

10. REPORT

10.1 The report shall include the following data (Note 11):

10.1.1 Mass of each fraction of each sample before the test.

10.1.2 Material from each fraction of the sample finer than the sieve designated in Section 8.1.2 for sieving after the test, expressed as a percentage of the original mass of the fraction.

10.1.3 Weighted average calculated from the percentage of loss for each fraction, based on the grading of the sample as received for examination determined by using PTM 616 or, preferably, on the average grading of the material from that portion of the supply of which the sample is representative except that:

10.1.3.1 For fine and coarse aggregates sizes finer than the 300 μm (No. 50) sieve they shall be assumed to have 0 percent loss.

10.1.3.2 For the purpose of calculating the weighted average, consider any size in Section 5.1 or 5.2 that contain less than 5 percent of the sample to have the same loss as the average of the next smaller and the next larger size, or if one of these sizes is absent, to have the same loss as the next larger or next smaller size, whichever is present.

10.1.3.3 For large rock tested according to Section 5.2.2 the weighted average (if more than one size fraction is tested) shall be the arithmetic mean of the loss on the fractions tested.

10.1.3.4 For large rock tested according to Sections 5.2.3 or 5.2.4, the weighted average shall be based on a sample grading conforming to the middle of the specification to which the aggregate will be produced, or the actual grading as produced. If the specification grading includes fractions larger than the 63 mm (2½") sieve, assume such sizes to have the same percentage loss as the 63 to 37.5 mm (2½ to 1½") fraction.

10.1.4 Report the weighted percentage loss to the nearest 0.01%.

10.1.5 In the case of particles coarser than the 19.0 mm (3/4") sieve before the test: (1) count the number of particles in each fraction before the test, and (2) count the number of particles affected, classified as to number disintegrating, splitting, crumbling, cracking, flaking, etc., as shown in Table 4.

Table 4 - Suggested Form for Qualitative Examination (with Illustrative Test Values)

Qualitative Examination of Coarse Sizes									
	Particles Exhibiting Distress								Total No. of Particles Before Test
	Splitting		Crumbling		Cracking		Flaking		
Sieve Size	No.	Percent	No.	Percent	No.	Percent	No.	Percent	
63 mm to 37.5 mm (2½ to 1½")	2	7			2	7			29
37.5 mm to 19.0 mm (1½ to ¾")	5	-	-	2	-	-	-	-	50

10.1.6 Type of solution (sodium sulfate)

10.1.7 Method of producing particles for test, when reduced from large pieces as described in Sections 5.2.2, 5.2.3, or 5.2.4

NOTE 11- Table 2, shown with test values inserted for purpose of illustration, is a suggested form for recording test data.

11. PRECISION

11.1 For coarse aggregate with weighted average sulfate soundness losses in the ranges of 6 to 16 percent for sodium sulfate, the precision indexes are as indicated, in Table 5 (Note 12).

Table 5 - Precision Indexes

	Coefficient of Variation (1S%), Percent[a]	Difference Between Two Tests (D2S%), Percent of Average[a]
Multilaboratory:		
Sodium sulfate	41	116
Single-Operator:		
Sodium sulfate	24	68

[a] These numbers represent, respectively, the (1S%) and (D2S%) limits as described in ASTM C 670.

NOTE 12- The values in the precision statement are based on testing according to this method prior to revision in 1991. The revisions in 1991 are believed to improve the precision of the method.

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LABORATORY TESTING SECTION

Method of Test for

SIEVE ANALYSIS OF COARSE AND FINE AGGREGATE

This PTM is a modification of AASHTO T-27. The full standard is available from American Association of State Highway and Transportation Officials, 444 N. Capitol Street, N.W., Suite 249, Washington, D.C. 20001 (www.transportation.org).

The modifications to AASHTO T-27 are as follows:

6. APPARATUS

6.4 Oven- An oven of appropriate size capable of maintaining a uniform temperature of 110 ± 5°C (230 ± 9°F). Hot plates either electric or gas may be used when test results must be obtained quickly. Confirmation samples shall be tested using ovens as described in this section.

7. SAMPLING

7.1 Sample the aggregate in accordance with PTM 607.

7.3 Fine Aggregate - The size of the test sample of aggregate, after drying shall have an approximate mass of 500 grams.

7.4 Coarse Aggregate- The mass of the test sample of coarse aggregate shall conform with the following:

AASHTO / PA Number	Minimum Mass of Sample	
	Kg	lb.
# 1	Usual inspection per section 850.2 (a) 1 & 2, Pub. 408	
# 3	20	44
# 5	10	22
# 57	10	22
# 67	10	22
# 7	10	22
# 8	5	11
# 10	1	2
2A	15	33
OGS	15	33

7.7.1 Delete this section
7.7.2 Delete this section
7.7.3 Delete this section

8. PROCEDURE

8.4 (For Fine Aggregates) - Sieve for a sufficient period and in such a manner that, after completion, not more than 0.5 percent by mass of the total sample passes any sieve during 1 minute of continuous hand sieving performed as follows: Hold the individual sieve, provided with a snug fitting pan and cover, in a slightly inclined position in one hand. Strike the side of the sieve sharply with an upward motion while holding the sieve in the other hand, at the rate of about 150 times per minute. Turn the sieve about one-sixth of a revolution at intervals of about 25 strokes.

(For Coarse Aggregates) - Sieve for a sufficient period and in such a manner that, after completion, not more than 0.5 percent by mass of the total sample passes any sieve during 1 minute of continuous mechanical shaking as follows: Weigh the material retained on each individual sieve after the initial shaking period. Individually place each sieve with the material retained on the sieve back into the mechanical shaking device and sieve for an additional minute. In determining the sufficiency of sieving for sizes larger than 4.75 mm (No. 4) sieve, limit the material on the sieve to a single layer of particles.

Note- The Sufficiency of Sieving procedure is documented in PTM 608.

8.7 Determine the mass of each size increment by weighing on a scale or balance conforming to the requirements specified in Section 6.1 to the nearest 0.1 percent of the total original dry sample mass. The total mass of the material after sieving shall check closely with the original mass of sample placed on the sieves. If the amounts differ by more than 0.8 percent, based on the original dry sample mass, the results shall not be used for acceptance purposes.

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PA Test Method No. 702
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LABORATORY TESTING SECTION

Method of Test for

QUANTITATIVE EXTRACTION OF BITUMEN FROM BITUMINOUS PAVING MIXTURES

l. SCOPE

1.1 This method covers procedures for the quantitative determination of bitumen in hot-mixed paving mixtures, mixtures containing liquid bituminous materials, and pavement samples. This method is a modification of AASHTO T-164. Contact the Innovation and Support Services Division, Laboratory Testing Section for copies of the AASHTO or ASTM test methods referred to in this PTM.

1.2 The extracted aggregate may be used for sieve analysis according to PTM No. 739.

NOTE 1- Although bitumen, by definition, is material soluble in carbon disulfide, 1,1,1-Trichloroethane is used in this method for safety reasons. Toluene or Trichloroethylene may also be used.

NOTE 2 - Terpene type solvents may be substituted for 1,1,1-Trichloroethane in Method A providing the following steps have been taken:

1. Follow all steps in Sections 8.2.1 and 8.3.1 modified for Terpene use.

2. A trial extraction of a sample with a known asphalt content has been performed using the modified procedures yielding satisfactory results (± 0.1 percent).

1.3 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. SUMMARY OF METHOD

2.1 The paving mixture is extracted with 1, 1, 1-Trichloroethane using the extraction equipment applicable to the particular method. The bitumen content is calculated by taking the difference between the mass of the original sample, and the combined mass of the extracted aggregate, moisture content, and ash from an aliquot part of the extract. A bitumenometer may be used to determine the bitumen content.

3. APPARATUS

3.1 Oven- Capable of maintaining the temperature at 163 ± 5ºC (325 ± 9 ºF).

3.2 Pan- Flat pan, 300 mm (12 in.) long, 200 mm (8 in.) wide, and 25 mm (1 in.) deep.

3.3 Balance- A balance conforming to the requirements of AASHTO M-231, Class G2.

3.4 Hot Plate- Electric, with an adjustable heating rate.

3.6 Graduated Cylinder- 1000 or 2000 mL capacity

3.7 Ignition Dish- 125 mL capacity

3.8 Desiccator

3.9 Analytical Balance- An analytical balance conforming to the requirements of AASHTO M-231, Class B.

3.10 Muffle furnace or gas burner capable of maintaining temperatures between 500 and 660 C (932 and 1220 F).

4. REAGENTS

4.1 Ammonium Carbonate- Saturated solution of reagent grade ammonium carbonate $(NH_4)_2CO_3$.

4.2 1,1,1-Trichloroethane- Conforming to Federal Specification O-T-620 a (Int. Amd. 3); Refer to Sec. 17.1 (Method D) for an additional requirement when the bitumenometer is used for bitumen content.

NOTE 3- The solvents shall be used only under a hood in a well-ventilated area, since they are all toxic to some degree. The maximum acceptable concentration for an eight hour exposure for 1,1,1-Trichloroethane is 500 ppm.

CAUTION: 1,1,1-Trichloroethane in the presence of heat and moisture may form acids that are extremely corrosive to certain metals, particularly, when subjected to contact over lengthy periods of time. Proper precautions shall be taken to not allow the solvents to remain, even in small quantities in the effluent tanks of aluminum vacuum extractors.

5. WATER DETERMINATION

5.1 Determine the water content of a representative portion of the mixture according to AASHTO T-110, Test for Moisture or Volatile Distillates in Hot-Mix Asphalt.

5.2 Calculate the mass of water in the sample (W_2) by multiplying the moisture content by the mass of the sample.

NOTE 4- The Water Determination Test is conducted only when water is known to be present or if its presence is suspected.

6. PREPARATION OF SAMPLE

6.1 If the mixture is not sufficiently soft to separate with a spatula or trowel, place the mixture in a large flat pan and warm until it can be handled at the following temperature 163 ± 5 ^{o}C (325 ± 9 ^{o} F). Separate the particles of the mixture as uniformly as possible using care not to fracture the mineral particles. Care shall be taken to avoid overheating the sample or leaving the sample in the oven for too long a period. Thoroughly mix the sample and form into a flat pile. Quarter the sample to the required size of sample for the extraction test.

6.2 Recommended approximate sizes of the sample are given in the test methods.

NOTE 5- In no case shall the selection of a predetermined mass be attempted.

NOTE 6- When the required minimum mass of the sample is greater than the allowable maximum mass for the method used, divide the sample into equal portions for testing. The masses for calculations will be the sum of like masses of the test portions.

6.3 Weighing of the extraction test apparatus and/or samples shall be done on a balance meeting the requirements of Section 3.3.

6.4 Mixtures containing liquid bituminous materials (such as cutbacks and emulsified asphalt) shall be cured before testing.

6.4.1 All bituminous mixtures containing emulsified asphalt and cutback asphalt (except stockpile patch mixes containing emulsified asphalt) shall be spread on a tray of sufficient size to hold the total sample, one layer deep. Place the sample in an oven maintained at 163 ± 5 ^{o}C (325 ± 9 ^{o}F) for one-half hour, remove and weigh. Place the sample back in the oven and remove at half-hour intervals until the sample has reached a constant mass. Approximately one to two hours are required. Proceed with the extraction.

6.4.2 Stockpiled patch mixes containing emulsified asphalt shall be cured for 15 minutes at 163 ± 1.5 ^{o}C (325 ±9 ^{o}F), either in an oven or on a hot plate, mixing occasionally.

6.4.3 Stockpiled patch mixes containing polypropylene fibers shall be cured in an oven, overnight at 88 ± 5.5 °C (190 ± 10°F). Also, the extracted aggregate shall be dried to a constant mass at 88 ± 5.5 °C (190 ± 10° F).

6.5 Mixtures containing tar (FB-1, FB-2, and some stockpile patch mixes) do not require curing. The sample is extracted by an approved method and the resulting bitumen content corrected for insoluble tar as determined in the remaining part of this section.

6.5.1 Apparatus

6.5.1.1 125 mL Erlenmeyer flask

6.5.1.2 Air cooled condenser, 7 mm glass tube approximately 500 mm (20 in.) long.

6.5.2 Procedure- Prepare a Gooch crucible according to AASHTO T-44 (Section 7) and follow the procedure in AASHTO T- 44 Sections 9 and 10 with the following change:

6.5.2.1 Transfer approximately 2 grams of the tar used to make the mix into a tared 125 mL Erlenmeyer Flask. Weigh accurately to the nearest 0.001 g. Add 100 mL of 1, 1, l-Trichloroethane and place the air condenser into the top of the flask. Place the flask on a hot plate and reflux for 30 minutes. Determine the percent soluble as stated in AASHTO T-44, Section 10.

6.5.2.2 Calculations- Divide the percent bitumen, as determined by extraction, by the percent soluble to find the correct bitumen (tar) content.

6.5.3 In lieu of this procedure, the percent soluble may be obtained from the Laboratory Testing Section, Harrisburg.

METHOD A (CENTRIFUGE METHOD)

7. APPARATUS

7.1 In addition to the apparatus listed in Section 3, the following apparatus is required for Method A.

7.1.1 Extraction apparatus- Consisting of a bowl approximating that shown in Figure 1, which may be revolved at controlled variable speeds up to 3600 rpm. The apparatus shall be provided with a container for catching the solvent thrown from the bowl and a drain for removing the solvent. The apparatus shall be provided with explosion proof features and installed in a hood to provide ventilation.

NOTE 7 - Similar apparatus of a larger size may be used.

7.1.2 Filter ring- A heavy, weighty, smooth, white medium fast filter paper (Eaton-Dikeman Grade 627 has been found satisfactory for this purpose) of a diameter at least equal to the bowl seating surfaces outside diameter and to internally exceed the bowl sealing surfaces width by at least 25.4 mm (1 in).

7.1.3 2000 mL Florence flask

7.1.4 Bitumenometer, 750 or 1500 mL

8. PROCEDURE

8.1 Weigh an approximate 500 to 2500 gram sample into the bowl to the nearest 0.1 gram. In no case shall the wearing course and binder samples be less than 500 and 1000 grams, respectively.

NOTE 8- In the case of Heavy Duty Bituminous Concrete Base Course and Heavy Duty ID-2 Binder, the mass of the sample shall not be less than 1400 grams.

8.2 Cover the sample in the bowl with 1,1,1-Trichloroethane and allow sufficient time for the solvent to disintegrate the sample (not over 1 hour). Place the bowl containing the sample and the solvent in the extraction apparatus. Dry and weigh the filter ring and place it around the edge of the bowl. Clamp the cover on the bowl tightly and place a 2000 mL Florence flask under the drain to collect the extract:

OR

8.2.1 Cover the sample in the bowl with Terpene solvent and let the sample digest for a minimum of 30 minutes. During this period, probe the sample with a metal rod at ten minute intervals. Place the bowl containing the sample and solvent in the extraction apparatus. Dry the bowl. Clamp the cover on the bowl tightly and place the 2000 mL Florence flask under the drain to collect the extract.

8.3 If using the procedure in Section 8.2: Start the centrifuge revolving slowly and gradually increase the speed to a maximum of 3600 rpm or until solvent ceases to flow from the drain. Allow the machine to stop, add 200 mL of solvent and repeat the procedure. Use sufficient 200 mL solvent additions (not less than three) so that the extract is clear and not darker than a light straw color. Collect the extract and the washings in a 2000 mL Florence flask.

8.3.1 If using the procedure in Section 8.2.1: Start the centrifuge revolving and gradually increase the speed to a maximum of 3600 rpm or until solvent ceases to flow from the drain. Allow the machine to stop, add 300 mL of solvent and repeat the procedure. Use three (3) 300 mL solvent additions. Remove the 2000 mL Florence flask with the extract for use in Section 8.5. Place a container under the drain, charge the bowl with 500 mL of tepid water and extract. Repeat using five (5) 300 mL tepid water washings.

NOTE 9- The number of water washings may be decreased if the extraction of samples of known asphalt content indicate satisfactory results (± 0.1 percent).

8.4 Remove the filter ring from the bowl and dry in air. Remove as much of the mineral matter adhering to the filter ring is as possible and add the mineral matter to the aggregate in the bowl. Dry the ring to constant mass in an oven at 163 ± 5 ^{o}C (325 ± 9 ^{o}F). Dry the contents of the bowl to a constant mass in an oven at 163 ± 5 ^{o}C (325 ± 9 ^{o}F).

NOTE 10- The sample shall be dried until further drying at 163 ± 5 ^{o}C (325 ± 9 ^{o}F) does not alter the mass 0.1 percent, the precision of weighing.

8.5 Agitate the extract in the Florence flask thoroughly by swirling to insure uniform dispersion and immediately measure 100 mL into a previously weighed ignition dish. Pour the remaining extract liquid into the graduate, and record the volume (V). Evaporate the extract liquid in the ignition dish to dryness on a hot plate. Burn the residue at a dull red heat (500 to 600 ^{o}C), cool, and add 5 mL of saturated ammonium carbonate solution $(NH_4)_2CO_3$ per gram of ash. Digest at room temperature for one hour. Dry the ash in an oven at 110 ± 5 ^{o}C (230 ± 9 ^{o}F) to a constant mass, cool in a desiccator, and weigh to 0.001 gram on an analytical balance.

8.6 An alternate procedure is to use a bitumenometer, following the procedure in Sections 19.5 and 20.

9. CALCULATIONS

9.1 Calculate the mass of mineral matter in the total volume of extract as follows:

$$\text{grams total ash} = G \times \frac{V + 100}{100}$$

Where:

G = Mineral matter in grams

V = Volume of the extract after removing the aliquot in milliliters

9.2 Calculate the percentage of bitumen in the sample as follows:

$$\%\ \text{Bitumen content of a dry sample} = [(W_1 - W_2) - (W_3 + W_4 + W_5)] \times \frac{100}{(W_1 - W_2)}$$

Where:

W_1 = mass of the sample

W_2 = mass of water in the sample

W_3 = mass of the extracted mineral matter

W_4 = mass of mineral matter in the extract

W_5 = mass of mineral matter on the filter ring

NOTE 11 - Add the increase in the mass of the filter ring to the masses of the recovered aggregate and the ash in the recovered bitumen.

METHOD C (MARYLAND METHOD)

10. APPARATUS

10.1 In addition to the apparatus listed in Section 3, the following apparatus is required for Method C.

10.1.1 Extraction apparatus- Consisting of metal containers, condenser lid and stand similar to that shown in Figure 2.

10.1.2 A basket for the sample as shown in Figure 2. A 4.75 mm (No. 4) or heavier screen shall be placed in the basket to support the sample.

10.1.3 Filter Cloth- (A 16 xx Swiss stencil cloth available from the Atlas Silk Screen Supply Co., 1733 Milwaukee Ave., Chicago, IL 60647 is suitable for this purpose) with approximately 85 µm openings (No.185 mesh), shaped to cover completely the inside of the basket.

10.1.4 Thermometer-, Accurate to 0.1 ^{o}C (0.2^{o} F), covering a temperature range of 19 to 27 ^{o}C (66 to 80 ^{o}F), conforming to the requirements for a 17C (17F) thermometer as prescribed in ASTM Specification E-1.

10.1.5 Scraper- To loosen asphalt and fine bituminous mixture on the bottom of the extractor.

10.1.6 Rubber Gloves, Gas Mask, Trowel, Rubber Tubing, etc.

11. REAGENT

11.1 1,1,1-Trichloroethane.

12. PREPARATION OF SAMPLE

12.1 Samples do not have to be heated prior to extracting but shall be thoroughly dry. The sample size shall be between 3,500 and 11,000 grams. Weigh the basket assembly, place the sample in the basket, and obtain the total mass to the nearest gram.

13. PROCEDURE

13.1 Place the basket with the sample in the extractor. Pour 1150 to 1250 mL of Trichloroethane over the sample. Put the extractor lid tightly in place and allow water to circulate freely through the condenser on the top. Apply heat from a gas ring burner.

13.2 Reflux the samples for 1.5 to 3 hours until all the bitumen is extracted from the aggregate. Shut down the extractor after 1.5 hours and inspect the sample. Mix the sample with a trowel and continue extraction to completion.

NOTE 12- The sample is completely extracted when upon inspection, no discoloration is found either on the aggregate or on the surface of the trowel which has thoroughly mixed the sample.

13.3 Drain the extract from the extraction and wash clean the extractor apparatus with fresh solvent. Recover the extract in a 2000 mL Florence flask. Agitate the extract liquid in the 2000 mL graduate and record the volume. Remove the sample basket and dry in air. The basket shall be dried on a hot plate or oven at 163 ± 5 ^{o}C (325 ± 9 ^{o}F) to a constant mass. Determine the ash recovered bitumen as described in Section 8.5.

13.4 When using the bitumenometer method of bitumen determination use the procedure as stated in Section 19.5.

14. CALCULATIONS

14.1 Calculate the percentage bitumen in the sample as described in Section 9, if the ash method is used, or as in Section 20 when using the bitumenometer.

METHOD D (IMMERSION-REFLUX METHOD)

15. SCOPE

15.1 This method of test is intended for the determination of the percentage of bitumen in a paving mixture in which the aggregate size does not exceed 63 mm (2.5 inches) (NOTE 13). The sample is first immersed in hot solvent, for rapid disintegration of the mixture and extraction of the bitumen, and is then thoroughly washed by refluxing to complete the extraction. The

percentage of bitumen is determined by calculation from the specific gravities and the volume of the materials in the extract, using a pycnometer. The mineral matter recovered from either test can be used for the sieve analysis.

NOTE 13 - These methods are adaptable to paving mixtures in which aggregate size is up to 90 mm (3.5 inches) by employing an extractor four times larger than that described herein and a larger pycnometer (bitumenometer) of 1500 mL capacity. The larger apparatus accommodates samples of up to 7000 grams of sample with a larger size aggregate.

16. APPARATUS

16.1 In addition to the apparatus listed in Section 3, the following apparatus is required for Method D.

16.1.1 Extraction apparatus- (Figure 3) Consisting of an extraction kettle of stainless steel or borosilicate glass, with a perforated basket and condenser. The underside of condenser shall be covered with numerous rounded knobs to distribute condensed solvent uniformly onto the surface of the sample. The suspension of the basket shall be arranged to support the basket 12.5 mm (0.5 inches) above the bottom of kettle for immersion of the sample in solvent, a minimum of 75 mm (3 inches) above the bottom of the kettle for refluxing. The apparatus preferably shall be used under a hood to provide ventilation.

16.2 Cloth Filter Sacks for lining the basket

16.3 Bitumenometer (Pycnometer)- Approximately 750 mL capacity, as shown in Figure 3, calibrated to the nearest 0.1 mL. A 1500 mL capacity pycnometer is required for the larger sized extractor.

16.4 Thermometer- Accurate to 0.1 ^{o}C (0.2^{o} F), covering a temperature range of 19 to 27 ^{o}C (66 to 80 ^{o}F), conforming to the requirements for a 17C (17F) thermometer as prescribed in ASTM Specification E-1.

16.5 Cold Water Bath, Metal Funnel, Washing Bottle, Brush, Spatula, etc.

17. SOLVENT

17.1 1,1,1-Trichloroethane- For the bitumenometer method of extract analysis, the specific gravity of solvent must be known within 0.001, and must remain constant through the extraction process. This is considered very important. If the solvent has proper inhibitor(s), the specific gravity should not change. This can be verified by extracting mixtures of known bitumen contents or by subjecting the solvent to the extraction process (without a sample) and measuring the specific gravity before and after the process.

18. PREPARATION OF SAMPLE

18.1 If the mixture is not sufficiently soft to separate with a spatula or trowel, place 2000 to 5000 grams in an oven at 163 ^{o}C (325 ^{o}F) for a maximum of two hours, or on a hot plate over low heat, until it can be handled. Use care not to fracture the mineral particles. Thoroughly mix, form into a flat pile, and quarter to the required size of sample. Insert a filter sack in the extractor basket and weigh the filter and basket with the tared pan to determine the total tared mass. Weigh into the filter sack a representative sample of mix not less than 500 grams if the maximum aggregate size is less than 12.7 mm (0.5 inches). If the maximum aggregate size is 12.7 to 63.5 mm (0.5 to 2.5 inches), the mass of the sample shall not be less than 1000 grams. While transferring the mix onto the filter sack, any fine mix sticking to the inside of the spatula shall be scrapped and included with the sample for extraction. All weighing shall be to nearest 0.1 gram. Larger samples up to 7000 grams may be tested by using a larger apparatus. In no case, however, shall the selection of a sample of a predetermined mass be attempted.

NOTE 14 - In the case of Heavy Duty Bituminous Concrete Base Course and Heavy Duty ID-2 Binder, the mass of the sample shall not be less than 1500 grams.

19. PROCEDURE

19.1 Attach the suspension rod to the loaded basket and set the assembly into the extraction kettle. Pour carefully approximately 600 mL of solvent over sample. The extractor can be filled with the solvent prior to suspending the loaded basket in the extraction kettle. Set the condenser cover in place on the kettle. Provide a flow of cold water through the condenser cover.

19.2 Raise the basket to the immersion level, i.e. 12.5 mm (0.5 inch) above the bottom of the kettle, by inserting the support pin through the upper hole of the suspension rod. Place the extractor on the hot plate or over a burner and adjust the heating rate so that solvent is maintained at a gentle boil. Avoid vigorous boiling which might wash fines over the sides of the basket. Continue heating the sample during the immersion position for 15 to 30 minutes, depending upon composition, size, and age of sample.

19.3 Raise the basket to the refluxing level, a minimum of 75 mm (3 inches) above the bottom of the kettle, by inserting the pin through the lower hole of the suspension rod. Increase the heat and maintain active boiling for 15 to 30 minutes, or until solvent dripping from the basket appears colorless. If a stainless steel kettle is used, solvent can be examined by lifting the basket out of the condenser assembly.

19.4 Remove the extractor from the heat source and allow the extractor to cool for several minutes. Lift the basket out of the condenser assembly. Remove the filter sack, distribute its contents onto the tared pan in which the sample was originally weighed, dry on hot plate over low heat, or in an oven at 163 ± 5 ^{o}C (325 ± 9 ^{o}F) to a constant mass, with the filter sack on top of the aggregate. Use care not to char the sack. Place the extractor basket onto the pan, and weigh the assembly of aggregate, filter sack, extractor, and tared pan. Subtract the total tared mass from the mass of this assembly and record this weight as the mass of extracted aggregate.

19.5 While the aggregate is being dried, set the covered kettle in a cold water bath 50 to 120 mm (2 to 4 inches) deep to hasten cooling to approximately 27 °C (80 °F). Transfer the extract to the bitumenometer, using a funnel. Wash down the inside of the kettle with solvent, adding enough additional solvent to fill the bitumenometer to the base of the neck. Air bubbles must be eliminated. Adjust the temperature of the bitumenometer contents to 25 °C (77.0 °F) (NOTE 15). Insert the volume adjustment stopper, fill the stopper capillary and apply the overflow cap. Dry the outside of the bitumenometer and weigh to the nearest 0.1 of a gram (NOTE 16). Subtract the mass of the bitumenometer from this mass and record as the mass of the extract. Record the actual temperature of the extract to the nearest 0.1 °C (0.2 °F) at the time of weighing.

NOTE 15 – A correction can be applied for extract temperatures differing from 25 °C (77.0 °F), between 23 and 27 °C (74 and 80 °F). Corrections for solvents can be computed from their specific gravity and coefficient of expansion. If a 750 mL bitumenometer is used, the following corrections have been determined to be adequate: add 1.23 grams to the mass of the extract for each degree °C above 25 °C (0.7 g per degree above 77 °F), and subtract 1.23 grams from the weight for each degree below 25 °C (0.7 g per degree below 77 °F).

NOTE 16 - The mass of the bitumenometer filled with the extract liquid shall be taken very carefully. Variations of ± 0.5 gram in mass can affect the asphalt content determination by ± 0.1 percent.

20. CALCULATIONS

20.1 Calculate the percentage bitumen in the sample using one of the following procedures:

PROCEDURE 1

$$\% \text{ bitumen} = [G_2/(W_1(G_3-G_2))] \times [G_3(V_l-((W_2+W_3-W_l)/G_l))+W_3-W_l] \times 100$$

Where:

G_1 = Specific gravity of the solvent at 25 °C (77.0 °F) (within 0.001)

G_2 = Specific gravity of the bitumen at 25 °C (77.0 °F) (within 0.01)

G_3 = Specific gravity of the aggregate fines at 25 °C (77.0° F) (within 0.1)

V_l = Volume of the bitumenometer at 25 °C (77.0° F)

W_1 = Mass of the original dry sample

W_2 = Mass of the extract

W_3 = Mass of the extracted aggregate

NOTE 17- The formula above corrects for the amount of fines contained in the extract.

NOTE 18- It is very important that the specific gravity values of solvent and bitumen are very accurate. The bitumen content will vary by approximately ± 0.1 percent for the following variations in the measurements of specific gravities:

specific gravity of the solvent ± 0.001
specific gravity of the bitumen ± 0.01

NOTE 19 - If the specific gravity values of aggregate fines are not known, the following values may be used:

stone	2.70
gravel	2.60
slag	2.95

20.2 Calculate the mass of fines in the extract as follows:

$$W_4 = (G_3/(G_3-G_2)) \text{ X } [W_l-W_3-G_2(V_1-((W_2-W_l+W_3)/G_l))]$$

Where:

W_4 = Mass of the fines in the extract

PROCEDURE 2

Percent Bitumen Calculation

Specific Gravity of Bitumen (± 0.01) at 25 C (77.0 F)	G_2 =
Specific Gravity of Aggregate Fines (± 0.1) at 25 C (77.0 F)	G_3 =
Specific Gravity of Solvent (± 0.001) at 25 C (77.0 F)	G_1 =
Volume of Bitumenometer at 25 C (77.0 F)	V_1 =
Weight of Original Sample	W_1 =
- Weight of Extracted Sample	W_3 =
Weight of Extraction Loss or weight of bitumen and fines:	$W_c = W_1-W_3$
Weight of Bitumenometer and Extracted liquid	W_a =

- Weight of Bitumenometer W_b =

Weight of Extracted Liquid $W_2 = W_a - W_b$

Weight of Extracted Liquid W_2 =

- Weight of Extraction loss or weight of bitumen and fines W_c =

Weight of Solvent $W_d = W_2 - W_c$

Weight of Solvent (W_d) ( ) = Volume of Solvent (V_a)
Sp. Gr. Of Solvent (G_1) ( ) in the Bitumenometer

Volume of Bitumenometer V_1 =

- Volume of Solvent V_a =

Volume of Extraction Loss or Volume of Bitumen & Fines:

$V_b = V_1 - Va$

Volume of Extraction Loss V_b =

x Sp. Gr. Of Aggregate Fines G_3 =

Algebraic Term (Weight of Extraction Loss) $a_1 = V_b \times G_3$ =

Algebraic Term (Weight of Extraction Loss) a_1 =

- Weight of Extraction Loss W_c =

Algebraic Term (Weight of Bitumen) $a_2 = a_1 - W_c$ =

Specific Gravity of Aggregate Fines G_3 =

- Specific Gravity of Bitumen G_2 =

Algebraic Term (Weight of Bitumen) $a_3 = G_3 - G_2$ =

Algebraic Term (Weight of Bitumen) (a_2) ( ) = Volume of Bitumen
Algebraic Term (Sp. Gr. Of Bitumen) (a_3)( ) in Sample (V_c)

Volume of Bitumen in Sample V_c =

x Specific Gravity of Bitumen G_2 =

Weight of Bitumen in Sample $W_e = V_c \times G_2$ =

Weight of Bitumen in Sample (W_e) ( ) x 100 = % of Bitumen
Weight of Original Sample (W_1) ( ) in Sample

Weight of Original Sample W_1 =

- Weight of Bitumen W_e =

Weight of Total Aggregate in Sample $W_f = W_1 - W_e$ =

Weight of Extraction loss (bitumen and fines) W_c =

- Weight of Bitumen W_e =

Weight of Fines in Sample $W_4 = W_c - W_e$ =

PROCEDURE 3

Percent Bitumen Calculation

20.3 If the ash method is used, calculate the percent bitumen in the sample as described in Section 9.

MODIFIED METHOD D (IMMERSION-REFLUX-CENTRIFUGE)

21 SCOPE

21.1 This method of test is intended for the determination of asphalt content of bituminous mixtures in which the aggregate size does not exceed 63mm (2.5 inches). The sample is first immersed in hot solvent, for rapid disintegration of the mixture and extraction of the bitumen. The sample is thoroughly washed by refluxing, the extract liquid is run through a centrifuge to trap the fines.

22. APPARATUS

22.1 In addition to the apparatus listed in Section 3, the following apparatus is required for Modified Method D.

22.1.1 Extraction apparatus (Figure 3)- Consisting of an extraction kettle of stainless steel or borosilicate glass, with a perforated basket and condenser. The underside of the condenser shall be covered with numerous rounded knobs to distribute condensed solvent uniformly onto the surface of the sample. The suspension of the basket shall be arranged to support the basket 12.5 mm (0.5 inches) above the bottom of the kettle for immersion of the sample in solvent, a minimum of 75 mm (3 inches) above the bottom of the kettle for refluxing. The apparatus preferably shall be used under a hood to provide ventilation.

22.1.2 Cloth Filter Sacks for lining the basket

22.1.3 Centrifuge- High-speed (3000 rev./min or higher). A continuous flow type with a metal thimble to catch the fines.

23. SOLVENT

23.1 normal-Propyl Bromide (*n*PB), conforming to ASTM D6368

24. PREPARATION OF SAMPLE

24.1 If the collected mixture sample is not sufficiently soft to separate with a spatula, scoop, or trowel, place the collected mixture sample in an oven at 163 ± 5°C (325 ± 9°F) for a maximum of 2 hours, or on a hot plate over low heat, until it is sufficiently soft to separate. Thoroughly mix, form into a flat pile, and quarter the mixture sample. Use care not to fracture the mineral particles. The minimum mass of the test sample shall be the result of quartering from a larger mixture sample and shall conform to the minimum mass requirements in Table 1.

Table 1

Superpave or SMA Mixture Nominal Maximum Aggregate Size (NMAS), mm	**Other Asphalt Mixtures or Material Classes**	**Minimum Mass of Test Sample, g**
12.5 or smaller	FJ-1, FJ-1C, FJ-4, FB-1W, FB-2W, FB-3 Modified, Micro-Surfacing, Ultra-Thin Friction Course, Cold Path	500
19	ATPBC, FB-1B, FB-2B, FB-Modified	1000
25 or greater		1500

25. PROCEDURE

25.1 Insert a filter sack in the extractor basket and determine the total tare mass of the filter, basket, suspension rod, and pan to the nearest 0.1 g.

25.2 Prepare the test sample according to Section 24. Using a scoop, add the minimum mass of test sample according to Table 1 into the filter sack. Scrape any fine mixture particles that stick to the inside of the scoop with a spatula and include the fine particles in the filter sack with the mixture test sample for extraction.

25.3 Attach the suspension rod to the basket and set the assembly into the extraction kettle. Carefully pour 700 ± 50 ml of solvent over the sample. The extractor can be filled with solvent prior to suspending the loaded basket. Set the condenser cover in place on the kettle. Provide a flow of cold water through the condenser cover.

25.4 Raise the basket to the immersion level, 12mm (0.5 inches) above the bottom of the kettle by inserting the support pin through the upper hole of the suspension rod. Place the extractor on the hot plate and adjust the heat rate so that the solvent is maintained at a gentle boil. Avoid vigorous boiling which might wash fines over the sides of the basket. Continue heating with the sample in the immersion position for a minimum of 30 minutes.

25.5 Raise the basket to the reflux level, a minimum of 75mm (3 inches) above the bottom of the kettle by inserting the pin through the lower hole of the suspension rod. Increase the heat and maintain active boiling for a minimum of 30 minutes, or until solvent dripping from the basket appears colorless. If a stainless steel kettle is used, the solvent can be examined by lifting the basket out of the condenser assembly.

25.6 Remove the extractor from the hot plate and lift the basket out of the condenser assembly. Remove the suspension rod and basket from the condenser assembly. Remove the filter sack, distribute its contents into the pan and dry on a hot plate over low heat, or in an oven at 163°C $\pm$ 5°C (325°F $\pm$ 9°F) to a constant mass, with the filter sack on top of the aggregate. Use care not to char the filter sack.

25.7 When the aggregate is dry, place the extractor basket and the suspension rod assembly into the pan. Weigh and record the mass of the aggregate, filter sack, suspension rod assembly and pan to the nearest 0.1 g.

25.8 While the aggregate is being dried, allow the kettle to cool to approximately 27°C (80°F). To hasten cooling set the kettle in a cold water bath 50 mm to 120 mm (2 to 4 inches) deep.

25.9 Place a pre-weighed thimble in the centrifuge. Run the extract liquid through the centrifuge 3 times. Wash the material in the thimble using a final wash of approximately 200 ml of clean solvent or enough wash solvent until the wash runs clear.

25.10 Dry the thimble and material in an oven at 163 C $\pm$ 5°C (325 F $\pm$ 9°F). Record the weight of the thimble and material.

26. CALCULATIONS

Calculate the percentage bitumen in the sample using the following procedure:

1. Wt. of pan + basket + filter + sample _____

2. Wt. of pan + basket+ filter _____

A. 1-2 = Wt. of original sample _____

3. Wt. of pan + basket + filter + aggregate _____

4. Wt. of pan + basket + filter _____

B. 3-4 = Wt. of aggregate in the pan _____

5. Wt of aggregate in the thimble _____

6. Wt. of the thimble _____

C. 5-6 = Wt. of aggregate in the thimble _____

Calculation for Percent Bitumen:

$$\frac{A-(B+C)}{A} \times 100 = \% \text{ AC}$$

27. PRECISION

The following data shall be used for judging the acceptability of the results (95 percent probability).

27.1 Duplicate results by the same operator should be considered suspect if they differ by more than the following amounts:

	repeatability
standard deviation, percent	0.12
bitumen content, percent	0.34

27.2 The result submitted by one laboratory should not be considered suspect unless the result differs from that of another laboratory by more than the following amounts:

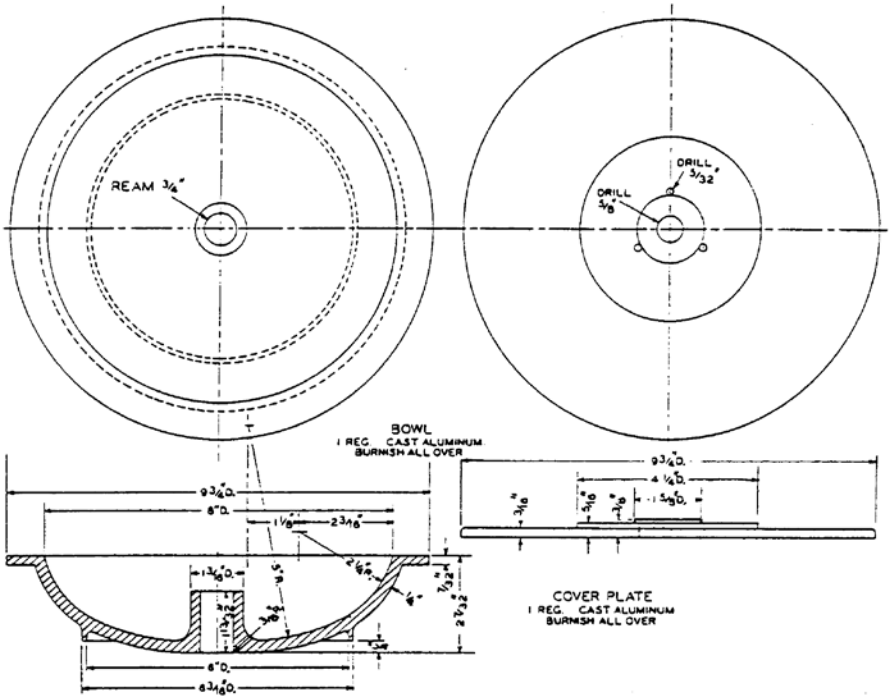
	reproducibility
standard deviation, percent	0.20
bitumen content, percent	0.56

NOTE 20- The precision statement is derived from 10 laboratories testing 4 samples with 3 replicates per test.

28. REFERENCE

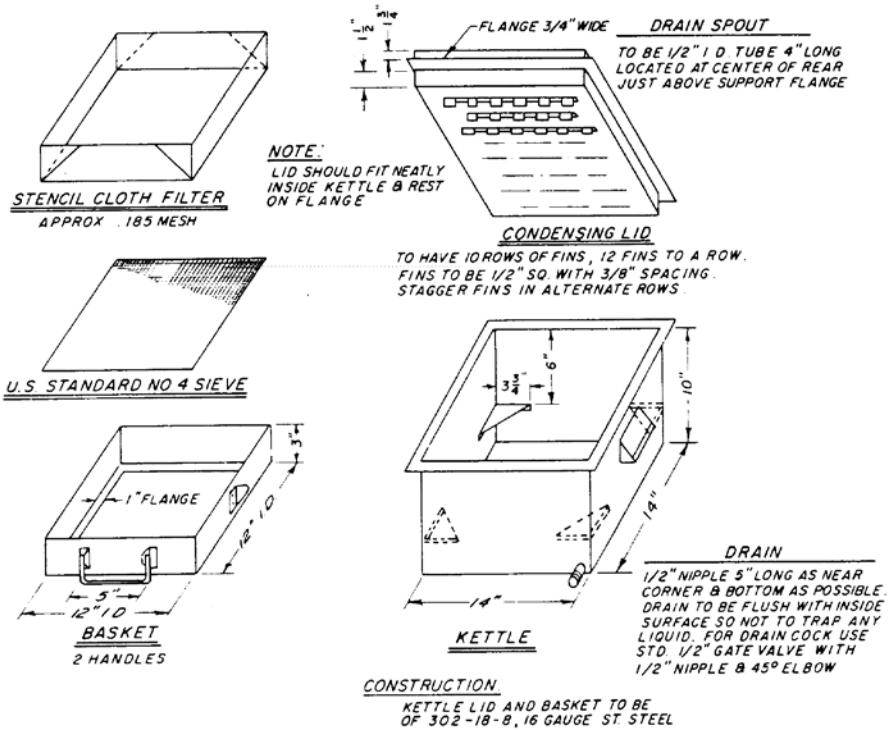
AASHTO Method T-164 ASTM Method D 2172

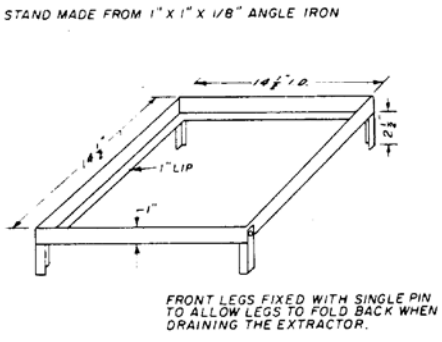
Attachments: Figures 1 thru 4; Table 1.



NOTE—See Table 1 for metric equivalents.

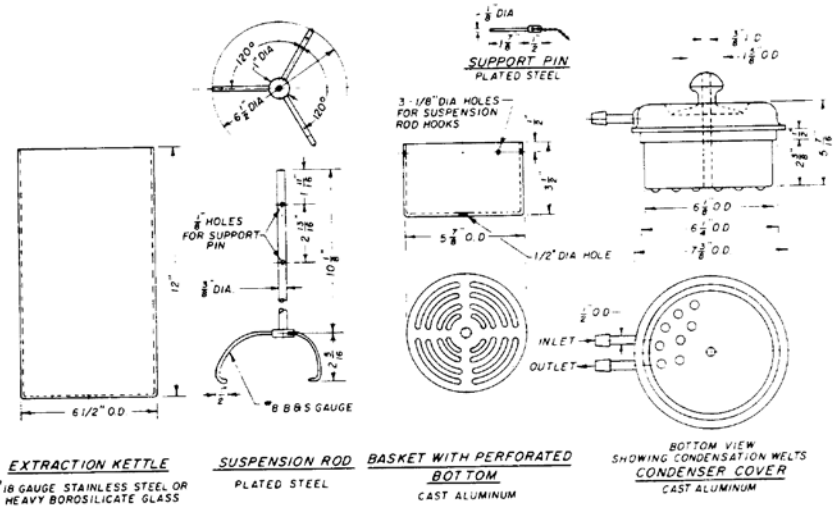
Figure 1 - Extraction Unit Bowl





See Table 1 for metric equivalents.

FIG. 2



NOTE—See Table 1 for metric equivalents.

FIG. 3

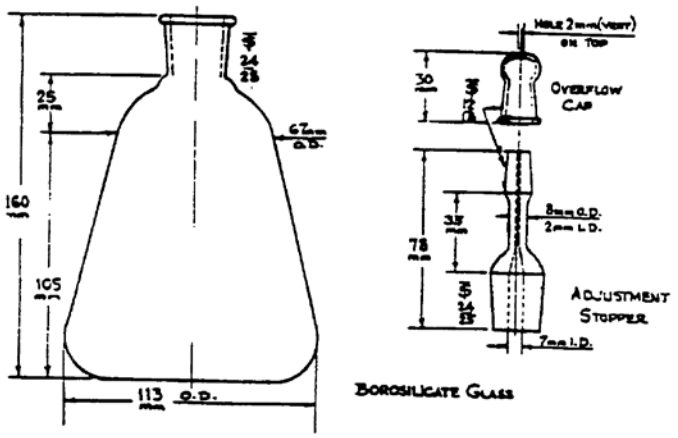


Figure 4 - Bitumenometer, 750ml Capacity

TABLE 1 Metric Equivalents for Figures

Inch-Pound Units, in.	SI Equivalent,mm	Inch-Pound Units, in.	SI Equivalent,mm	Inch-Pound Units, in.	SI Equivalent,mm
1/8	3.2	1 11/16	43	5 7/8	149
3/16	4.8	1 3/4	44	6	152
7/32	5.6	2 3/16	55	6 1/8	155
1/4	6.3	2 7/32	56	6 3/16	157
5/16	7.9	2 5/16	59	6 1/4	159
3/8	9.5	2 1/2	64	6 1/2	165
1/2	12.7	2 5/8	69	7 3/8	187
5/8	15.9	2 13/16	72	8	207
3/4	19.0	3	76	9 3/4	247
1	25.0	3 3/4	96	10	254
1 1/8	28.6	4	102	10 1/8	257
1 3/16	30.2	4 1/4	108	12	305
1 13/32	35.7	5	127	14	355
1 1/2	38.0	5 7/16	138	14 1/2	370
1 5/8	41.0				

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LABORATORY TESTING SECTION

Method of Test for

EFFECTIVE ASPHALT CONTENT OF BITUMINOUS PAVING MIXTURES

1. SCOPE

1.1 This method computes the effective asphalt content in a bituminous paving mixture. The effective asphalt content (P_{be}) of a paving mixture is the total asphalt content (P_b) minus the quantity of asphalt lost by absorption into the aggregate particles. It is the portion of the total asphalt content that remains as a coating on the outside of the aggregate particles in which the service performance of a paving mixture depends.

1.2 The effective asphalt content (not the total asphalt content) is to be used to compute the VMA (voids in mineral aggregate) and the VFA (voids filled with asphalt) in Marshall specimens (PTM No. 705) and pavement cores.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

2.1.1 R 76, Reducing Samples of Aggregate to Testing Size

2.1.2 T 84, Specific Gravity and Absorption of Fine Aggregate

2.1.3 T 85, Specific Gravity and Absorption of Coarse Aggregate

2.1.4 T 133, Density of Hydraulic Cement

2.1.5 T 209, Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)

2.1.6 T 228, Specific Gravity of Semi-Solid Asphalt Materials

2.2 Pennsylvania Test Methods:

2.2.1 PTM No. 705, Marshall Criteria for Compacted Bituminous Specimens

3. MATERIALS AND TESTS

3.1 Coarse Aggregate(s)

3.1.1 A representative sample of the coarse aggregate(s) shall be obtained in accordance with AASHTO R 76.

Nominal Maximum Size (inches)	Minimum Mass of Sample (kg)
12.5 mm (1/2 inch) or less, (1B) aggregate	2.5
25.0 mm (1 inch), (2B) aggregate	4.5

3.1.2 The bulk specific gravity (dry) of the coarse aggregate(s) shall be determined in accordance with AASHTO T 85 using the following formula (the value shall be reported to three decimal places):

$$\text{Bulk Sp. Gr.} = \frac{A}{B - C}$$

3.2 Fine Aggregate(s)

3.2.1 A representative sample of the fine aggregate(s) weighing at least 1.0 kg shall be obtained in accordance with AASHTO R 76.

3.2.2 The bulk specific gravity (dry) of the fine aggregate(s) shall be determined in accordance with AASHTO T 84 using the following formula (the test value shall be reported to three decimal places):

$$\text{Bulk Sp. Gr.} = \frac{A}{B + S - C}$$

3.3 Mineral Filler

3.3.1 If a mineral filler is added separately to the paving mixture, a representative sample weighing at least 200 g shall be obtained in a plastic lined bag.

3.3.2 The specific gravity of the mineral filler shall be determined in accordance with AASHTO T 133 using kerosene as a wetting agent. The test value shall be reported to three decimal places.

3.4 Asphalt Cement

3.4.1 The specific gravity of the asphalt cement (G_b) shall be determined at 25 °C (77F) in accordance with AASHTO T 228 and shall be reported to three decimal places. The value furnished by the asphalt supplier may be used.

3.5 Bituminous Paving Mixture

3.5.1 The maximum specific gravity (G_{mm}) of the loose bituminous paving mixture containing a known asphalt content (P_b), by total mass of the mixture, shall be determined by AASHTO T 209.

3.5.2 The effective specific gravity (G_{se}) of the combined aggregates in the same mixture shall be calculated as follows (Note 1):

$$G_{se} = \frac{G_{mm}\,(100 - P_b)}{100 - \dfrac{G_{mm}\,\text{FUNCx}\,P_b}{G_b}}$$

Where:

G_{se} = effective specific gravity of the aggregates

G_{mm} = maximum specific gravity of the loose paving mixture

P_b = asphalt content, percent by total weight of the mixture

G_b = specific gravity of the asphalt

NOTE 1- A worksheet to calculate the effective specific gravity(G_{se}) by the above formula is appended to this PTM.

4. CALCULATIONS

4.1 Bulk specific gravity of the total aggregate (G_{sb})- When the total aggregate consists of separate fractions of coarse aggregate(s), fine aggregate(s), and mineral filler (if added separately), all having different specific gravities, the combined bulk specific gravity for the total aggregate is calculated as follows (assuming there are three aggregates):

$$G_{sb} = \frac{P_1 + P_2 + P_3}{\frac{P_1}{G_1} + \frac{P_2}{G_2} + \frac{P_3}{G_3}}$$

Where:

G_{sb} = bulk specific gravity of the total aggregate

P_1, P_2, P_3 = percentages by weight of aggregates l, 2 and 3 in the paving mixture

G_1, G_2, G_3 = bulk specific gravities of aggregates l, 2, and 3 (Sections 3.1, 3.2, and 3.3 of this PTM)

NOTE 2- A worksheet to calculate G_{sb} by the above formula is appended to this PTM.

4.2 Percent asphalt absorbed by the aggregate (P_{ba})- Absorption is expressed as a percentage by weight of aggregate rather than as a percentage by total weight of the mixture. It shall be calculated as follows:

$$P_{ba} = \frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}} \times G_b \times 100$$

Where:

P_{ba} = absorbed asphalt, percent by weight of aggregate

G_{se} = effective specific gravity of the aggregate

G_{sb} = bulk specific gravity of the aggregate

G_b = specific gravity of the asphalt

NOTE 3 - A worksheet to calculate P_{ba} by the above formula is appended to this PTM.

4.3 Effective asphalt content of the paving mixture- The effective asphalt content (P_{be}) of a paving mixture is the total asphalt content minus the quantity of asphalt lost by absorption into the aggregate particles.

Effective asphalt content (P_{be}) shall be calculated as follows:

$$P_{be} = P_b - \frac{P_{ba}}{100}(100 - P_b)$$

Where:

P_{be} = effective asphalt content, percent by total weight of the mixture

P_b = asphalt content, percent by total weight of the mixture

P_{ba} = absorbed asphalt, percent by weight of the aggregate

NOTE 4 - A worksheet to calculate P_{be} by the above formula is appended to this PTM.

5. REPORT

5.1 Effective asphalt content (P_{be}) shall be reported to the nearest 0.1 percent.

5.2 Effective asphalt content (P_{be})is intended to be used to compute the VMA (voids in mineral aggregate) and the VFA (voids filled with asphalt) using the Marshall specimen worksheet (PTM No. 705).

6. REFERENCES

6.1 Asphalt Institute MS-2, Asphalt Mix Design Methods

APPENDIX TO PTM No. 709

EXAMPLE 1 (Using Formula)

Given:

Constituent Material	Value	Bulk Sp. Gr Test Method	Percent by Weight Total Mix
Coarse aggregate	2.604 (G_1)	AASHTO T 85	51.4 (P_1)
Fine aggregate #1	2.827 (G_2)	AASHTO T 84	18.7 (P_2)
Fine aggregate #2	2.619 (G_3)	AASHTO T 84	22.9 (P_3)
Asphalt cement	1.010 (G_b)	AASHTO T 228	7.0 (P_b)
		TOTAL:	100.0

Maximum Sp. Gr. of Mix (AASHTO T 209) = 2.439 (G_{mm})

Calculate the Effective Asphalt Content in the above mixture as follows:

(a) Bulk Sp. Gr. of the Total Aggregate (G_{sb})

$$G_{sb} = \frac{P_1 + P_2 + P_3}{\frac{P_1}{G_1} + \frac{P_2}{G_2} + \frac{P_3}{G_3}}$$

$$= \frac{51.4 + 18.7 + 22.9}{\frac{51.4}{2.604} + \frac{18.7}{2.827} + \frac{22.9}{2.619}}$$

$$= \frac{93.0}{19.739 + 6.615 + 8.744}$$

$$= \frac{93.0}{35.098} = 2.650$$

(b) Effective Sp. Gr. of the Total Aggregate (G_{se}):

$$G_{se} = \frac{G_{mm}\,(100 - P_b)}{100 - \frac{G_{mm} \times P_b}{G_b}}$$

$$= \frac{2.439\,(100 - 7.0)}{100 - \frac{2.439 \times 7.0}{1.010}}$$

$$= \frac{226.827}{100 - 16.904}$$

$$= \frac{226.827}{83.096} = 2.730$$

(c) Percent Asphalt Absorbed by the Aggregate (P_{ba}):

$$P_{ba} = \frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}} \times G_b \times 100$$

$$= \frac{2.730 - 2.650}{2.730 \times 2.650} \times 1.010 \times 100$$

$$= \frac{0.080}{7.234} \times 101.0 = 1.117$$

(d) Effective Asphalt Content (P_{be}) in the Mixture:

$$P_{be} = P_b - \frac{P_{ba}}{100}(100 - P_b)$$

$$= 7.0 - \frac{1.117}{100}(100 - 7.0)$$

$$= 7.0 - 1.039$$

$$= 5.961 = 6.0 \text{ (rounded to one-tenth percent)}$$

WORK SHEET
DETERMINATION OF EFFECTIVE ASPHALT CONTENT

A. BULK SP. GR. OF TOTAL AGGREGATE (G_{sb})

Aggregate	Type (Coarse or Fine)	Percentage in Mix (P)	Bulk Sp. Gr. (G)	P/G
Aggregate #1	Coarse (1B)	51.4	2.604	19.739
Aggregate #2	Fine (Nat. Sand)	18.7	2.827	6.615
Aggregate #3	Fine (Screenings)	22.9	2.619	8.744
Aggregate #4	—	—	—	—
Mineral Filler	—	—	—	—
TOTALS	—	93.0	—	35.098

$$G_{sb} = \frac{\text{Summation of P}}{\text{Summation of P/G}} = \frac{93.0}{35.098} = 2.650$$

B. EFFECTIVE SP. GR. OF TOTAL AGGREGATE (G_{se})

Line		1	2	3
1	Max. Sp. Gr. Of Mix (G_{mm})	2.439		
2	% Total AC in Mix (P_b)	7.0		
3	Sp. Gr. Of AC (G_b)	1.010		
4	Line 2 ÷ Line 3 (cc of AC)	6.931		
5	100 - Line 2	93.0		
6	Line 1 x Line 5	226.827		
7	Line 1 x Line 4	16.905		
8	100 - Line 7	83.095		
9	Line 6 ÷ Line 8 (Effective Sp. Gr. Of Total Aggregate, (G_{se})	2.730		

Average Value of G_{se} =

C. PERCENT ASPHALT ABSORBED BY AGGREGATE (P_{ba})

Line		
1	Effective Sp. Gr. Of Total Aggregate (G_{se})	2.730
2	Bulk. Sp. Gr. Of Total Aggregate (G_{sb})	2.650
3	Sp. Gr. Of Asphalt Cement (G_b)	1.010
4	Line 1 - Line 2	0.080
5	Line 1 x Line 2	7.2345
6	Line 4 ÷ Line 5	0.01106
7	Line 6 x Line 3	0.01117
8	Line 7 x 100 (Percent AC Absorbed by Aggregate, P_{ba})	1.117

D. EFFECTIVE ASPHALT CONTENT IN MIX (P_{be})

Line		
1	% Total AC in Mix (P_b)	7.0
2	% AC Absorbed by Aggregate (P_{ba})	1.117
3	Line 2 - 100	0.01117
4	100 - Line 1	93.0
5	Line 3 x Line 4	1.0388
6	Line 1 - Line 5 (Effective Asphalt Content in Mix, P_{be})	5.9612 6.0 (rounded)

TR-4265 (9-77)
M (1/96)

Example

MARSHALL SPECIMEN WORK SHEET

SAMPLE NO.	1					
SPECIFICATION	ID-2W					
AGGREGATE	Gravel					
% ASPHALT (Total) P_b	7.0					
MASS SAMPLE + H_2O	1826.9					
– MASS S.S.D. SAMP.	1229.3					
= VOL WATER	597.6					
VOL VOLUMETER	1122.8					
– VOL WATER	597.6					
= VOL SAMPLE	525.2					
MASS SAMPLE	1228.8					
÷ VOL SAMPLE	2.439					
= SP GR SAMPLE	503.8					
MASS SAMPLE	1228.8					
÷ THEOR. SP GR (Gmm)	2.439					
= THEOR. VOL.	503.8					
VOL. SAMPLE	525.2					
– THEOR. VOL.	503.8					
= VOL. VOIDS	21.4					
÷ VOL. SAMPLE	525.2					
= % VOIDS	4.1					
MASS SAMPLE	1228.8					
x % ASPHALT (Effective) P_{be}	6.0					
= MASS ASPHALT	73.7					
÷ SP GR A.C.	1.010					
= VOL. A.C.	73.0					
+ VOL. VOIDS	21.4					
= VOL. V.M.A.	94.4					
÷ VOL. SAMPLE	525.2					
= % V.M.A.	18.0					
VOL. ASPHALT	73.0					
÷ VOL. V.M.A.	94.4					
= % V.F.A.	77.3					
MASS S.S.D. SAMP.						
– DRY MASS						
= MASS ABSORB.						
÷ VOL. SAMPLE						
= % ABSORB (VOL.)						
STABILITY						
FLOW						
AVG. SP. GR.						
AVG. % VOIDS						
AVG. % VMA						
AVG. % VFA						
AVG. STABILITY						
AVG. FLOW						

TR-4265 (9-77)
M (1/96)

MARSHALL SPECIMEN WORK SHEET

SAMPLE NO.						
SPECIFICATION						
AGGREGATE						
% ASPHALT						
MASS SAMPLE + H_2O						
– MASS S.S.D. SAMP.						
= VOL WATER						
VOL VOLUMETER						
– VOL WATER						
= VOL SAMPLE						
MASS SAMPLE						
÷ VOL SAMPLE						
= SP GR SAMPLE						
MASS SAMPLE						
÷ THEOR. SP GR						
= THEOR. VOL.						
VOL. SAMPLE						
– THEOR. VOL.						
= VOL. VOIDS						
÷ VOL. SAMPLE						
= % VOIDS						
MASS SAMPLE						
x % ASPHALT *(Effective)*						
= MASS ASPHALT						
÷ SP GR A.C.						
= VOL. A.C.						
+ VOL. VOIDS						
= VOL. V.M.A.						
÷ VOL. SAMPLE						
= % V.M.A.						
VOL. ASPHALT						
÷ VOL. V.M.A.						
= % V.F.A.						
MASS S.S.D. SAMP.						
– DRY MASS						
= MASS ABSORB.						
÷ VOL. SAMPLE						
= % ABSORB (VOL.)						
STABILITY						
FLOW						
AVG. SP. GR.						
AVG. % VOIDS						
AVG. % VMA						
AVG. % VFA						
AVG. STABILITY						
AVG. FLOW						

WORK SHEET FOR DETERMINATION OF
EFFECTIVE ASPHALT CONTENT

A. BULK SP. GR. OF THE TOTAL AGGREGATE (G_{sb})

Aggregate	Type (Coarse or Fine)	Percentage in Mix (P)	Bulk Sp. Gr. (G)	$\frac{P}{G}$
Aggregate #1				
Aggregate #2				
Aggregate #3				
Aggregate #4				
Mineral Filler				
TOTALS				

$$G_{sb} = \frac{\text{Summation of P}}{\text{Summation of P/G}} =$$

B. EFFECTIVE SP. GR. OF THE TOTAL AGGREGATE (G_{se})

		1	2	3
1	Max. Sp. Gr. of the Mix (G_{mm})			
2	% Total AC in the Mix (P_b)			
3	Sp. Gr. of the AC (G_b)			
4	Line 2 ÷ Line 3 (cc of AC)			
5	100 - Line 2			
6	Line 1 x Line 5			
7	Line 1 x Line 4			
8	100 - Line 7			
9	Line 6 ÷ Line 8 (Effective Sp. Gr. of the total aggregate, (G_{se})			

Average Value of G_{se} =

C. PERCENT ASPHALT ABSORBED BY AGGREGATE (P_{ba})

Line		
1	Effective Sp. Gr. of the total aggregate (G_{se})	
2	Bulk. Sp. Gr. of the total aggregate (G_{sb})	
3	Sp. Gr. of the Asphalt Cement (G_b)	
4	Line 1 - Line 2	
5	Line 1 x Line 2	
6	Line 4 ÷ Line 5	
7	Line 6 x Line 3	
8	Line 7 x 100 (Percent AC Absorbed by the aggregate, P_{ba})	

D. EFFECTIVE ASPHALT CONTENT IN MIX (P_{be})

Line		
1	% Total AC in the Mix (P_b)	
2	% AC Absorbed by the aggregate (P_{ba})	
3	Line 2 - 100	
4	100 - Line 1	
5	Line 3 x Line 4	
6	Line 1 - Line 5 (Effective Asphalt Content in the Mix, P_{be})	

Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 715
October 2013
5 Pages

LABORATORY TESTING SECTION

Method of Test for

DETERMINATION OF BULK SPECIFIC GRAVITY OF COMPACTED BITUMINOUS MIXTURES

1. SCOPE

1.1 This method of test is intended for determining the bulk specific gravity of laboratory compacted bituminous mixtures or bituminous roadway samples, such as cores, small sawed slabs, density ring samples, etc. This method shall not be used if the samples contain open or interconnecting voids and/or absorb more than 3.0 percent water. For such samples, PTM No. 716 shall be used.

2. TEST SPECIMEN

2.1 Compacted specimens in accordance with PENNDOT Methods or obtained in accordance with PENNDOT methods of sampling a compacted roadway.

2.2 Size of specimens- It is recommended, (1) that the diameter of cylindrically molded or cored specimens, or the length of the sides of the sawed specimens, be at least equal to four times the nominal maximum size of the aggregate; and (2) that the thickness of the specimens be at least 1.5 times the nominal maximum size of the aggregate.

2.3 Specimens shall be free of foreign materials such as seal coat, tack coat, foundation material, soil, paper, or foil.

2.4 If desired, specimens may be separated from the other pavement layers by sawing or other suitable means. Care shall be exercised to ensure sawing does not damage the specimens.

METHOD A (VOLUMETER)

3. APPARATUS

3.1 Weighing Device-A weighing device conforming to the requirements of AASHTO M-231, Class G2

3.2 Water Bath- Thermostatically controlled so as to maintain the bath temperature at 25 ± 0.5ºC (77 ± 0.9ºF)

3.3 Thermometer- ASTM 17C (17F), having a range of 19 to 27ºC (66 to 80ºF), graduated in 0.1ºC (0.2ºF) subdivisions

3.4 Volumeter[1] - Calibrated, 1.2 L or an appropriate capacity depending upon the size of the test sample

4. PROCEDURE

4.1 Immerse the specimen in the water bath and let saturate for at least 10 minutes. At the end of the 10 minute period, fill a calibrated volumeter with distilled water at 25 ± 1ºC (77 ± 1.8ºF). Place the saturated specimen into the volumeter. Bring the temperature of the water in the volumeter to 25 ± 1ºC (77 ± 1.8ºF), and cover the volumeter making certain that some water escapes through the capillary bore of the tapered lid. Wipe the volumeter dry with a dry absorbent cloth and weigh the volumeter and contents to the nearest 0.1 of a gram.

4.2 Remove the immersed and saturated specimen from the volumeter, quickly damp dry the saturated specimen with a damp towel, and as quickly as possible weigh the specimen. Any water that seeps from the specimen during the weighing operation is considered as a part of the saturated specimen. Dry the specimen to constant mass (NOTE 1). Weigh the dried specimen to the nearest 0.1 of a gram.

> NOTE 1- Constant mass shall be defined as the mass at which further drying at 52 ± 3ºC (125 ± 5ºF) does not alter the mass by more than 0.05 percent. Samples saturated with water shall initially be dried overnight at 52 ± 3ºC (125 ± 5ºF), flipped top to bottom, then dried until a Minimum Standard Drying Time of 20 hours has elapsed. This Minimum Standard Drying Time shall be reestablished using the procedure in NOTE 1A if there are substantial changes in ovens, paving materials, or mix design methods from 2002 conditions. Laboratory compacted specimens and density ring samples need not be dried.

[1]Aluminum Volumeters of different sizes available from Pine Instrument Co., 101 Industrial Drive, Grove City, PA. 16127 and Rainhart Co., 604 Williams St., Austin, TX, 78765 have been found suitable.

NOTE 1A- PROCEDURE FOR DETERMINING A MINIMUM STANDARD DRYING TIME: Assemble a random sample of cores representing the compacted asphalt mixtures typically tested. Saturate the cores with water, and place the saturated cores in the 52 ± 3ºC (125 ± 5ºF) oven overnight. At the start of the following workday flip the cores top to bottom. Continue to dry and weigh the cores at two-hour intervals until constant mass is attained. Document and use the time it took for all cores to reach constant weight as the Minimum Standard Drying Time.

NOTE 2- If desired, the sequence of testing operations can be changed to expedite the test results. For example, first the dry mass of the specimen can be determined. Then the volumeter containing the saturated specimen and water can be weighed. The mass of the saturated specimen can be obtained last.

5. CALCULATIONS

5.1 Calculate the bulk specific gravity (dry basis) of the samples as follows (report the value to three decimal places):

$$GSm = \frac{WSm}{(0.997\ g/mL) \times [VVo - (1.003\ mL/g) \times (WT - WSa - WVo)]}$$

Where:

GSm = bulk specific gravity of the specimen at 25.0ºC (77ºF)

WSm = mass in grams of the dry specimen

VVo = volume in mL of the volumeter at 25.0ºC (77ºF) to the nearest tenth of a milliliter

WT = total mass in grams of the volumeter, saturated specimen, and water in the volumeter at 25.0ºC (77ºF)

WSa = mass in grams of the saturated specimen

WVo = mass in grams of the volumeter

5.2 Calculate the percent water absorbed by the specimen as follows (report the value to one decimal place):

$$\text{Percent Water Absorbed} = \frac{WSa - WSm}{(0.997\ g/mL) \times [VVo - (1.003\ mL/g) \times (WT - WSa - WVo)]} \times 100$$

If the percent water absorbed is more than 3.0 percent, use PTM No. 716.

METHOD B (SUSPENSION IN WATER)

AASHTO T-166, Method A, except as follows:

NOTE 1- replace with the following*:* Constant mass shall be defined as the mass at which further drying at 52 ± 3ºC (125 ± 5ºF) does not alter the mass by more than 0.05 percent. Samples saturated with water shall initially be dried overnight at 52 ± 3ºC (125 ± 5ºF), flipped top to bottom, then dried until a Minimum Standard Drying Time of 20 hours has elapsed. This Minimum Standard Drying Time shall be reestablished using the procedure in NOTE 1A if there are substantial changes in ovens, paving materials, or mix design methods from 2002 conditions. Laboratory compacted specimens and density ring samples need not be dried.

Add: NOTE 4 – Referee Method- In case of discrepancies between the test results obtained by Method A and Method B, the referee test shall be Method A.

METHOD C (RAPID TEST)

AASHTO T-166, Method C

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Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 716
October 2013
6 Pages

LABORATORY TESTING SECTION

Method of Test for

DETERMINATION OF BULK SPECIFIC GRAVITY OF COMPACTED BITUMINOUS MIXTURES THAT ABSORB MORE THAN 3.0 PERCENT WATER BY VOLUME

1. SCOPE

1.1 This method of test is intended for determining the bulk specific gravity of laboratory compacted bituminous mixtures or bituminous roadway samples that contain open or interconnecting voids and/or absorb more than 3.0 percent of water by volume.

2. TEST SPECIMEN

2.1 Compacted specimens in accordance with PENNDOT Methods or obtained in accordance with PENNDOT Methods of sampling a compacted roadway.

METHOD A (VOLUMETER)

3. APPARATUS

3.1 Balance- A balance conforming to the requirements of AASHTO M-231, Class G2

3.2 Water Bath- A thermostatically controlled bath, capable of maintaining the bath temperature at 25 ± 0.5ºC (77 ± 0.9ºF)

3.3 Thermometer- An ASTM 17 C (17 F), having a range of 19 to 27ºC (66 to 80ºF), graduated in 0.1ºC (0.2ºF) subdivisions

3.4 Volumeter[1] – Calibrated, 1.2 L or an appropriate capacity depending on the size of the test sample

[1]Aluminum Volumeters of different sizes available from Pine Instrument Co., 101 Industrial Drive, Grove City, PA. 16127 and Rainhart Co., 604 Williams St., Austin. TX 78765 have been found suitable.

4. PROCEDURE

4.1 Dry the specimen to constant mass (NOTE 1) and weigh the specimen to the nearest tenth (0.1) of a gram.

NOTE 1- Constant mass shall be defined as the mass at which further drying at 52 ± 3ºC (125 ± 5ºF) does not alter the mass by more than 0.05 percent of the test load.

4.2 Coat the specimen with melted paraffin sufficiently thick to seal all surface voids. Allow the specimen to cool in air at room temperature for 30 minutes, and then weigh to the nearest tenth (0.1) of a gram.

NOTE 2- Application of the paraffin may be accomplished by chilling the specimen in a refrigerating unit to a temperature of approximately 4.5ºC (40ºF) for 30 min. and then dipping the specimen in warm paraffin at 5.5ºC (10º F) above the melting point. It may be necessary to brush the surface of the specimen with added hot paraffin in order to fill any pinpoint holes.

4.3 Fill a calibrated volumeter with distilled water at 25ºC (77ºF). Place the coated specimen into the volumeter and cover the volumeter making certain that some water escapes through the capillary bore in the tapered lid. Wipe the volumeter dry with a dry absorbent cloth and weigh the volumeter and its contents to the nearest tenth (0.1) of a gram.

4.4 Determine the specific gravity of the paraffin at 25 ± 1ºC (77 F ± 2ºF), if unknown, using the bitumenometer method, as is used for determining the specific gravity of bitumen (AASHTO T-228).

5. CALCULATIONS

5.1 Calculate as follows:

$$GSm = \frac{WSm}{VVo - [(PWSm + WWa) - PWSm + \frac{(PWSm - WSm)}{GP}}$$

Where:

GSm = Specific gravity of the specimen at 25.0ºC (77ºF)

WSm= Mass in grams of the uncoated specimen in air at 25.0ºC (77ºF)

VVO = Volume in cc of the volumeter at 25.0 ºC (77ºF)

PWSm = Mass in grams of the paraffin coated specimen in air at 25.0 ºC (77ºF)

(PWSm + WWa) = Mass in grams of the paraffin coated specimen and water in the volumeter at 25.0ºC (77ºF)

GP = Specific gravity of the paraffin at 25.0ºC (77ºF)

5.2 Report the bulk specific gravity value to three decimal places.

NOTE 3- The mass of the specimen and water in the above formula does not include the mass of the volumeter. The use of a tare weight for the volumeter is recommended.

NOTE 4- If the bulk specific gravity value of the sample is to be converted to kg/m^3 (pounds per cubic foot), it shall be multiplied by 1000 (62.4) and the value rounded to the nearest tenth.

METHOD B (SUSPENSION IN WATER)

6. APPARATUS

6.1 Balance-Conforming to the requirements of AASHTO M- 231, Class G2. The balance shall be equipped with a suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of the scale pan of the balance (NOTE 5).

NOTE 5- The holder should be immersed to a depth sufficient to cover it and the sample during weighing. Wire suspending the holder should be the smallest practical size to minimize any possible effects of a variable immersed length.

6.2 Water Bath- For immersing the specimen in water while suspended under the balance, equipped with an overflow outlet for maintaining a constant water level. The water bath temperature shall be maintained at 25 ± 1ºC (77 ± 2ºF).

7. PROCEDURE

7.1 Weigh the uncoated specimen after it has been dried to constant mass (NOTE 1). Designate this as mass A.

7.2 Coat the test specimen on all surfaces with melted paraffin sufficiently thick to seal all voids. Allow the specimen to cool in air at room temperature for 30 minutes, then weigh the specimen. Designate this as mass D (NOTE 2).

7.3 Weigh the coated specimen in the water bath at 25 ± 1ºC (77 ± 2ºF). Designate this as mass E.

7.4 Determine the specific gravity of the paraffin at 25ºC (77ºF), if unknown, and designate this as mass F.

8. CALCULATION

8.1 Calculate the bulk specific gravity of the specimen as follows (report to three decimal places):

$$\text{Bulk Specific Gravity} = \frac{A}{D - E - \frac{(D - A)}{F}}$$

Where:

A = mass of the dry specimen in air

D = mass of the dry specimen plus paraffin in air

E = mass of the coated specimen in water

F = specific gravity of the paraffin at 25ºC (77ºF)

9. REFEREE METHOD

9.1 In case of discrepancies between the test results obtained by Methods A and B. The referee test shall be Method A.

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LABORATORY TESTING SECTION

Method of Test for

SIEVE ANALYSIS OF EXTRACTED AGGREGATE

1. SCOPE

1.1 This method of test covers a procedure for the determination of the particle size distribution of aggregates extracted from bituminous mixtures using sieves with square openings. This method was developed for use with PTM 702, Method D.

2. APPARATUS

2.1 Balance- Conforming to the requirements of AASHTO M-231, Class G2.

2.2 Sieves- Square openings and conforming to the requirements AASHTO M-92. All sizes shall be available as required by bituminous concrete specification.

2.3 Timer- An electric timer accurate and variable in one-minute increments with a minimum range of 15 minutes.

2.4 Mechanical Shaker- Capable of performing the sieving action as specified in Section 4.3.

3. SAMPLE

3.1 The sample shall consist of the entire aggregate sample from PTM 702.

NOTE 1- When the extracted sample is too large in quantity to be sieved over one set of 203.2 mm (8") sieves, the sample may be split and sieved over more than one set of 203.2 mm (8") sieves. The weights on each sieve size are combined for calculation of the final percent passing. For sieves with openings of 4.75 mm (No.4) and larger, the mass retained in grams at the completion of the sieving operation shall not exceed the product of 2,500 x (sieve opening in mm) x (sieving surface area in m^2). For the 2.36 mm (No.8) sieve, the mass retained shall not exceed 9 kg/m^2 ($6g/in.^2$), or 300 g for the usual 8-inch diameter sieve. For sieves with openings smaller than 2.36 mm (No.8), the mass retained shall not exceed 6 kg/m^2 ($4g/in.^2$), or 200 g for the usual 8-inch diameter sieves.

3.2 If the sample has remained at room temperature for more than one hour it shall be dried to constant mass.

4. PROCEDURE

4.1 Record the mass of the extracted aggregate from PTM No. 702.

4.2 The sample shall be sieved over sieves of various sizes as required by the bituminous concrete specifications. The mass of material passing each sieve and retained on the next shall be recorded, starting with the pan mass (material passing the 75 μm (No. 200) mesh) and continuing up to and including the maximum sieve size.

4.3 The sieving operation shall be conducted by means of a circular motion of the sieve accompanied by a jarring action to keep the sample moving continuously over the surface of the sieve. In no case shall fragments in the sample be turned or manipulated through the sieve by hand. Mechanical sieving shall be controlled by a timer and shall continue for the pre-determined time. The pre-determined time is established when not more than one percent by mass of the residue passes the sieve during one minute of hand sieving. Hand sieving shall be used to evaluate the thoroughness of mechanical sieving.

NOTE 2- When mechanical shakers and 8 inch sieves are used, 8 minutes has generally shown to be a suitable shaking time.

4.4 The mass of each size aggregate shall be obtained by weighing the pan material and accumulating the mass of each increasing sieve size (Column A, Table 1). All sieve masses shall be accurate to within 0.1 percent of the total sample mass.

4.5 Add the mass of fine aggregate in the extract liquid (Column B, Table 1) as determined in PTM 702, to the mass of aggregate passing each sieve used in the gradation, (Column A, Table 1), to obtain the total mass passing each sieve (Column C, Table 1).

NOTE 3- The mass of fine aggregate in the extract liquid may be obtained with suitable accuracy by subtracting the total mass obtained on the maximum sieve size from the total mass of aggregate in the sample. The total mass of aggregate in the sample is obtained by subtracting the mass of the bitumen in the sample from the total mass of the sample. This calculation assumes that all mass loss on grading is passing the 75 μm (No. 200) mesh sieve. The mass loss on grading shall be limited to 0.4 percent of the total sample. All weights for the wash test are recorded to the nearest 0.1 g (0.004 ounce). All weights for the gradation testing are recorded to the nearest 1 g (0.04 ounce).

5. CALCULATIONS

5.1 Divide the total mass of the extracted aggregate into the total mass passing each sieve (Column C, Table 1), and record in Column D, Table 1, as the percent of raw aggregate passing each sieve.

6. REPORT

6.1 Percentages shall be reported to the nearest whole number except for the percentage passing the 75 μm (No. 200) sieve which shall be reported to the nearest 0.1 percent.

GRADATION WORK SHEET
Table 1

(All masses in grams)

Mass of Original Sample = 2173.8
Mass of Extracted Sample = 2073.2
Mass of Aggregate in Extract = 19.0
Mass of Total Extracted Aggregate= 2092.2

Mass of Bitumen = 81.6
% Aggregate = 96.2
% Bitumen = 3.8

Passing Sieve Size	Mass Passing each Sieve		Fines in Ext. Liq.		Total Mass Passing each Sieve	Raw Aggreg. % Passing
	A	+	B	=	C	D
37.5 mm (1½)	2073		19		2092	100
25 mm (1)	2018		19		2037	97
12.5 mm (1/2)	1035		19		1054	50
4.75 mm (No.4)	593		19		612	29
2.36 mm (No. 8)	435		19		454	22
1.18 mm (No. 16)	363		19		382	18
600 mm (No. 30)	156		19		175	8
300 mm (No. 50)	89		19		108	5
150 mm (No. 100)	56		19		75	4
75 mm (No. 200)	35		19		54	2.6

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PA Test Method No. 757
November 2018
12 Pages

LABORATORY TESTING SECTION

Method of Test for

DETERMINATION OF ASPHALT CONTENT AND GRADATION OF BITUMINOUS MIXTURES BY THE IGNITION METHOD

1. SCOPE

1.1 This test method covers the determination of asphalt content of bituminous mixtures by the ignition of the asphalt binder at 538 °C ± 5 °C (1000F ± 9F) in a furnace, and is a modification of AASHTO T 308. The aggregate remaining after burning can be used for the sieve analysis using AASHTO T 30 as modified herein.

1.2 The values in metric units are to be regarded as the standard.

1.3 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards

2.1.1 M 231, Weighing Devices Used in the Testing of Materials

2.1.2 R 76, Reducing Samples of Aggregate to Testing Size

2.1.3 R 90, Sampling Aggregate Products

2.1.4 T 30, Mechanical Analysis of Extracted Aggregate

2.1.5 T 40, Sampling Bituminous Materials

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

2.2 Pennsylvania Test Methods

2.2.1 PTM No. 729, Sampling Roadway Bituminous Concrete

2.2.2 PTM No. 746, Sampling Bituminous Paving Mixtures

2.3 Furnace manufacturer’s instruction manual.

3. SUMMARY OF TEST METHODS

3.1 The asphalt binder in the bituminous mixture is ignited using the furnace equipment applicable to the particular method. The asphalt content is calculated as the difference between the initial mass of the bituminous mixture and the mass of the residual aggregate, any calibration factor(s) and moisture content. The asphalt content is expressed as a mass percent of the moisture-free mixture.

4. SIGNIFICANCE AND USE

4.1 This method can be used for quantitative determinations of asphalt binder content and gradation in bituminous paving and patching mixtures and pavement samples for quality control, specification acceptance, and mixture evaluation studies. This method does not require the use of solvents. Aggregate obtained by this test method may be used for gradation analysis according to AASHTO T 30 as modified herein.

5. SAMPLING

5.1 Obtain samples of aggregate in accordance with AASHTO R 90.

5.1.1 The test specimen shall be the end result of quartering a larger sample taken in accordance with AASHTO R 76.

5.2 Obtain samples of asphalt binder in accordance with AASHTO T 40.

5.3 Obtain samples of freshly produced bituminous mixture in accordance with PTM No. 746, or samples of compacted roadway in accordance with PTM No. 729, or prepared mixture samples composed of the design aggregate structure and design asphalt content as directed in Section 6.2 for mix calibration.

5.3.1 The size of the test sample shall be the result of quartering from a larger sample, according to PTM No. 746 and shall conform to the mass requirement in Table 1. Specimen size shall not be more than 200 grams greater than the minimum recommended specimen size.

Table 1

Bituminous Mixture	Minimum Mass of Specimen, g
SP9.5, SP12.5, FJ's, ID2W, ID2WHD, FB1W, FB2W, FB3Mod, Micro-Surfacing, Ultra-Thin Friction Course, Cold Patch	1200
SP19, ID3W, ID2B, ATPBC, FB1B, FB2B, FBMod, SMA	1500
SP25, SP37.5, BCBC, ID2BHD	2000

6. CALIBRATION

6.1 Apparatus Calibration and Certification

6.1.1 Items requiring periodic verification by calibration include ignition furnaces and balances. Calibration is performed annually using standards traceable to nationally or internationally recognized standards. Calibration services may be performed by the original manufacturer or by other outside certified agencies.

6.1.2 Ignition Furnaces and their internal balances shall be calibrated using the manufacturer's procedure and tolerances for temperature and mass determination. Each furnace or balance is given a calibration status, which indicates the most recent calibration date.

6.1.3 Balances used to weigh pans, baskets, or graded aggregate shall be calibrated to conform to the tolerances outlined in the most recent edition of AASHTO M 231 for the type and class of balance being used.

6.2 Mix Calibration

6.2.1 This method may be affected by the type of aggregate in the mixture. The results may also be affected by the presence of additives and modifiers. Accordingly, to optimize accuracy, a Calibration factor (Cf) shall be established by testing a set of calibration samples for each mix type. This procedure must be performed before any acceptance testing is completed.

6.2.2 The calibration shall be repeated each time if there is a change in the mix ingredients or design.

6.2.3 According to the requirements of Section 5, prepare two calibration samples at the design asphalt content and aggregate structure, which shall also include additives and modifiers, if any. Prior to mixing, prepare a butter mix at the design asphalt content. The purpose of the butter mix is to condition the mixing bowl to provide a coating of asphalt and fines in the bowl. Mix and discard the butter mix prior to mixing any of the calibration specimens to ensure accurate asphalt content. Aggregate used for the calibration specimens shall be sampled from stockpiled material produced in the current production season and designated for use on the candidate project. Any method may be used to combine the aggregates, however, an additional "blank" specimen shall be batched and tested for the aggregate gradation according to AASHTO T 30. The washed gradation shall fall within the mix design tolerances.

6.2.4 The freshly mixed specimens may be placed directly in the sample baskets except for mixtures containing cutbacks or emulsions as directed in Section 8.2. If allowed to cool, the samples must be preheated in a 163 °C ± 5 °C (325F ± 9F) oven for 25 minutes. Do not preheat the sample baskets.

6.2.5 Test the specimens in accordance with Sections 9 and 10 (Test Method A) or Sections 11 and 12 (Test Method B).

6.2.6 Once all of the calibration specimens have been burned, determine the measured asphalt content for each sample by calculation or from the furnace printout.

6.2.7 If the difference between the measured asphalt contents of the two samples exceeds 0.15 percent, repeat the two tests, and from the four tests, discard the high and low result. Determine the Cf from the two remaining results. Calculate the difference between the measured and actual asphalt content for each sample. The Cf is the average of the differences expressed in percent by weight of the asphalt mixture, (measured-actual). Sign convention (+/-) is important and must be maintained.

6.2.8 It will be necessary to determine a separate Cf for the material passing the 75μm (No. 200) sieve. Perform a gradation analysis on the residual aggregate as indicated in Section 13. Compare this gradation, to the gradation of the unburned, "blank" specimen in Section 6.2.3, to evaluate the amount of aggregate breakdown. The No. 200 sieve Cf shall be the average percent passing the 75 μm (No. 200) sieve of the burnt samples minus the percent passing the 75 μm (No. 200) sieve of the blank sample.

6.3 RAP Calibration Factor Determination

6.3.1 Test a minimum of four 100% RAP samples. The sample size shall conform to Table 1. Test each sample according to Method A or Method B (60-minute burn time) to determine the AC content of each.

6.3.2 Determine the average total loss of the four samples. Subtract 0.5% from the average total percent loss (NOTE 1). This is the corrected percent of AC of the RAP (Pbr).

NOTE 1- Since it is difficult and time consuming to determine the actual Cf for 100% RAP without a blank (virgin) aggregate specimen, 0.5% will be the standard Cf for 100% RAP. Only if prior testing experience with a specific RAP source indicates inadequate accuracy when compared to alternate methods, such as solvent extraction, should this standard factor (0.5%) not be used.

6.3.3 The value determined in Section 6.3.2 will be considered the corrected percent of asphalt in the RAP (Pbr).

6.3.4 Perform a sieve analysis (Washed) on three of the incinerated RAP samples as per Section 13. The average of the three samples will be considered the gradation for the 100% RAP. The fourth incinerated (unwashed) sample will be used to make the blank sample in Section 6.3.5.

6.3.5 Batch and test two calibration samples (plus a butter mix) according to Section 6.2.3, and according to the proportions of RAP and virgin materials established in the JMF. Also, batch a blank sample (aggregate only) meeting the JMF of the RAP/virgin aggregate combination, using material from the unwashed RAP sample of Section 6.3.4. The actual asphalt content used to calculate the Cf shall be a combination of the Pbr and the virgin asphalt added. The No.200 sieve Cf shall be the average percent passing the 75 μm (No. 200) sieve of the burnt samples minus the percent passing the 75 μm (No. 200) sieve of the blank sample.

6.3.6 Calculations for Cf for mixtures with RAP:

Actual asphalt % = [(%RAP/100) x Pbr] + % Virgin Asphalt Added

Pbr = Corrected Percent Asphalt in 100% RAP

% Virgin Asphalt Added = % of new asphalt by total mix weight

EXAMPLE: If THE JMF INDICATES 20% RAP Material:

6.2% Avg. Total Loss

Pbr = 6.2% - 0.5% = 5.7%

4.3% new asphalt added

THEN: Actual Asphalt % = [(20/100) x 5.7] + 4.3%
Actual Asphalt % = 1.14% + 4.3% = 5.44%

$$Cf = \frac{[(D1 - P1) + (D2 - P2)]}{2}$$

Where: D1, D2 = Total sample loss in percent for Calibration samples 1 and 2.
P1, P2 = Actual asphalt % for Calibration samples 1 and 2.

IF: D1 = 5.52%
D2 = 5.61%
P1 and P2 = 5.44%

THEN: Cf = 0.13%

7. MOISTURE CONTENT

7.1 Determine the moisture content of a representative portion of the mixture according to PTM No. 749 Apparent Moisture In Bituminous Paving Mixtures.

NOTE 2- The Moisture Content Test is conducted only when water is known or suspected to be present.

8. SAMPLE PREPARATION

8.1 If the mixture is not sufficiently soft to separate with a spatula, scoop, or trowel, place 2000 to 5000 grams in an oven at 163 °C ± 5 °C (325F ± 9F) for a maximum of two hours or on a hot plate over low heat, until the mixture can be handled. Use care not to fracture the mineral particles. Thoroughly mix and form into a flat pile and quarter to the required size.

8.2 Mixtures containing liquid bituminous materials such as cutbacks and emulsified asphalt shall be cured before testing.

8.2.1 All bituminous mixtures containing emulsified asphalt and cutback asphalt shall be spread uniformly on a tray of sufficient size to hold the total sample. Place the sample in an oven maintained at 163 °C ± 5 °C (325F ± 9F) for approximately 15 minutes, remove and weigh. Place the sample back in the oven and remove at approximately 15 minute intervals, mixing occasionally, until the sample has reached constant mass.

NOTE 3- Constant mass will be defined as the mass at which further drying at 163 °C ± 5 °C (325F ± 9F) does not alter the mass by more than 0.6 grams.

TEST METHOD A

9. APPARATUS

9.1 Ignition furnace- A forced air ignition furnace, capable of maintaining the temperature at 578 °C ± 5 °C (1072F ± 9F), with an internal balance thermally isolated from the furnace chamber accurate to 0.1 g. The balance shall be capable of weighing a 3500 gram sample in addition to the sample baskets. A data collection system shall be included so that the weight can be automatically determined and displayed during the test. The furnace shall have a built-in computer program to calculate the change in mass of the sample and provide for the input of a correction factor for determining the aggregate loss. The furnace shall produce a printed ticket with the initial specimen mass, specimen mass loss, temperature compensation, correction factor, corrected asphalt content (%), test time, and test temperature. The furnace chamber dimensions shall be adequate to accommodate a sample size of 3500 grams. The furnace shall provide an audible alarm and indicator light when the sample mass loss does not exceed 0.01 percent of the total sample mass for three consecutive minutes. The furnace door shall be equipped so that the door cannot be opened during the ignition test. A method of reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside. When set up properly the

furnace shall have no noticeable odors escaping into the laboratory. The furnace shall have a fan with the capability of pulling air through the furnace to expedite the test, and to reduce the escape of smoke into the laboratory.

9.2 Sample basket(s)- Of an appropriate size that allows the samples to be thinly spread, and allows airflow through and around the sample particles. Sets with two or more baskets shall be nested. The sample shall be completely enclosed with screen mesh or a perforated stainless steel plate, or other suitable material.

> NOTE 4- Screen mesh or other suitable materials with maximum and minimum openings of 2.36 mm (No. 8) and 600 μm (No. 30), respectively, have been found to perform well.

9.3 Catch Pan- Of sufficient size to hold the sample basket(s) so that aggregate particles and melted asphalt binder falling through the screen mesh are caught.

9.4 Oven- Capable of maintaining 163 °C ± 5 °C (325F ± 9F)

9.5 Balance- External balance used to weigh pans, baskets, bituminous samples, or graded aggregate, conforming to AASHTO M 231 Class G2.

9.6 Safety Equipment - Safety glasses or a face shield, high temperature gloves, long sleeve jacket, a heat resistant surface capable of withstanding 650 °C (1202°F), and a protective cage capable of surrounding the sample and baskets during the cooling period

9.7 Miscellaneous Equipment - A pan larger than the sample basket(s) for transferring the sample after ignition, spatulas, scoops, bowls, and wire brushes

10. TEST PROCEDURES

10.1 Preheat the ignition furnace to 538 °C ± 5 °C (1000F ± 9F). Manually record the furnace temperature (set point) prior to the initiation of the test if the furnace does not record it automatically.

10.2 The Cf value shall be entered into the ignition furnace for the specific mix to be tested as determined in Section 6.2 or 6.3.

10.3 Weigh and record the mass of the sample basket(s) and catch pan (with guards in place).

10.4 Prepare the sample as described in Section 8. Evenly distribute the required amount of sample in the sample basket(s) that have been placed in the catch pan, taking care to keep the material away from the edges of the basket. While transferring the mix into the baskets, any fine mix sticking to the inside of the spatula shall be scraped and included in the sample. Use a spatula or trowel to level the specimen. The required sample sizes are listed in Section 5, Table 1.

10.5 Weigh and record the total mass of the sample, basket(s), catch pan, and basket guards. Calculate and record the initial mass of the specimen (total mass - the mass of the specimen basket assembly).

10.6 Input the initial mass of the specimen, in whole grams, into the ignition furnace controller. Press the enter key. Verify that the correct mass has been entered.

10.7 Open the chamber door and place the sample baskets in the furnace. Close the chamber door and verify that the sample mass (including the basket(s)) displayed on the furnace scale equals the total mass recorded in Section 10.5 within ± 5 g. Differences greater than 5 g or failure of the furnace scale to stabilize may indicate that the sample basket(s) are contacting the furnace wall. Initiate the test by pressing the start/stop button. This will lock the sample chamber and start the combustion blower.

> NOTE 5- The furnace temperature will drop below the set point when the door is opened, but will recover with the door closed and when ignition occurs. Sample ignition typically increases the temperature well above the set point, depending on sample size and asphalt content.

10.8 Allow the test to continue until the stable light and audible stable indicator indicate the test is complete (the change in mass does not exceed 0.01 percent for three consecutive minutes). Press the start/stop button. This will unlock the sample chamber and cause the printer to print out the test results.

10.9 Open the chamber door, remove the sample basket(s) and allow the baskets to cool to room temperature (approximately 30 minutes).

10.10 Use the corrected asphalt content (%) from the furnace printout. If a moisture content has been determined, subtract the moisture content from the printed ticket corrected asphalt content and report the difference as the corrected asphalt content.

> NOTE 6- In the event of a suspect result, it is recommended that the burnt aggregate be weighed after the aggregate has cooled (Never weigh the baskets hot, see Section 10.9) and calculate the asphalt content manually (see the formula in Section 12.15).

TEST METHOD B

11. APPARATUS

11.1 Ignition Furnace- A forced air furnace, capable of maintaining the temperature at 578 °C ± 5 °C (1072F ± 9F). The furnace chamber dimensions shall be adequate to accommodate a sample size of 3500 grams. The furnace door shall be equipped so that the door cannot be opened during the ignition test. A method of reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside. When set up properly the furnace shall have no noticeable odors escaping into the laboratory. The furnace shall have a fan with the capability of pulling air through the furnace to expedite the test, and to reduce the escape of smoke into the laboratory.

11.2 Sample basket(s)- Of an appropriate size that allows the samples to be thinly spread out and allows airflow through and around the sample particles. Sets with two or more baskets shall be nested. The sample shall be completely enclosed with screen mesh or a perforated stainless steel plate or other suitable material.

> NOTE 7- Screen mesh or other suitable materials with maximum and minimum openings of 2.36 mm (No. 8) and 600 μm (No. 30), respectively, have been found to perform well.

11.3 Catch Pan- Of sufficient size to hold the sample basket(s) so that aggregate particles and melted asphalt binder falling through the screen mesh are caught.

11.4 Oven- capable of maintaining 163 °C ± 5 °C (325F ± 9F)

11.5 Balance- Of sufficient capacity and conforming to the requirements of AASHTO M 231, Class G2 for weighing the specimen and basket(s).

11.6 Safety Equipment- Safety glasses or a face shield, high temperature gloves, long sleeve jacket, a heat resistant surface capable of withstanding 650 °C (1202F), and a protective cage capable of surrounding the sample and baskets during the cooling period

11.7 Miscellaneous Equipment- A pan larger than the sample basket(s) for transferring the sample after ignition, spatulas, scoops, bowls, and wire brushes

12. TEST PROCEDURES

12.1 Preheat the ignition furnace to 538 °C ± 5 °C (1000F ± 9F).

12.2 Enter the Cf value into the ignition furnace for the specific mix to be tested as determined in Section 6.2 or 6.3.

12.3 Weigh and record the mass of the sample basket(s) and each pan (with guards in

place).

12.4 Prepare the sample as described in Section 8. Place the sample baskets in the catch pan. Evenly distribute the sample in the basket(s) taking care to keep the material away from the edge.

12.5 Weigh and record the total mass of the sample, basket(s), catch pan, and basket guards. Calculate and record the initial mass of the specimen (total mass - the mass of the specimen basket assembly).

12.6 Burn the sample in the furnace for at least 45 minutes.

NOTE 8- The appropriate time for the initial burn of a sample is dependent on the sample size. For large samples, the time could be significantly longer than 45 minutes. See the manufacturer's manual for guidelines.

12.7 Remove the sample from the furnace after ignition and allow the sample to cool to approximately room temperature (at least 30 minutes).

12.8 Weigh and record the mass (W_a) of the sample after ignition to the nearest 0.1 gram.

12.9 Return the sample to the furnace.

12.10 After the furnace reaches the set temperature, burn the sample for at least 15 minutes.

12.11 Remove the sample from the furnace and allow it to cool to approximately room temperature (at least 30 minutes).

12.12 Weigh and record the mass (W_a) of the sample after ignition.

12.13 Repeat these steps until the change in measured mass (W_a) of the sample after ignition does not exceed 0.01 percent of the initial sample mass (W_s).

12.14 Record the last value obtained for (W_a) as the mass (W_a) of the sample after ignition.

NOTE 9- Steps 12.9 through 12.14 may not be necessary if it can be demonstrated from the mix calibration data that constant mass can be achieved by heating the sample for the same time as the calibration samples. The type and mass of the sample being tested shall be reasonably close (within 200 grams) to those of the calibration sample.

12.15 Calculate the asphalt content of the sample as follows:

$$AC\% = \frac{W_s - W_a}{W_s} \times 100 - Cf$$

Where:

AC% = the measured (corrected) asphalt content percent by weight of the sample
W_a = the total weight of the aggregate remaining after ignition
W_s = the total weight of the sample prior to ignition
Cf = calibration factor, percent by weight of the sample

13. GRADATION, METHODS A & B

13.1 Allow the specimen to cool to approximately room temperature in the sample baskets.

13.2 Empty the contents of the baskets into a flat pan. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets.

13.3 Perform the gradation analysis according to AASHTO T 30 with the exception of NOTES 10 and 11.

NOTE 10- All gradations are to be washed. To expedite drying samples to a constant weight after washing, samples may be dried at 191 °C ± 5 °C (375F ± 9F).

NOTE 11- The permissible limit for mass retained on the 2.36 mm (No. 8) sieve shall be 9 kg/m^2 (6 g/square inch), or 300 g for the usual 8-inch diameter sieve.

13.4 A gradation worksheet example is attached.

14. REPORT, METHODS A & B

14.1 Always report the test method (A or B), corrected asphalt content, Cf for asphalt content, Cf for the percent passing the 75µm (No. 200) sieve, temperature compensation factor (if applicable), total percent loss, sample mass, moisture content (if determined), and test temperature. For units with internal balances attach a copy of the furnace printout to the report.

Worksheet EXAMPLE

A	**Mass of Aggregate before wash**	**=**	**1143.0**
B	**Mass of Aggregate after wash**	**=**	**1085.4**
C	**Mass Loss on wash**	**=**	**57.6**
D	**No. 200 Calibration factor (200Cf)**	**=**	**0.5**

Passing Sieve Size	Mass Passing each sieve E		Mass loss on wash F		Total Mass Passing each sieve G=(E+F)	Raw Agg. % passing H=(G/A)	Corrected No. 200 I=(H-D)
12.5 mm (1/2 in.)	1085	+	57.6	=	1142.6	100	
9.5 mm (3/8 in.)	1048	+	57.6	=	1105.6	97	
4.75 mm (No. 4)	674	+	57.6	=	731.6	64	
2.36 mm (No. 8)	478	+	57.6	=	535.6	47	
1.18 mm (No. 16)	233	+	57.6	=	290.6	25	
600μm (No. 30)	126	+	57.6	=	183.6	16	
300μm (No. 50)	61	+	57.6	=	118.6	10	
150μm (No. 100)	23	+	57.6	=	80.6	7	
75μm (No. 200)	**1.3**	**+**	**57.6**	**=**	**58.9**	**5.2**	**- 0.5 = 4.7**