PENNDOT ASPHALT TECHNICIAN CERTIFICATION PROGRAM

FIELD TECHNICIAN UPDATE/REFRESHER HANDOUT 2020

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PennState

NECEPT Asphalt Field Technician Update/Refresher Course

Table of Contents

NECEPT Asphalt Field Technician Update/Refresher Course

PTM 747 – Determination of Distributor Application Rate in the Field

PTM 751 – Measuring Surface Macrotexture Depth Using a Volumetric Technique and Determining Pattern Segregation

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Worksheet: Determining Lots & Sublots and Sampling Locations

Info Sheet: Sampling Made Simple

N E C E P T

NECEPT

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Northeast Center of Excellence for Pavement Technology

Certified Asphalt Field Technician Update/ Refresher Course

2020

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ACRONYMS

2

AASHTO	HMA	NMAS	RAM
ACE	IRI	OSHA	RAP
AET	JMF	PAPA	RAS
AI	LTS	PG	SRL
ATPBC	MTV	PTM	SMA
ASTM	MUTCD	QC/QA	TAC
ESAL	NAPA	RPS	VMA
FHWA	NECEPT	PWT	WMA

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N E C E P T

NECEPT

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Website: www.superpave.psu.edu

Email: superpave @ psu.edu

Training
PENNDOT Certification Program

Course Information:
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Course Objective

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- **This is an *update/refresher* course for Certified Asphalt Field Technicians.**
- **This course provides credit toward renewal of certification for participants.**
- **The course objective is to provide a *update/refresher* of essential information regarding PennDOT Specifications and operations and procedures for Hot-Mix Asphalt (HMA) and Warm Mix (WMA) paving and a discussion of 'hot' topics with experts in the field.**

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N E C E P T

Course Agenda

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- **Introduction, Specifications & PTMs Review & Update**
- **Hot Topics**
  - **?**
  - **?**
  - **?**
- **Problem Solving Session**
- **Open Discussion: Questions, Areas of Concern.**

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Excellent Resource

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- **Hot-Mix Asphalt Paving Handbook 2000 (July 2001)**
- **Available from NAPA* Online Store**
  - **List Price: FREE**
  - **231 Pages**
  - **64 MB**

- **https://store.asphaltpavement.org/index.php?productID=819**
- ***National Asphalt Pavement Association**

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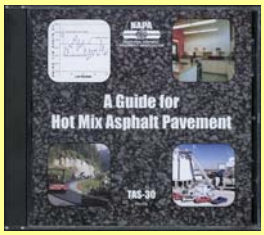
Excellent Resource

- **A Guide for Hot Mix Asphalt Pavement CD-ROM**
- **Available from NAPA* Online Store, $30**



– **https://store.asphaltpavement.org/index.php?productID=266**

***National Asphalt Pavement Association**

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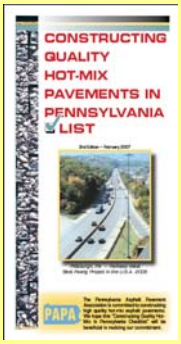
Excellent Resource

Pennsylvania Asphalt Pavement Association

Constructing Quality Hot-Mix Pavements in Pennsylvania Checklist



Website currently under construction.

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N E C E P T

HMA Construction Program

Certified Asphalt Field Technician

Introduction, Technician's Responsibility, Specifications, and PA Test Methods

Northeast Center of Excellence for Pavement Technology
NECEPT

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Technician Certification Program

- **PennDOT Pub 351**
  - **Background Info**
  - **Certification & Recertification Requirements**
  - **Application Procedures**
  - **Exam Review & Retest**
  - **Code of Ethics**

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Asphalt Technician in Training NEW requirements will affect YOU

- **Field Supervisor will need to sign off on experience (24 hours)**
- **ACE will need to sign off on capabilities.**
- **Must take Review and Certification Course in next Cycle (Passing Grade)**

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Certification Renewal

Pub 351: Section IX

- **Must be Certified for previous 5 years**
- **Must have 500 documented hours experience on State Asphalt Paving projects**
- **Must have PennDOT or PTC signature to confirm satisfactory performance**
- **Within the 5 years, must have attended :**
  - **2 NECEPT Field Technician Update/Refresher Courses, or….**
  - **1 NECEPT Update/Refresher Course and 1 acceptable asphalt-related conference, seminar, or workshop**

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Certification Renewal

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Acceptable Asphalt-Related Annual Conference Seminars, or 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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Certification Renewal

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Submit:

- **Recertification Application**
- **With Processing Fee ($35.00)**

www.superpave.psu.edu

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Section XIII: Code of Ethics

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Four Principles:

a. Demonstrate a concern for the welfare and dignity of the recipients of the services, including Department personnel.

b. Maintain high standards of professional competence.

c. Provide accurate information about asphalt technician services.

d. Function with discretion and integrity in relations with colleagues and other professionals.

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As a certified Technician, you may represent one of the following:

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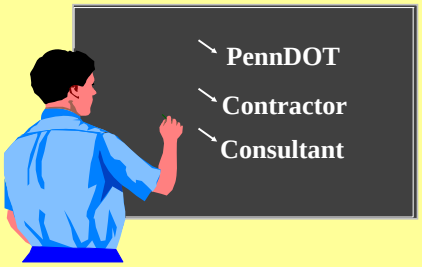

In any case, your responsibility is to insure a quality product is being placed.

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What are your responsibilities ?

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1. Know the specifications
2. Know the PTMs needed to insure quality control
3. Be familiar with paving operations
4. Recognize mix and paving deficiencies
5. Be able to recommend corrective action
6. Adhere to the four principals of the code of ethics

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Responsibilities: Pre-Pave Set Up

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- Review Job Mix Formula
- Review Project Quality Control Plan & Special Provisions
- Insure proper preparation of the Nuclear Gauge or Electrical Impedance Gauge
- Check Compaction Equipment
- Set Up Initial Rolling Pattern
- Check Box Sample and/or Core Locations

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Responsibilities: Start of Paving Operation

- **Check surface preparation**
- **Check Mix Temperature**
- **Record Initial Density Readings**
- **Check Mat Temperature**
- **Check Mat Appearance**
- **Check Joints**
- **Make Adjustments as Required**
- **Record Initial Roller Pattern/ Temps**

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Responsibilities: Paving Operation

- **Monitor Startup Operations**
- **Monitor Truck Exchange**
- **Monitor Compaction**
- **Check with Plant**
- **Check Finished Product**
- **Specify Coring Locations for Acceptance**
- **Maintain Good Communications.**

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Your Effort Towards Achieving A Quality Paving Job Makes The Difference Between A Great Job And A Mediocre One.

MAKE THE EFFORT!

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R34D 7H15

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7H15 M3554G3 53RV35 70 PROV3 7H47 OUR M1ND5 C4N DO 1MPR3551V3 TH1NG5! 1N 7H3 B3G1NN1NG 17 WA5 H4RD BU7 NOW, ON 7H15 LIN3 YOUR M1ND 15 R34D1NG 4UTOM471C4LLY W17HOU7 3V3N 7H1NK1NG 4BOU7 17. ONLY C3R741N P3OPL3 C4N R34D 7H15!

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Experience

- **Experience allows you to recognize a mistake when you make it again.**
- **Keep records of mix tendencies as to temperature, amplitude, vibration, cross-slope and grade as related to density and ride.**

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PennDOT Specifications

Which Specifications Are Most Significant?

The specifications that cover your project and affect YOU are the most important. Be aware of the effective change dates and your project let date.

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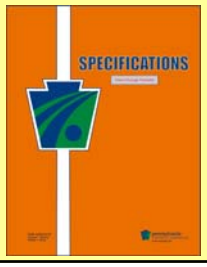
What you need to know...

- **PennDOT Specifications Publication 408:**
- **Sections covering HMA, WMA & the important aspects of these specifications**
- **PennDOT website: www.penndot.gov**

Effective October 7, 2016



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These changes are now incorporated into the 2016 Pub 408

Commonwealth of Pennsylvania
Department of Transportation

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

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Pub 408 Table of Contents

Section	Title	
100	General Provisions	←
200	Earthwork	
300	Base Courses	←
400	Flexible Pavements	←
500	Rigid Pavements	
600	Incidental Construction	
700	Material	←
800	Roadside Development	
900	Traffic Accommodation & Control	
1000	Structures	
1100	Manufactured Material	

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Pub 408 HMA Specifications

106	Control of Material
309	Superpave Asphalt Mixture Design, Standard Construction, HMA Base Course
311	Superpave Asphalt Mixture Design, Standard Construction, WMA Base Course ←
316	Flexible Base Replacement
344	Full Depth Reclamation
360	Asphalt Treated Permeable Base Course
404	Evaluation of Asphalt Pavement Ride Quality and Payment of Incentive
405	Evaluation of Asphalt Pavement Longitudinal Joint Density And Payment of Incentive/Disincentive
409	Superpave Mixture Design, Standard & RPS Construction of Plant-Mixed HMA Courses

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Pub 408 HMA Specifications

410	Superpave Mixture Design, Standard & RPS Construction of Plant-Mixed HMA Fine-Graded Courses ←
411	Superpave Mixture Design, Standard & RPS Construction of Plant-Mixed WMA Courses ←
419	Stone Matrix Asphalt Mixture Design, RPS Construction of Plant-Mixed HMA Wearing Courses ←
420	Pervious Asphalt Pavement System
460	Asphalt Tack Coat ←
483	Polymer-Modified Emulsified Asphalt Paving System (Microsurfacing) ←
489	Ultra-Thin Bonded Wearing Course
496	Asphalt Concrete Pavement, 60-Month Warranty

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HMA/WMA Standard Special Provisions

a10650	Minimum Effective Asphalt for 9.5 mm or 12.5 mm Superpave Mixtures
c0411	Item 4411-0010 Superpave Asphalt Mixture Design, WMA Binder Course (Leveling), High RAP
b04001 and b04002	Superpave Asphalt Mixture Design, Standard and RPS Construction of Asphalt Pavements with Percent Within Tolerance and LTS Testing (PWT-LTS)
b04003 and b04004	Superpave Asphalt Mixture Design, Standard and RPS Construction of Asphalt Pavements with Department Local Acceptance, and Payment by Percent Within Tolerance (PWT-HOLA)
b04091	Section 409 for Specific Gravity (Gmm)

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New Sections 313 and 413

- **These will become new specifications for projects with PWL and LTS testing**

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Other Related Pub 408 Specifications

210	Subgrade
350	Subbase
450	Manual Asphalt Patching
461	Asphalt Prime Coat
469	Asphalt Joint & Crack Sealing
491	Milling of Asphalt Paving Surface
492	Profile Milling of Asphalt Paving Surfaces

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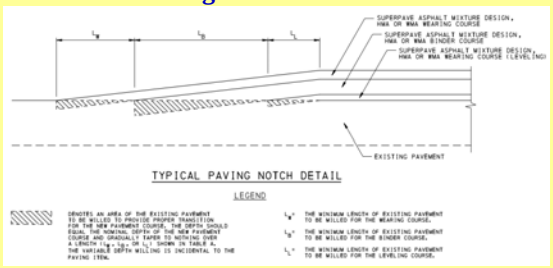
Paving Notches RC 28



TYPICAL PAVING NOTCH DETAIL

LEGEND

DENOTES AN AREA OF THE EXISTING PAVEMENT TO BE MILLED TO PROVIDE PROPER TRANSITION FOR THE NEW PAVEMENT COURSE. THE DEPTH SHOULD EQUAL THE NOMINAL DEPTH OF THE NEW PAVEMENT COURSE TO BE PLACED, BUT NOT EXCEED A DEPTH OF 2 INCHES OR AS SHOWN IN TABLE A. THE VARIABLE DEPTH MILLING IS INCIDENTAL TO THE PAVING ITEM.

L_W = THE MINIMUM LENGTH OF EXISTING PAVEMENT TO BE MILLED FOR THE WEARING COURSE.

L_B = THE MINIMUM LENGTH OF EXISTING PAVEMENT TO BE MILLED FOR THE BINDER COURSE.

L_L = THE MINIMUM LENGTH OF EXISTING PAVEMENT TO BE MILLED FOR THE LEVELING COURSE.

TABLE A

REGULATORY POSTED SPEED LIMIT (mph)	MINIMUM LENGTH OF MILLING L_L	L_B	L_W
> 65	35'	80'	80'
≥ 55 TO < 65	35'	80'	60'
≥ 45 TO < 55	25'	35'	30'
< 45	15'	25'	20'

New for 2017

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Milling Length for Transition

TABLE A

REGULATORY POSTED SPEED LIMIT (mph)	MINIMUM LENGTH OF MILLING L_L	L_B	L_W
> 65	35'	80'	80'
≥ 55 TO < 65	35'	80'	60'
≥ 45 TO < 55	25'	35'	30'
< 45	15'	25'	20'

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Remember…

- **Keep familiar with Pub 408 specifications and current changes.**
- **Learn where to find particular specifications in Pub 408 and specific details.**

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Remember

- 408 specs are superseded by Supplemental Specifications which are superseded by special provisions.
- Standard Drawings (RC standards) are superseded by Construction Plans and Cross Sections.

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Specification Different Sections

- 309.1 Description
- 309.2 Materials
- 309.3 Construction
- 309.4 Measurement & Payment

Note that construction related specifications are always in the ".3" portion of ANY section

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Section 309: Superpave Asphalt Mix Design, HMA Base Course

- 309.1 Description - This work is the standard construction of plant mixed Hot-Mix Asphalt (HMA) base course on a prepared surface using a volumetric mixture design developed with the Superpave Gyratory Compactor.
- 309.2 Materials – follows 409.2.

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Section 309: Superpave Asphalt Mix Design, HMA Base Course

- 309.3 Construction – follows 409.3 for Standard construction, except:
  - (b) Weather Limitations: Placement prohibited when prepared surfaces are wet or when air or surface temperature is 35°F or below.
  - (h) 1.b Spreading & Finishing:
    - For 25.0 mm HMA base, if compacted depth is > 6", place in two or more ≈ equal lifts, with no lift < 3" or > 6".
    - For 37.5 mm HMA base, if compacted depth is > 8", place in two or more ≈ equal lifts, with no lift < 4" or > 8".

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Section 309: Superpave Asphalt Mix Design, HMA Base Course

- 309.3 Construction – follows 409.3 for Standard construction, except:
  - (l) Surface Tolerance: Pavement defective if irregularities are more than ¼ inch
  - (m) Tests for Depth:
    - One random core using PTM No. 1 on top lift in each 3000 sq. yds, with additional cores if deficiency suspected
    - Measure depth according to PTM No. 737. Pavement defective if depth deficient by ½ inch or more

Note difference between surface tolerance and depth acceptance.

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Specification for WMA Spec 408, Section 311

Change 3 Pub 408 2016

- Section 311: Superpave Asphalt Mixture Design, Standard Construction, WMA Base Course
- 311.2 ref. 411.2
- 311.3 ref 411.3 **EXCEPT**
- No placement below 35°F
- Defective if surface irregularities are >1/4 in.

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Section 316- Flexible Base Replacement

- **Ref: RC 28M, RC 30M for Drawings**
- **SAW or MILL perimeter of area to be replaced**
- **Vertical Edges clean and coated with PG 64-22**
- **Material placed to minimize segregation**

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Section 344 Full Depth Reclamation (FDR) A Review

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Section 344 (CHANGE 9) Full Depth Reclamation (FDR)

- **344.1 this work is the in-place pulverizing and mixing of existing roadway materials, stabilizing additives and imported aggregate or RAP as required to specified depths—to form a new pavement base layer upon which an asphalt overlay or surface treatment is applied.**

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Section 344 FDR

- **344.2 reclaimed existing material and incorporated RAP must have 95% passing 2 inch sieve**
- **Stabilizing Additives:**
- **Emulsified Asphalt: CMS-2, SS-1h, CSS-1h, CSS-1hPM**

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Section 344 Full Depth Reclamation (FDR)

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Section 344 FDR -Chemicals

- **Portland Cement, Hydrated Lime, Fly Ash, Pozzolans, Calcium Chloride, Magnesium Chloride**
- **All Projects must have an approved mix design.**

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Section 344 FDR--Construction

- **Reclaimer must be able to pulverize to a depth of 16 inches at 8 feet wide in one pass and control oversized material.**
- **Computerized to control injection of water and/or stabilizing agents.**
- **Motor Grader or approved method for shaping**

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Section 344 FDR- Compaction

- **20 ton pneumatic tire roller for 8" depth or less, and for final compaction of depths > 8"**
- **Vibratory pad foot roller for depths > 8"**
- **12-14 ton static steel drum roller for finish rolling**
- **Allowed to cure until 7 day design strength is met**

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Section 344 FDR— Compaction and Acceptance

- **One test for each 3000 sq. yds.– must be 95% of lab results using PTM 402**
- **Not to exceed ¾ inch of irregularity for line, grade, or cross slope**
- **Surface tolerance of not > ½ inch under ten foot straight edge.**
- **Acceptance by surface tolerance and project density specs.**

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Section 360 Asphalt Treated Permeable Base

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Section 360: Asphalt Treated Permeable Base Course

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Section 360: Asphalt Treated Permeable Base Course

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Section 360: Asphalt Treated Permeable Base Course

- 360.1 Description: This work is the standard construction of an asphalt treated permeable base course (ATPBC) on a prepared surface.
- 360.2(a) Asphalt Material: Asphalt Cement, Class PG 64-22

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Section 360: Asphalt Treated Permeable Base Course

- 360.3 Construction: follows 409.3 for construction, except:
  - (b) Weather Limitations: Placement prohibited when prepared surfaces are unstable, frozen, or when air or surface temperature is below 35ºF
  - (c)4. Preparation of Mixture: Produce ATPBC below 320°F providing suitable viscosity; do not stockpile; place within 8 hours

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Section 360: Asphalt Treated Permeable Base Course

- 360.3 Construction: follows 409.3 for construction, except:
  - (h) Spreading & Finishing: Maximum 4" compacted lifts, mixture to cool to 100°F before placing subsequent layers or pavement courses.
  - (i) Compaction: Seat ATPBC with 8 to 10 ton steel wheeled rollers (static mode only). Compact by 4 roller passes. Do not over compact.

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Section 360: Asphalt Treated Permeable Base Course

- 360.3 Construction: follows 409.3 for construction, except:
  - (j) Mat Density Acceptance: No Density Requirements
  - (l) Surface Tolerance:
    - Testing with 10-foot straightedge in stages of 5 linear feet.
    - Pavement irregularities more than ½ inch need correction
    - DO NOT mill or grind the ATPBC

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Section 360: Asphalt Treated Permeable Base Course

- 360.3 Construction: follows 409.3 for construction, except:
  - (m) Tests for Depth:
    - Dig or drill one 6" diameter test hole in each 3000 sq. yds, with additional cores if deficiency suspected
    - Measure depth , remove & replace if depth deficient by ½ inch or more
  - (n) Protection of Courses: Traffic not permitted on ATPBC except to place next layer

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

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

404.1 Description – This work is evaluating an asphalt pavement surface profile & determining ride quality incentive

- **404.1(a) General Requirements**
  - **Measure surface profile using PTM No. 428 to determine payment based on the IRI (International Roughness Index)**
  - **Various exclusions to be measured separately – ramps less than 1500 feet in length, tapers, shoulders, transition areas, bridge approaches, etc..**

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Section 404 Verification Process

- **IRI values and payment data to be verified on random projects (FHWA req.)**
- **PennDOT needs lot IRI summary AND raw, unfiltered data files (see PTM 428 for details)**
- **Data to be forwarded to PennDOT BOMO for verification on randomly selected projects**

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

404.1(b) Lot Size

- **Full lot = 528 feet of a single lane of pavement**
- **Lots start at beginning of paving and continue to end of paving for each pavement lane and ramp that is 12 feet or wider**
- **Partial lot designated at end of paving or at an excluded area and evaluated as a percentage of a full lot**

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

404.3 Construction

- **(a) Equipment & Operator**
  - **Provide pavement surface profile measuring equipment according to PTM No.428**
  - **Calibrate distance sensor, check profile system calibration daily in presence of Inspector**
  - **Provide Department certified operator**

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

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

404.3(b) Testing

(1) Lots

- **Provide traffic control, clean pavement as necessary**
- **Determine surface profile of each lot according to PTM No. 428, in presence of Inspector**

(2) Excluded Areas

- **Measure with 10 foot straightedge, parallel to centerline**
- **Advance in five foot increments**

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

404.3(c) Acceptance

1. Lots. Lot IRI compared to Table A in Section 404.4

- **Perform corrective action if Table indicates or any individual bump (irregularity) is greater than 3/16 inch tested with a 10 foot straightedge**

2. Excluded Areas. Not included for incentive payment

- **To be corrected if irregularities more than 3/16 inch**

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

404.3(d) Corrective Action

- **Perform before testing for pavement depth**
- **Use carbide grinding, diamond grinding, or remove & replace**
- **Produce surfaces that are neat, of uniform texture, with not more than 1/8 inch deviation with existing pavement**

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

404.3(e) Defective Work:

- **Lot is defective if:**
  - **IRI exceeds maximum acceptable IRI specified in Table A Schedule A or B**
  - **Any individual bump with irregularity of more than 3/16 inch**
  - **Surface adjacent to another lot deviates more than 1/8 inch**
- **Remove & replace defective areas and retest lot**

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

404.4 Measurement & Payment

- **Payment:**
  - **Lots not defective will be paid according to IRI using Table A Schedule A or B**
  - **On defective lots, payment based on retest for IRI after corrective action.**
  - **Remove & replace defective areas and retest lot**

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

Table A
Schedule for Ride Quality Incentive
Schedule A
For Expressway Work Using Three Operations

IRI inches/mile/lot	Amount
≤ 35	$600
≤ 50	$300
≤ 60	$150
≤70	$0
>70	Corrective Action Required

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

Table A
Schedule for Ride Quality Incentive
Schedule B
For Expressway Work Using Two Operations And Non-Expressway Work Using Two or More Operations

IRI inches/mile/lot	Amount
≤ 45	$600
≤ 55	$300
≤ 70	$150
≤ 90	$0
> 90	Corrective Action Required

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- **Usage: For use on any project meeting ALL of the following criteria:**
  - **RPS (regardless of network) or Standard pavements on the National Highway System (NHS)**
  - **Density acceptance by cores**
  - **Length of testable longitudinal joint >12,500 feet**

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- **405.1 Description: This work is evaluating longitudinal joint samples on the surface wearing course for determining densities and the incentives/disincentive, including necessary corrective actions required as result of evaluation.**

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- **405.3 Construction:**

  (a) General Requirements: Lots for this spec completely independent from lots defined in other sections of the Specs for pavement acceptance

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- **405.3 (b) Lot Size**
  - **Full lot is 12, 500 feet of longitudinal joint**
  - **5 sublots of 2500 feet per full lot**
  - **One joint core drilled per sublot as paving progresses until full lot obtained**
  - **Single lot need not be contiguous & may include multiple joints within project**

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- **405.3 (c) Quality Control Strip**

  On first day paving of longitudinal joint, in addition to incentive/disincentive payment sublot joint cores, obtain 5 randomly located core samples on longitudinal joint for QC density testing

  Cores to be tested and results supplied within 24 hours in order to make any adjustments to ensure adequate in place density is achieved

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- 405.3 (d) Excluded Areas. Following joint areas excluded from lots:
  - Joints where one or both sides pavement were accepted for density by other means
  - Joints where one side is formed by existing pavement not constructed under this project
  - Areas within 1 foot longitudinally of an obstruction
  - Small areas (intersections, gores, transitions) not allowing for consistent joint construction

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- 405.3 (e) Sampling.
  - One 6 inch core in each sublot located using PTM 1 and PTM 729 no later than day following placement.
  - For vertical joints center core over surface joint.
  - For notch-wedge joints, center core 6 inches or one half of joint taper width away from joint line in direction of wedge.

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- 405.3 (e) Sampling. (continued)
  - Identify by lot & sublot, location, placement date, mixture type, & as acceptance samples (Sample Class AS)
  - Cores tested by LTS
  - If damaged, replacement obtained from within 12 inches of original
  - Hole backfilled with same JMF & sealed within 24 hours

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- 405.3 (g) Corrective Action
  - For each lot, if average joint core density is less than 88%, seal entire length of longitudinal joint in lot
  - Seal the surface of the longitudinal joint with PG 64-22
  - Sealant temperature between 265°F & 320°F

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- 405.3 (g) Corrective Action (continued)
  - Joints clean, dry , free of loose material
  - Air temperature 40°F or above
  - Seal with a 4 inch ±1 inch band & thickness of 1/16 inch ±1/32 inch
  - Center the band within 1 inch of the joint
  - Coordinate sealing with application of pavement markings

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- 405.4 Measurement and Payment
  - Uses the Percent within Tolerance (PWT) from Section 106.03(a)3 with Table of this Section 405.4 for payment by lot.
  - Sets percentage values of Table A amount for partial lots of less than 5 sublots.

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Section 405
Evaluation of Asphalt Pavement Longitudinal Joints Density and Payment of Incentive/Disincentive

- Lower density limit for incentive payment is ≥90% per lot
- Full incentive for ≥92% per lot
- Maximum disincentive $10,000 per lot
- Lots with density ≥ 89% but < 90% maximum disincentive of $1,000 per sublot.

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Section 409
Superpave Mixture Design, Standard & RPS Construction of Plant-Mixed HMA Course

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Section 409
Superpave Mixture Design, Standard & 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: Refers to Sections 106 & 700; discusses use of RAP, RAM, RAS Job-Mix Formula and tolerance requirements for completed mix

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Section 409
Superpave Mixture Design, Standard & RPS Construction of Plant-Mixed HMA Courses

- 409.2(f) Mixture Acceptance:
  - Need an approved Mixture Acceptance Plan
  - RPS Construction accepted by lots
  - For Standard Construction, use Table C:
- 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)

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.2(f)2 Certification Acceptance. Appropriate for:**
  - **Scratch or Leveling <2", driveway adjustments.**
  - **Mixtures used by Dept. maintenance forces.**
  - **Mixtures used by municipal governments.**
  - **Small quantities <500 tons in a continuous operation.**
  - **Other mixtures, conditions, or applications as approved**

All others by Lot Acceptance!

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Change 7 –Loose Box Samples

- **Loose box samples eliminated for any quantity < 500 ton**
- **Coring allowed for density acceptance on materials accepted by Certification**

To be discussed at

Pre-Placement meeting

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3 Construction**
  - **(a) Paving operation QC Plan: Contractor must submit a paving operation QC plan for the project (Form CS-409)**
  - **(b) Weather Limitations: Paving prohibited**
    - **from November 1 to March 31**
    - **when surfaces are wet**
    - **when the temperature of air or surface ≤ 40 ºF**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(b) Weather Limitations**
  - **1. Wearing Courses: With design ESALs ≥10 million or with PG 76-22, paving prohibited:**
    - **Oct. 1 to March 31 in Districts 1-0, 2-0, 3-0, 4-0, 5-0 (Monroe Co & Carbon Co), 9-0 (Cambria Co & Somerset Co) and 10-0**
    - **Oct 16 to March 31 in Districts 5-0 (except Monroe Co & Carbon Co.) 6-0, 8-0, 9-0 (except Cambria Co & Somerset Co.) , 11-0, 12-0.**

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Extended-Season Paving

- **Written request at 14 calendar days prior to extended season paving**
- **PG 76-22 > 10 million ESALS, 4.75mm or other courses less than 1 ½ inches compacted, April 1 until November 15**
- **All other courses March 1 until Dec. 15**
- **Must use WMA with temps as per 409, table A**
- **Must use MTV for lengths > 1500 ft.**

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Extended Season Paving

- **Project Representative MUST release Material**
- **Extended season pre-placement meeting at least 5 days prior to review details of Extended Season Paving Plan (CS 409 ES)**
- **MUST follow Plan or STOP PAVING**

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Extended Season Paving

- **Density acceptance for RPS and standard paving on stable/uniform bases at Table G depths will be by pavement cores.**

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Extended Season Paving

- **CS 409ES to be completed and provided to Dept. within 24 hours of completion of paving.**
- **Extended Season Fall paving will be subject to Spring Evaluation by May 1 as per Pub 336.**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3 Construction**
  - **(d) Hauling Equipment**
    - **Tightly sealed vehicles**
    - **Provide covers to protect entire load**
    - **Provide insulation/heated or double-walled truck bodies when air temp is below 50°F from October 1 to April 30.**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3 Construction**
  - **(e) 1 Asphalt Pavers** (e) 2 --Paving Equipment Dec 2011
    - **Self-contained power-propelled units with automatic screed controls.**
    - **Hydraulic or other extensions only fed & activated same as main screed.**
  - **(f) Rollers**
    - **Steel-wheel, pneumatic tire, vibratory or oscillating rollers as specified in Section 108.05(c)3 with separate controls for frequency and amplitude.**

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Wideners Defined
409.3 (e) 2

- **Self-contained, power propelled capable of producing a true finished surface**
- **Sufficient capacity hoppers**
- **Uniform placement of mixtures**

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Section 409: Superpave Mixture Design, Standard & RPS Construction

- **409.3 Construction**
  - **(g) Preparation of Existing Surface**
    - **Clean**
    - **Correct irregularities in binder course**
    - **Paint existing vertical surfaces with asphalt Class TACK, NTT/ CNTT in two or more applications or hot asphalt of class & type designated for course.**

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Scratch & Leveling courses

- Use scratch course to fill wheel ruts & other local small depressions even with surrounding pavement'
- Use leveling course to provide a relatively uniform working platform for placing binder or wearing courses

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- 409.3 Construction
  - (h) Spreading and Finishing
    - Deliver and place at laying temperatures specified in Table A (Section 409.2(e)1.d.)
      - PG 58-28 260 ºF to 310 ºF
      - PG 64-22 265 ºF to 320 ºF
      - PG 76-22 285 ºF to 330 ºF
    - Courses >6" in compacted depth, place in 2 or more equal layers, none <3" or >6" compacted depth
    - Do not use rakes.

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Note on Binder Grade

- Binder Grade are in Degrees Celsius.
  - PG 58 -28 is 136.4 -18.4 in °F
  - PG 64 -22 is 147.2 -7.6 in °F
  - PG 76 -22 is 168.8 -7.6 in °F

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- 409.3 Construction
- MTV required for RPS pavement by Change 9, Oct 2, 2015
  - (h)1.c Field Technician
    - Provide Certified HMA Field Technician
    - Must be onsite
    - Must carry valid certification card

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- 409.3 Construction
  - (h)2 Mixture Lot Acceptance (Standard & RPS Construction)
  - (h)2.a Lots and sublots
    - Lots established for each JMF
    - Normal lot size = 2,500 Tons
    - Normal sublot size = 500 Tons (5 per lot)
    - 1 box sample + 1 core sample obtained from each sublot (PTM No. 1)

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- 409.3(h)2.a Lots and Sublots
  - If project size or operational conditions dictate. Lot *(final lot)* will be adjusted as in Table D
  - Stoppages of 5 days or more, last lot will be adjusted as in Table D.
  - New lot established when work resumes after 5 day stoppage.

Full Size Table D at End of Module

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409.3(h)2.a Lots and Sublots: Table D

Re-adjustment of Lot Size & 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 previous lot, (n=5)
Less than 500 tons with a combination of one mixture acceptance sample and one core	One new sublot defined & quantity combined with previous lot, (n=6)
500 tons to less than 1000 tons without a combination of two mixture acceptance samples and two cores	One new sublot defined & quantity combined with previous lot, (n=6)
500 tons to less than 1000 tons with a combination of two mixture acceptance samples and two cores	Two new sublots defined & quantity combined with previous lot, (n=7)
1000 tons to less than 1500 tons without a combination of three mixture acceptance samples and three cores	Two new sublots defined & quantity combined with previous lot, (n=7)
1000 tons to less than 1500 tons with a combination of three mixture acceptance samples and three cores	New lot defined, (n=3)

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409.3(h)2.a: Table D *continued*

Re-adjustment of Lot Size & Associated Number of Sublots

Remaining Quantity* Following Last Full Lot	Action
1500 tons to less than 2000 tons without a combination of four mixture acceptance samples and four cores	New lot defined, (n=3)
1500 tons to less than 2000 tons with a combination of four mixture acceptance samples and four cores	New lot defined, (n=4)
2000 tons to less than 2500 tons without a combination of five mixture acceptance samples and five cores	New lot defined, (n=4)
2000 tons to less than 2500 tons with a combination of five mixture acceptance samples and five cores	New lot defined, (n=5)

- 409.3(h)2.a.1
  - Partially Completed Lot (n=2 or less): When partially completed lot (2 sublots or less) cannot be combined with most recent completed lot, samples will be independently evaluated

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- 409.3(h)2.a.2 JMF's less than 2500 tons
  - JMF's > 500 tons and < 2500 tons, tonnage considered a lot and divided into 5 equal sublots
  - JMF's ≤ 500 tons, tonnage may be considered a lot and divided into 3 equal sublots, if density acceptance by pavement cores (an option) mixture acceptance is only by certification.

For total JMF less than 2500 tons, Table D does not apply, do not use!

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Section 409.3 (a) 2
Preplacement meeting

- At least two weeks prior to placement of mixtures
- Contractor and Dept. Representative
- Discussion topics at a MINIMUM: specifications, QC plan, sequencing, mix and density acceptance, care and custody of acceptance samples.

This is also the time to discuss sampling of monolithic mainline and shoulder areas, untestable locations and any other issue that has created after-the fact dilemmas in your experience.

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- 409.3(h)2.b Mixture Acceptance Samples
  - Loose samples
    - taken directly behind the paving equipment
    - identify ECMS #,lot & sublot, location, placement date, mixture type, & as Sample Class AS
    - For 19 mm and smaller NMAS, Package individual samples in cardboard boxes ~ 3 ¾" x 4 ¾" x 9 ½" (approx.. 8 lbs of mix)
    - Package all samples for one lot in one container or tie together
    - Utilize LTS testing
  - Location of samples determined using PTM 1 & PTM 746

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- Samples are now to be taken from behind wideners
- Additional directions for packaging and marking loose samples are in PTM 746
- -Projects with Gmm verification requirements will require an additional loose box sample.

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)3.a Evaluating Pattern Segregation**
  - **Inspector will notify Contractor of observed pattern segregation**
  - **Contractor may continue at own risk**
  - **Project Representative will witness the PTM 751 (pavement surface macrotexture depth test)**
  - **Unacceptable segregation if average texture depth between the non-segregated area and segregated areas exceeds 0.024 inch.**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)3.b Test Section**
  - **If segregation identified, stop paving!**
  - **Department will evaluate segregation to determine corrective work**
  - **Test section then placed, <200 tons**
  - **Resume normal paving after successful test section**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)3.b Test Section**
  - **If segregation identified, stop paving!**
  - **Department will evaluate segregation to determine corrective work**
  - **Test section then placed, <200 tons**
  - **Resume normal paving after successful test section**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)3.c Defective Pavement**
  - **Cores taken – 3 from segregated area & 3 from non-segregated area , tested for density, asphalt content and gradation**
  - **If tests determine pavement is defective, remove & replace full width of affected lane plus minimum of 5 feet beyond each end of unaccepted area.**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)4. Flushing**
  - **Provide a mix that will not flush**
  - **Flushing is continuous or repeated areas of excessive asphalt on the pavement surface**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)4.a. Evaluating Flushing**
  - **When flushing is observed, Project Representative will notify Contractor**
  - **Contractor may continue at its own risk while adjusting to eliminate further flushing**
  - **Average pavement surface macrotexture depth is determined by PTM 751 in suspected flushing area**
  - **Average depth $\leq$ 0.006 inches, pavement considered flushed & defective**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(h)4.b. Test Section**
  - **If flushing identified, stop paving!**
  - **Department will evaluate flushing to determine corrective work**
  - **Remove & replace defective wearing course for full lane width + minimum 5 feet beyond each end of defective area**
  - **After Project Representative allows paving to resume, place test section not to exceed 200 tons.**
  - **Normal paving can be resumed after construction of an entire test section without flushing.**

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Section 409

Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3 Construction**
  - **(i) Compaction**
    - **Compact to achieve required density & eliminate all roller marks**
    - **Adjust speed, amplitude, frequency, etc., to eliminate displacement, shoving, cracking, or aggregate breakage.**
    - **Use pneumatic-tire for compacting scratch courses.**
    - **For roller inaccessible areas, use mechanical vibrating hand tampers**

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Compaction Equipment

Types of Rollers

- **Static Steel Wheel**
- **Pneumatic / Rubber Tired**
- **Vibratory**
- **Oscillation**




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Vibratory Rollers

- **Amplitude**
- **Frequency**
- **Impact Spacing**



Double Drum Articulated


Double Drum Vibratory

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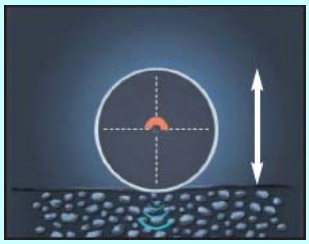
Vibratory Rollers

- **Vibration = Vertical impact forces**
  - **Uses an eccentric weight in the drum, rotated at high speeds causing drum to vibrate and vertically move or 'jump', generating vertical impact forces into the asphalt.**


Courtesy of Hamm Compaction Division, Wirtgen America, Inc.

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Vibratory Rollers

- **Caution! Vibratory rollers can cause damage to:**
  - **Underground utilities**
  - **Box culverts or other structures**
  - **Bridge and bridge decks**

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Time Available for Compaction (TAC)

Computer Program used to determine TAC

Minnesota Department of Transportation

PaveCool

PaveCool Asphalt Pavement Cooling Tool
© 2000-2006 Minnesota Department of Transportation

Free Download from Website:
http://www.dot.state.mn.us/app/pavecool/index.html

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RECOMMENDED MINIMUM MIXTURE LAYDOWN TEMPERATURE
BY COMPACTED THICKNESS FOR HOT MIX ASPHALT* CONTAINING PG 64-22

Surface Temperature	3/4"	1"	1½"	2"	3" and greater
40 to 50 °F	-	310 °F	300 °F	285 °F	275 °F
50 to 60 °F	310 °F	300 °F	295 °F	280 °F	270 °F
60 to 70 °F	300 °F	290 °F	285 °F	275 °F	
70 to 80 °F	290 °F	285 °F	280 °F	270 °F	
80 to 90 °F	280 °F	275 °F	270 °F		
90 °F	275 °F	270 °F			
Rolling Time (min.)	6	8	12	15	15

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3 Construction**
  - **(j) Mat Density Acceptance**
    - **Standard Construction (non-RPS): Density acceptance according to one of the levels in Table F**
    - **RPS: Density acceptance by Pavement Cores (lot acceptance)**
    - **Department must approve density-acceptance level (QC Plan)**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j) Mat Density Acceptance**
  - **Standard Construction (non-RPS)**

Table F: Density Acceptance

Density Acceptance Level	*Acceptance Criteria*
Non-movement	Table H
Optimum Rolling Pattern	Table H
Pavement Cores*	Table I
*Only when mixture is accepted by lots	

Cores may now be used for density acceptance for quantities < 500 ton (Change 9 Oct 2, 2015)

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j) Mat Density Acceptance**
  - **409.3(j)2. Non-Movement (Density accepted when mix does not move under compaction equipment) acceptance for:**
    - **Scratch or leveling < 1" or ≤ 110 lbs/yd².**
    - **Area of paving/patching < 4' in width.**
    - **Following materials if determined non-critical for density:**
      - **Materials placed in < 500 tons continuous.**
      - **Mixtures placed on unstable or non-uniform bases.**
      - **Mixtures used for patching, widening, shoulders*, driveway adjustments, or other miscellaneous applications.**

shoulders considered critical accepted by pavement cores

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j) Mat Density Acceptance**
  - **409.3(j)3. Optimum Rolling Pattern**
    - **Materials placed in small quantities < 500 tons.**
    - **Mixtures placed on unstable or non-uniform bases.**
    - **Leveling or other courses ≥ 1" or ≥ 110 lbs/yd².**
    - **Mixtures used for patching, widening, shoulders*, driveway adjustments, or other miscellaneous applications.**
    - **Mixtures placed at < minimum compacted depths in Table G**

shoulders considered critical accepted by pavement cores

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j)3. Optimum Rolling Pattern**
  - **Density tested by nuclear gauge (PTM 402) or electrical impedance gauge (PTM 403)**
  - **Inspector & contractor's certified field technician present**
  - **Nuclear gauge must have licensed operator**
  - **Use approved gauges or approved equal**
  - **Use procedure and forms in PTM 402/403**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j) Mat Density Acceptance**
  - **409.3(j)4. Pavement Cores (Standard or RPS).**
    - **Material placed at minimum compacted depths according to Table G.**
    - **Materials placed on stable and uniform bases**
    - **Before Change 7, pavement cores were required only if mixture acceptance was also by lots**
    - **Cores are now an option on quantities< 500 ton**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j) Mat Density Acceptance**
  - **409.3(j)4. Pavement Cores (Std or RPS)**

Table G: Mixture Minimum Compacted Depths

Mixture	*Minimum Depth*
9.5 mm Wearing Course	1 ½"(40 mm)
12.5 mm Wearing Course	1 ½"(40 mm)
19 mm Wearing and Binder Courses	2 ½" (60 mm)
25 mm Binder Course	3"(80 mm)

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j)4 Pavement Cores (Std or RPS)**
  - **409.3(j)4.c Density Acceptance Samples**
    - **Locations selected by PTM 1, PTM 729, &PTM 746**
    - **6-inch cores no later than day following placement**
    - **If damaged, replacement obtained from within 12 inches or original**
    - **Hole backfilled with same JMF & sealed within 24 hours**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j)4 Pavement Cores (Std or RPS)**
  - **409.3(j)4.c Density Acceptance Samples**
    - **Normal lot size = 2,500 Tons**
    - **Normal sublot size = 500 Tons (5 per lot)**
    - **1 core obtained from each sublot**
    - **Identify by lot & sublot, location, placement date, mixture type, & as acceptance samples (Sample Class AS)**
    - **Submit samples for one lot in one container.**
    - **Cores tested by LTS**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(j)4 Pavement Cores (Std or RPS)**
  - **409.3(j)4.d Acceptance Sample Testing**
    - **Density cores tested according to PTM 715 & PTM 716**
    - **Acceptance as specified in Section 409.4(a)4 or 409.4(b)**
    - **If cores not taken within 1 day after mix placement or if density for 2 consecutive lots or a total of 3 lots does not meet density requirement for 100% payment, stop paving operations.**
    - **Pavement resumes after evaluation of problem, approved proposed solution, & Department authorization**

NOTE:
New instructions for packaging and marking cores are in PTM 729, Dec 2011

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **If cores not taken within 1 day after mix placement or if density for 2 consecutive lots or a total of 3 lots does not meet density requirement for 100% payment, stop paving operations.**

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Lot – Sublot Definitions

- ***Normal lot* size is 2500 tons with 5 sublots of 500 ton each.**
- **A *complete lot* will have at least 3, but no more than 7 sublots**
- **Lots with less than 3 sublots are "incomplete"**
- **A *complete sublot* MUST have a core and a loose (mixture or box) sample**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k) Joints**
  - **409.3(k)1. Longitudinal Joints**
  - **409.3(k)1.a General**
    - **Offset joints ~ 6 inches**
    - **Joint in top layer at centerline of 2-lane roadways & within 12" of center in multilane roadways**
    - **Avoid joints directly beneath planned pavement markings**
    - **Before placing abutting lanes, paint joint face with PG binder in mix or PG 64-22.**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k)1. Longitudinal Joints**
  - **409.3(k)1.a General**
    - **Adhere to the following additional requirements for the construction of longitudinal joints that will not be evaluated as specified in Section 405:**

This is a new requirement added in Pub 208/2011 which also adds Section 405. This requirement & Section 405 were made effective by SOL 424-10-02 (dated June 3, 2010) as Special Provisions on all projects meeting certain criteria and let after July 9, 2010.

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k)1. Longitudinal Joints**
  - **409.3(k)1.a General**
    - **Assure a true line of paving**
    - **When compacting unsupported edge, make first roller pass with edge of drum overhanging edge by 3 to 6 inches**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k)1. Longitudinal Joints**
  - **409.3(k)1.a General**
    - **Placement of mix adjacent to compacted lane, operate paver to overlap previously placed lane by 1 to 1 ½ inches**
    - **DO NOT bump back or lute overlapped material**
    - **Compact with forward pass of roller 18 inches inches from the joint; then overlapping the joint 2 to 6 inches on the backward and subsequent passes**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k)1. Longitudinal Joints**
  - **409.3(k)1.b Vertical Joints**
    - **For base, binder and wearing courses**
    - **Place abutting lane same day, leaving less than 25 lineal feet of exposed edge**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k)1. Longitudinal Joints**
  - **409.3(k)1c Notched Wedge Joints**
    - **For wearing & binder course with nominal maximum aggregate size of 19.0mm or smaller**
    - **Use Standard Drawing RC-28**
    - **If joint next to opposing traffic, place abutting lane within 1 day**
    - **If next to traffic in same direction, place abutting lane within 2 days**

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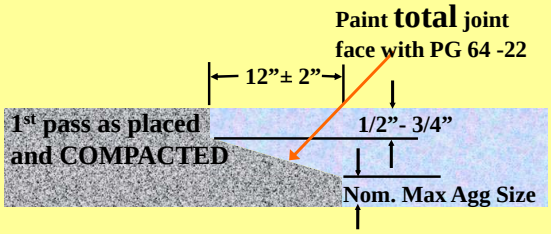
PA's Notched Wedge Joint

Pub 72M, Standard RC-28



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Longitudinal Joint Construction

Paint joint faces with PG 64 -22 binder

- **Or PG in mix**
- **Thin even application**
- **Helps bonding, waterproofing and filling voids**

148

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What We Don't Want

149

150

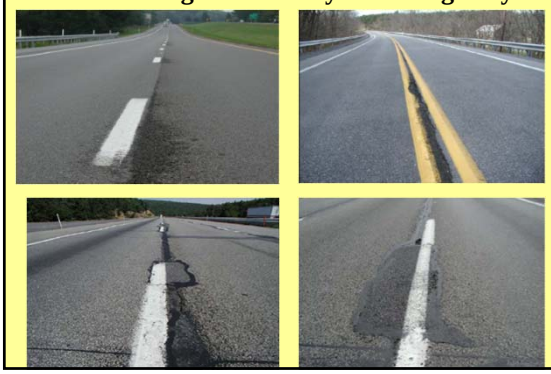
Trial Unit for Forming and Compacting NWJ

150

151

Why New Procedures?

Common sight on Pennsylvania Highways



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Penndot/PAPA longitudinal joint Construction Video

INSERT VIDEO HERE, PLEASE

152

153

Recap of Video

- **Plan ahead to avoid joints whenever possible**
- **Offset joints 6” from previous layer**
- **TACK must be 6” wider than pavement**
- **First Pass MUST be straight**
- **Overhang Roller 3-6” on unsupported edge**

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Recap of Video –Second Pass

- **Lightly coat entire surface of NWJ or vertical joint with 64-22 or Asphalt in mix**
- **Paver should overlap previous lane by 1-1/2 inches**
- **Depth of overlap should match rolldown**

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Recap of Video –Second Pass Compaction

- **Compact from edge toward joint**
- **Leave about 18 inches of uncompacted material at NWJ**
- **Last pass overlaps Longitudinal joint by 3-6 inches**
- **Joint must receive as many passes as the rest of the mat**

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Longitudinal Joint Construction

1) **Plan work to minimize longitudinal joints**
   - **No joint always superior**
   - **Utilize paver extensions when practical & cost effective**
   - **Pave in echelon (two pavers) creating a hot joint for superior performance**
   - **Does this joint need TACK?**

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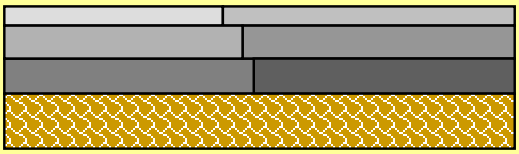
Longitudinal Joint Construction

2) Offset joints from layer below by 6”



Where should the top surface joint be located?

157

158

Longitudinal Joint Construction

Offsetting joints:

- **Avoids plane of weakness down through pavement layers**
- **Locate surface joints near centerline but off of line striping locations**

158

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Longitudinal Joint Construction

- **1st pull of paver leaves unsupported edge**
  - **Needs to be clean, straight, uniform**
  - **Will have lower density than rest of mat**

159

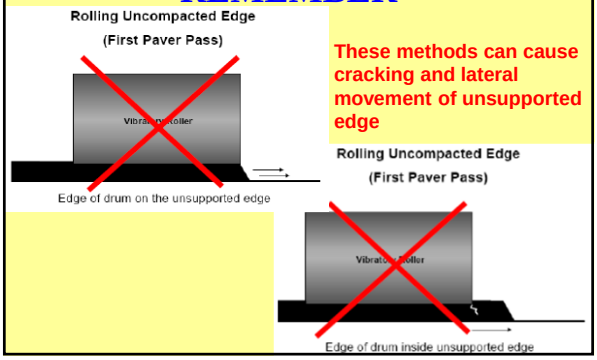
160

What We Don’t Want

160

161

First Roller Pass on Outside Edge REMEMBER



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PA’s Notched Wedge Joint Placement Requirements

Paint TOTAL joint face

with PG 64 -22

162

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Longitudinal Joint Construction Placement Requirements

5) **Paint joint faces with PG 64 -22 binder**
   - **Or PG in mix**
   - **Thin even application**
   - **Helps bonding, waterproofing and filling voids**

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What we don't want

164

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Longitudinal Joint Construction Placement of 2nd Pass Requirement

6) **Overlap 1-1½" onto cold mat coming out of paver screed**
   - **Paver augers should push mix up tightly against face of joint NO ROLLDOWN**

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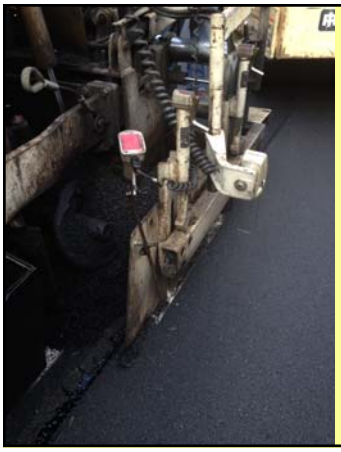

Proper overlap of longitudinal joint

1"to 1 ½" as per Section 409.3 k,1.a

166

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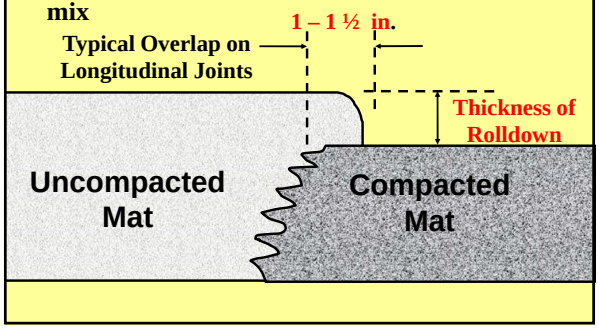
- **Proper overlap between the new and old mat allows just enough material on top of the joint for proper compaction without having extra mix**



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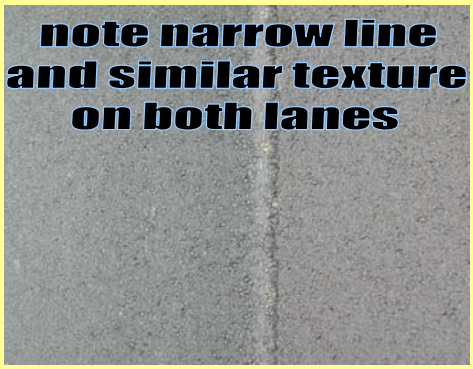

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Longitudinal Joint Construction

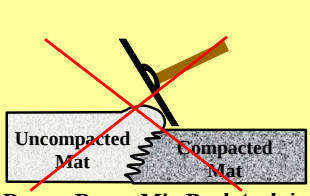
169

Do not "bump" material, NO Luting-----
just roll overlapped material into pavement

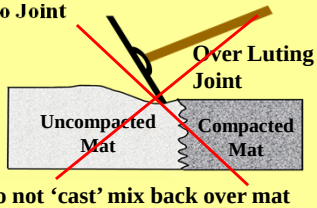
169

"DO NOT"

170



Do not Bump Mix Back to Joint



Do not 'cast' mix back over mat

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If too large an overlap occurs…

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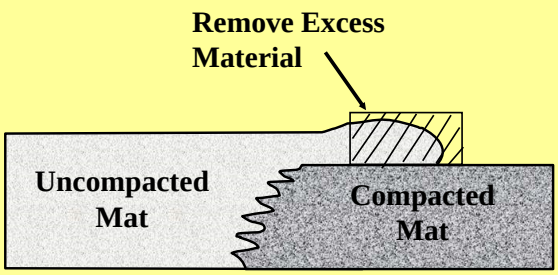

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Bridging From Improper Overlap

172

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Obvious Bridging from Excessive Overlap and/or

173

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Rolling Longitudinal Joint

174

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175

Finished Joint Appearance

This method results in a crushed stone line that is mostly cosmetic and will wear off in time

175

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Joint Construction Issues

Filling the joint fully and getting good density is what's important for good performance.

White line of crushed aggregate is excessively wide.

176

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Joint Construction

Remember!

- **Properly set up, the transverse and longitudinal joints will need minimal handwork.**

177

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(k) Joints**
  - **409.3(k)2. Transverse Joints**
    - **Perpendicular to centerline**
    - **Use temporary bulkheads or saw joint**
    - **Paint joint face with PG binder in mix or PG 64-22.**
  - **409.3(k)3. Other Joints**
    - **Seal joint for new wearing course abutting existing pavement; apply min 6 inches on both sides of joint, using PG binder in mix, AET, E-6, or E-8**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(l) Surface Tolerance**
  - **Test with 10 foot straightedge**
  - **Defective if irregularities >3/16"**
- **409.3(m) Tests for Depth**
  - **Density acceptance by lots, measure depth of each sublot**
  - **Defective if depth deficiency >1/4" or depth deficiency in 3 or more adjacent cores >1/8"**

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Section 409
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Courses

- **409.3(n) Protection of courses**
  - **No traffic for 24 hours or mat temp is 140°F or less *and adequate stability and adhesion is obtained***
- **409.3(o) Defective work**
  - **Remove, replace or repair defective work as directed**

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TABLE I (Section 409.4) Mat Density Change 6 April 4, 2014 For 100% payment

All RPS 9.5, 12.5, 19 & 25 mm, Wearing & Binder	All individual sublot test results are ≥92% & ≤97%
All Standard 9.5, 12.5, 19 & 25 mm, Wearing & Binder	All individual sublot test results are ≥90% & ≤97% and lot average is ≥92% and ≤97%
All Base Courses	All individual sublot test results are ≥90% and < 100% of the maximum theoretically density

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Section 410
Superpave Mixture Design, Standard & RPS
Construction of Plant-Mixed HMA Fine-Graded Courses

- **410.2 Materials. Refers to Section 409.2 using the 9.5 mm mix with modifications**
- **410.3 Construction. Refers to Section 409.3 using a 9.5 mm mix with modifications and a revised Table G:**

Mixture Minimum Compacted Depths

Mixture	*Minimum Depth*
9.5 mm Fine Grade Wearing Crse	1”(30 mm)

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Section 411
Superpave Asphalt Mixture Design, Standard and RPS Construction of Plant Mixed WMA Courses

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Specification for WMA
Spec 408, Section 411

Change 3 Pub 408 2016

- **Section 411: Superpave Asphalt Mixture Design, Standard and RPS Construction of Plant Mixed WMA Courses**
- **411.2 ref 409.2 and extensive production and testing of technology and additives**
- **411.3 ref 409.3 and Special temperature ranges**

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Warm Mix Asphalt

- **A generic term for various technologies allowing asphalt paving materials to be produced and placed at lower temperatures.**

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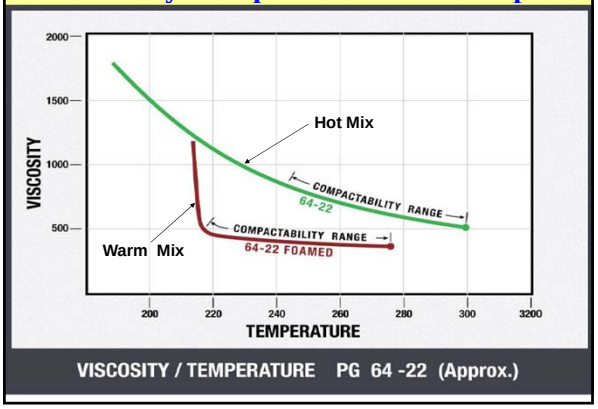
Viscosity /Temperature Relationship



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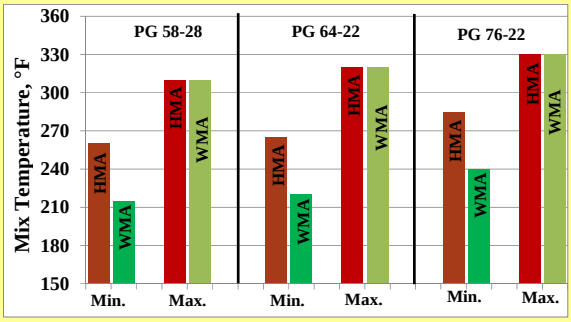
HMA /WMA min/max Temperature Ranges



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Spec 408, Section 411, Table A (2016, Change No. 3)

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.

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How do Warm Mix Asphalt Technologies Work?

A chemical package or water is added to the aggregate/bitumen mixture at the plant.

- **The additive reduces the viscosity and increases the workability of the binder at a lower temperature**
- **This allows lower mixing and placement/compaction temperatures**

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What are WMA Technologies?

Broken down into 3 classes:

- **Non-Foaming Additives (Wax)**
- **Foaming Processes (Water)**
- **Chemical Additives (Emulsions)**

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1

Non-Foaming Additives

- May be liquid or pellets
- May be pre-blended or added at plant to liquid binder
- May be introduced at the mixing drum
- Usually minor plant modifications to batch or drum plant.

1

2

Chemical Additives or Surfactants

- May be added at refinery or WMA plant directly to liquid asphalt.
- Can be teamed with foaming process
- Usually minor, if any, plant modifications required.

2

3

Foaming Process

- Water and perhaps other additives
- Water may be contained in the additive
- May be injected into supply line or added to drum or pug mill
- Plant modification involves installation of additional equipment
- 1 quart of water/ ton of mix (approx.)

3

4

Usage in PA

- All 3 types successfully used in PA.
- Placement is business as usual.
- More time/less effort for compaction.
- Excessive rolling may cause lateral stretching (widening), cracking or checking of the mat and lead to premature failures.

4

5

What is different for me?

- Field acceptance criteria remain tied to Sec. 309 or 409.
- Maximum temperature may not exceed maximum temperature of PG grade of respective Table A.
  1) Density cores
  2) Loose box samples
     - asphalt content
     - % minus #200 sieve

5

6

PennDOT Strike-Off Letter on WMA Permissive Policy for SP HMA Courses

- Effective for Projects let after Oct 4, 2013
- Change in Pub 242 (Pavement Policy Manual) – 5.7.4
  - Districts may specify HMA, or as alternate, WMA
  - District may directly specify WMA only
  - Districts may not specify HMA only

6

6

7

New Density Spec. PWT

- **Percent Within Tolerance (Table K) will be used to establish payment for results outside of Table E or I parameters**

7

8

Table K Section 409.4 (a)

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

8

9

Section 412
Superpave Mixture Design, Construction of Plant Mixed HMA/WMA 6.3 mm Thin Overlay Courses

9

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Section 412
Superpave Mixture Design, Construction of Plant Mixed HMA/WMA 6.3 mm Thin Overlay Courses

- **Used in Thin Lifts (3/4" min, 1 ¼" max.)**
- **Useful Tool for Pavement Preservation**
- **An alternative to microsurfacing and seal coats.**
- **PennDOT sponsored a four-year research project to develop specifications and guidelines for 6.3mm mixes (2012 to 2016).**

10

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6.3 mm Thin Overlay Courses

Mixture Details

- **PG 76-22 polymer modified-binder required**
- **Fine aggregates - SRL designation**
- **75 gyrations**
- **No RAP or RAS in mix**

Photo courtesy of pavementinteractive.org

11

12

6.3 mm Thin Overlay Courses

Construction details:

- **>50F air and surface temperature**
- **MTV required, unless waived by Rep.**
- **Box samples from roadway, hopper, or screed**
- **Density acceptance by optimum rolling pattern or non-movement**

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13

6.3 mm Thin Overlay Courses

Critical points for success:

- **Clean existing surface**
- **Proper, uniform tack application**
- **TAC--- all binders are 76-22**
- **Selection of compaction rollers**

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Safety Edge Requirements From FHWA

- **Affects both Binder and wearing courses >1 ½ inches**
- **Requires extrusion device at edge of pave (not just a strike-off)**
- **Incidental to course being laid**
- **26-40 degree increase in angle from adjacent pavement.**
- **May require additional pre work**

Note:
Drawings for this are in handouts. This cannot be laid on organic material and will be used in conjunction with shoulder back-up.

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Adjustable Safety Edge Device

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Thin Hot Mix Asphalt Overlays (THMAO)

- Placed up to 1.5 inches in thickness
- Ultrathin layers: ≥0.5" and ≤ 1"
- Could use Dense, Gap, or Open graded mixes
- NMAS ≥4.75 mm and ≤ 9.5 mm
- Ratio of Thickness to NMAS ≥3 and ≤ 5

NMAS: Nominal Max. Aggregate Size

19

20

Thin Hot Mix Asphalt Overlays (THMAO)

- **Thickness Considerations**
  - A thin layer for the surface course is defined as any mix placed in 1.5 inch thickness or thinner.
  - As the mix gets thinner, the mix gets finer.
    - Example: 4.75 mm mixes are placed in thicknesses not exceeding 3/4 inches, and 6.3 mm mixes are placed in thickness not exceeding 1 inch.
  - Typically, it is recommended to keep the ratio of thickness to nominal maximum size of the aggregate between 3 and 5.

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

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22

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
- 419.2 Materials: Refers to Sections 106 & 700; discusses aggregates, SRL, use of stabilizers, Job-Mix Formula and tolerance requirements for completed mix

Note: Crumb rubber now approved as a stabilizer (Pub 408 Section 419)

22

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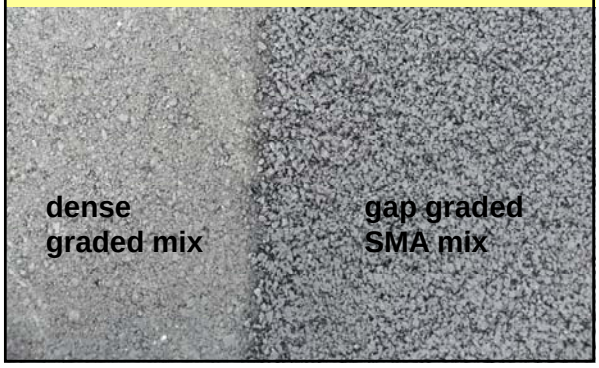
Dense Graded vs. SMA (Gap Graded)



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

- Change 3,OCT. 2016 added WMA and increased upper density limit to 98%
- Sampling to follow Section 409
- Crumb rubber included as approved stabilizer
- Notched Wedge Joints allowed as per Section 409.3 (k)

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

- **419.2(e) Mixture Composition:**
  - **Table D (Section 409.2(e)1.d.6) Temperature of Mixture**
    PG 76-22 285°F to 330°F
- **419.2(f) Mixture Acceptance:**
  - **By lot acceptance**
  - **Not accepted by certification**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(a) Paving operation QC Plan: Refers to 409.3(a), Contractor must submit a paving operation QC plan for the project (Form CS-409)**
  - **(b) Weather Limitations: Paving prohibited:**
    - **when surfaces are wet**
    - **when the temperature of air or surface ≤ 50°F**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(b) Weather Limitations: Paving prohibited:**
    - **Oct. 1 to March 31 in Districts 1-0, 2-0 (except Juniata Co & Mifflin Co), 3-0, 4-0, 5-0 (Monroe Co & Carbon Co only), 9-0 (Cambria Co & Somerset Co only) and 10-0**
    - **Oct 16 to March 31 in Districts 2-0 (Juniata Co & Mifflin Co only), 5-0, (except Monroe and Carbon Co.) 6-0, 8-0, 9-0 (except Cambria and Somerset Co.) , 11-0, 12-0.**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(d) Hauling Equipment: Refers to 409.3(d)**
  - **(e) Asphalt Pavers: Refers to 409.3(e)**
  - **(f) Rollers**
    - **Minimum 3 steel-wheeled rollers, each with 10 ton weight**
    - **Do not operate in vibratory mode unless demonstrated and approved that no breaking of aggregate or flushing of asphalt binder results**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(g) Demonstration**
    - **Before paving, perform trial demonstration outside projects limits by placing minimum of 100 tons.**
    - **Simulate actual hauling time for project**
    - **Obtain & test 3 loose mixture samples at plant for asphalt content, gradation, & draindown & 3 cores from demo pavement for density**
    - **If vibration is to be used, demo vibratory rolling**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(h) Preparation of Existing Surface: Refer to Section 409.3(g)**
  - **(i) Spreading & Finishing:**
    - **1.a Placing. Use MTV to apply final surface course (MTV to provide additional mixing)**
    - **1.b Spreading & Finishing. Refer to Section 409.3(h)1.b, do not allow surface to flush**
    - **1.c Field Technician. Refer to Section 409.3(h)1.c, Field Technician required**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(i) Spreading & Finishing:**
    - **(i)2. Mixture & Density Lot Acceptance**
      - **Lot acceptance required for RPS construction**
      - **Lot 2500 tons with 5 sublots of 500 tons each**
      - **2 cores obtained from each sublot: one as acceptance sample for mixture & one as acceptance sample for density**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**

A completed LOT must have 3 sublots

An incomplete (PARTIALLY COMPLETED) lot may have one or two sublots and are tested under different criteria

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**

NOTE: A completed sublot will contain 3 core samples or 2 core samples and one loose mixture (box) sample

WHY?

This spec is to address the need for the Gmm verification sample

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NOTE:

Gmm Verification Samples for SMA May be taken from auger tunnel or hopper, and may require an additional random sampling procedure.

This must be discussed at the pre-placement meeting and may vary by project and District.

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 Construction**
  - **(i) Spreading & Finishing:**
    - **(i)2. Mixture Acceptance and Gmm Verification Samples will be taken as per PTM 1, 729, and 746**
    - **May be two cores or 1 core and 1 loose from uncompacted mixture (auger tunnel or hopper)**

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Section 419: Stone Matrix Asphalt, RPS Construction

- **419.3 k Construction**
- ***Mat density acceptance cores will be taken as per PTM 1,729, and 746 at different locations from the Mixture acceptance samples.....***
- ***Change 4 Oct 10, 2017***

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Section 419: Stone Matrix Asphalt, RPS Construction

- 419.3 Construction
  - Lot less than 2500 tons, readjustment made as specified in Section 409.3(h)2.a.2 (total JMFs less than 2500 tons)
  - Lots that are terminated before a sample point is reached, obtain one sample for mixture and one for density acceptance
  - Stoppage of 5 days or more, begin new lot
  - Cores tested by LTS

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Section 419: Stone Matrix Asphalt, RPS Construction

- 419.3 Construction
  - (j) Compaction: Follows Section 409 with rollers as specified in Section 419.3(f)
  - (k) Mat Density Acceptance
    - 93%-98% for 100% payment (Table F, Section 419.4(a)3

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Section 419: Stone Matrix Asphalt, RPS Construction

- 419.3 Construction
  - (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: Remove & replace as specified for Section 409 (Flushing, surface tolerance, depth, etc..)

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Section 419: Stone Matrix Asphalt, RPS Construction

- 419.4 Measurement & Payment
  - Mixture & Density acceptance by lot using pavement cores adjusted for Payment Factor Percentages per Table F based on percent within tolerance using Table G.

40

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Section 420 Pervious Asphalt

- Allows infiltration of surface water
- 9.5 or 19 mm mixes
- 50 degrees or greater ambient temperature
- NO tack between layers

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Section 420 Pervious Asphalt

- 4 passes with static steel drum roller
- No pneumatic tire roller allowed
- DO NOT over compact or crush aggregate
- Surface irregularities > 3/8 inch are unacceptable
- Do NOT grind or mill
- Cool to 100 degrees between layers

42

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Section 422 Asphalt Wearing course FJ-1 and FJ-1C

- **This material was primarily used during bridge deck waterproofing operations.**
- **4.75 mm is the new material for box culvert scratch course and filling in shoulder rumble strips and was added to section 409 by change 3 Oct 2016.**

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Some of the Gap Graded CRM Projects Placed in PA

District	County	SR	Size	Year Paved
3	Snyder	15	12.5mm	2013
5	Berks	78	12.5mm	2012
8	Adams	15	12.5mm	2014/15
11	Lawrence	376	12.5mm	2014

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

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Section 460 Asphalt Tack Coat

- **460.1 Description – This work is the conditioning & treating of an existing surface with an application of bonding material**
- **460.2 Material**
- **Tack or NTT/CNTT with new application temperatures and residual rates**

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Penndot/PAPA Surface Prep Training Video

- **INSERT VIDEO HERE PLEASE**

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TABLE A
Bituminous Materials

Class of Material	Type of Material	Application Temperature F	
		Minimum	Maximum
TACK	Anionic or Cationic Emulsified Asphalt	90	150
NTT/CNTT	Anionic or Cationic Emulsified Asphalt	140	180

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TABLE B
Uniform Asphalt Residual Rates by Surface Type

Surface Type	Uniform Asphalt Residual Rates (RR) (gallons per square yard)
New Bituminous Paving	0.03 to 0.05
Existing Bituminous Paving	0.04 to 0.07
Milled Surface (Bituminous & Portland Cement Concrete)	0.04 to 0.08
Portland Cement Concrete	0.04 to 0.07

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Section 460 Asphalt Tack Coat

- 460.3 Construction
- Use asphalt distributor as specified: designed, equipped, calibrated maintained, & operated to uniformly apply material within a tolerance of 0.02 gal/sq yd up to 15' wide
- Hand-spraying equipment for inaccessible areas
- Distributor's application rate to be determined using PTM 747
- Apply tack only when air temperature is 40°F and rising and the surface is dry.

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Tack Changes Feb-16-2017

- New Material "TACK"
- 57% Asphalt MINIMUM
- 90 F to 150 F temperature range
- No visual separation after 30 days storage-circulated, re-tested after 30 days
- 100 foot test strip
- Apply 6" beyond longitudinal joint

51

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Tack Changes Feb-16-2017

- CNTT or NTT
- 50% Asphalt Minimum—No Maximum
- 140 F-180F Temperature Range
- No visual separation within 30 days—circulated and re-tested after 30 days

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New Application Rates

- Review application/residue rates at Pre-Placement Meeting
- Residual Rates Table B Sec,460
- .03 to .05 for New Asphalt Paving
- .04 to .07 for Existing Asphalt surface
- .04 to .08 for Milled Surface, Asphalt or PCC

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Tack Coat Inspection

- Road must be CLEAN and DRY (broom alone may not be enough)
- Obtain % Asphalt from BOL, Calculate the required application rate-- Sec. 460 table B for EACH Course--- Discuss with Operator
- Apply 100 ft MINIMUM test strip 6" beyond longitudinal joint (s)
- Adjust bar height, pressure, and nozzles to ensure 100% uniform coverage

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Tack Coat Inspection

- **DO NOT begin paving until an acceptable test strip has been demonstrated**
- **Allow the tack coat to break and set and ensure that tracking has been minimized**

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Spray Bar continued

Etnyre Spray Bar Nozzles

Ref.	Part No.	Description	Application Gallons Per Square Yard	Application (Metric) Liters Per Square Meter	US Flow Gallons Per Minute Per Foot
1	3353788	V Slot Tack Nozzle	.05 - .20	.23 - .91	3.0 to 4.5
2	3351008	S36-4 V Slot	.10 - .35	.45 - 1.58	4.0 to 7.5
3	3351009	S36-5 V Slot	.18 - .45	.81 - 2.04	7.0 to 10.0
4	3352368	Multi-Material V Slot	.15 - .40	.68 - 1.81	6.0 to 9.0
5	3351015	3/32" Coin Slot	.15 - .40	.68 - 1.81	6.0 to 9.0
6	3352204	Multi-Material V Slot	.35 - .95	1.58 - 4.30	12.0 to 21.0
7	3352205	Multi-Material V Slot	.20 - .55	.91 - 2.49	7.5 to 12.0
8	3352210	End Nozzle (3352205)	.20 - .55	.91 - 2.49	7.5 to 12.0
9	3351014	3/16" Coin Slot	.35 - .95	1.58 - 4.30	12.0 to 21.0
10	3351010	1/4" Coin Slot	.40 - 1.10	1.81 - 4.98	15.0 to 24.0

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Application Rate Calculation for TACK or NTT/CNTT

Required Tack coat = 0.04 gal/sq yd *Residue*

CNTT .67% Asphalt Residue (from Bill of Lading)

1 gal of CNTT = 2/3 asphalt (67%) and 1/3 water (33%)

To determine the application rate, divide the required residue by .67

.04÷ .67 = 0.059 (.06) gal/sq yd of CSS 1h *application rate*

Check: .06 X .67 = .04 residue

Note: Asphalt content must be obtained from the Bill of Lading

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Application Rate Calculation for 60% Residue TACK or NTT/CNTT

A. Application Rate: (AR)

AR= (required residue ÷ asphalt content as a decimal)

.03 RESIDUE required /sq. yd.

AR=.03 ÷ .60 (60%) OR AR = .05 /sq.yd./

Check: .05 applied X .60 asphalt content =.03 residue per square yd

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Section 483
Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing)

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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.**

Note: Section 483, Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing) was added by Change No. 1 to Pub 408/2011.

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Section 483
Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing)

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Section 483 Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing)

- **483.1 Description (continued) Three mix types of micro-surfacing:**
  - **Type A. Used to seal cracks, fill voids and shallow ruts (<1/2 inch) & provide a scratch course or surface seal.**
  - **Type B. Used to fill moderate ruts (1/2 to 1¼ inch) & provide a scratch course, a leveling course, a seal coat, or surface course**
  - **Type Rut fill (RF). Used to fill deep ruts (up to 2 inch) in a single pass**

Note: Type A and Type B can use a double application when specified, to meet total design pounds per square yard for surface courses.

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Section 483 Polymer-Modified Emulsified Asphalt Paving System (Micro Surfacing)

- **483.3 Construction**
  - **(f) Conditioning of Existing Surface. Section 409.3(g)1 & as follows:**
    - **Clean surface immediately before placing material**
    - **Remove all pavement markings & legends**
    - **For existing concrete surfaces, Apply tack coat (Section 460). Do not apply tack coat on existing asphalt surfaces**
    - **Apply water to dampen entire surface immediately before placing mixture**

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Remove Pavement Markings

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Micro Surfacing General Requirements

- **If mix is NOT set up within one hour the Dept. representative shall issue a warning to the contractor who may proceed with adjustments to ensure the one hour set up. If the material is not set up in 1hr and 20 minutes, stop the application and remove and replace the failed material.**

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Microsurfacing

- **Applied as a Mixture**
- **Polymers & Other Additives**
- **Lower Cost Compared to Overlay**
- **Relative Long Service Life (4 – 7 yrs)**
- **Specialized Equipment Needed**

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Microsurfacing

Purpose:

- **Improve surface friction**
- **Fill ruts/minor surface irregularities**
- **Seal pavement surface**

- **Designed to be open to traffic in 1 hour**

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Section 489 Ultra Thin Bonded Wearing Course

- **Plant mixed *UTWC***
- **Apply only 4/1 to 11/1 with ambient temperature of 50 degrees or greater**
- **Paver with built in spray bar, *UTWCEM* material applied within 5 seconds of *UTWC***
- **Roll without vibration at 185 degrees or greater (vibes may be used on joint)**
- **May use pneumatic tire roller**
- **Cracks sealed at least 24 hours prior**

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Section 489 Ultra Thin Bonded Wearing Course

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Section 489 Ultra Thin Bonded Wearing Course

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Section 496
Asphalt Concrete Pavement
60 month warranty

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Section 496
Asphalt Concrete Pavement
60 month warranty

Effective April 3, 2015

Discussions are ongoing as to implementation date and on site criteria.

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Section 496.3 Construction Depth Checks

- Combination of two or more courses
- 1 core 4" or larger for each 2,000 linear feet of pavement lane by PTM 1 through all courses.
- Depth deficiency in one location> 1/4 " or three consecutive locations > 1/8 " is considered defective work
- Limit of defective work to be determined by additional coring.

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Section 496.3 Information Samples

- *IF* directed and in the presence of the Inspector---
- Random locations using PTM 1
- One core for each 1,000 ton within 24 hours of placement
- Backfilled and sealed within 24 hours
- Delivered to LTS by Department

74

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Section 496 Performance Criteria

- Evaluated as per PUB 336 for 5 years
- Remedial action-- Table A of Sec. 496
- 12 foot straight edge to determine rutting
- No routine maintenance by Dept.
- ESAL levels monitored by Dept.
- Repairs to be square or rectangular and if distance between repairs is < 100 feet ; repair is to be continuous.
- Must meet surface tolerance of 409.3

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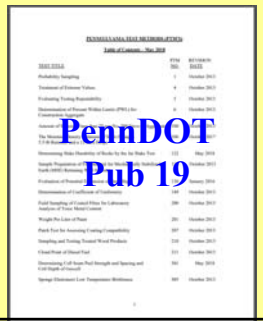
What you need to know... Which Pennsylvania Test Methods apply to the field?

- The P.T.M.'s in the HMAC paving operations
- The purpose of each of these important test methods



PennDOT Pub 19

77

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P.T.M.'s for Field Technicians

- PTM 1: Probability Sampling
- PTM 402: Determining In-Place Density by Use of Nuclear Gauges
- PTM 403: Determining In-Place Density Using Electrical Impedance Measurement Methods
- *PTM 402 and 403 are NEW in 2016*
- PTM 428: Measuring Pavement Profile Using a Light Weight Profiler

Laboratory Tests:

- PTM 715/716: Determination of Bulk Specific Gravity of Compacted Asphalt Mixtures
- AASHTO T209: Maximum Specific Gravity of Asphalt Mixtures (Vacuum Method)

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P.T.M.'s for Field Technicians

- PTM 729: Sampling Roadway Asphalt Concrete (Revised Oct 2013)
- PTM 737: Measuring Thickness of Asphalt Concrete Courses
- PTM 746: Sampling Asphalt Paving Mixtures (Revised Dec 2011)
- PTM 747: Determination of Distributor Application Rate in the Field
- PTM 751: Measuring Surface Macrotexture Depth Using a Volumetric Technique & Determining Pattern Segregation

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PTM 1
Probability Sampling

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PTM #1: Probability Sampling

- Selecting samples using probability sampling techniques.
- Selecting all Department samples in an unbiased manner, based entirely on chance.
- Samples divided into Lots and Sublots

81

82

Random Number Table

	X		Y
1.	0.29	R	0.66
2.	0.74	R	0.49
3.	0.89	L	0.79
4.	0.60	R	0.39
5.	0.88	R	0.31
	.		.
	.		.

Procedure:

- Determine lot size and number of sublots per lot from the specifications.
- Select a set of consecutive numbers from random number table--one for each sublot.
- For roadway sampling, values in X and Y columns give coordinates of sample

82

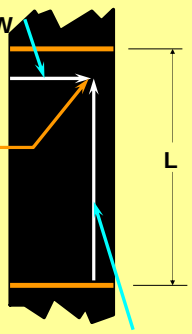
83

Random Number Table

	X		Y
1.	0.29	R	0.66
2.	0.74	R	0.49
3.	0.89	L	0.79
4.	0.60	R	0.39
5.	0.88	R	0.31

*R or L indicates measurement from right or left edge of paved lane

Y x W (width of paving) = 0.79 x W



X x L (Length of sublot) = 0.89 x L

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Determining Sample Location

Length or "X" value

Offset or "Y" value

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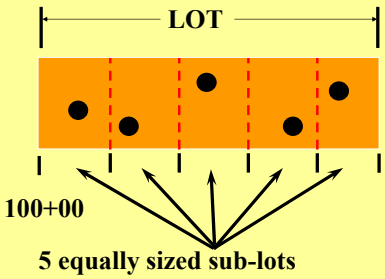
Example: RPS Lot (Box Sample)



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PTM 402
Determine In-Place Density by Use of Nuclear Gauges

and

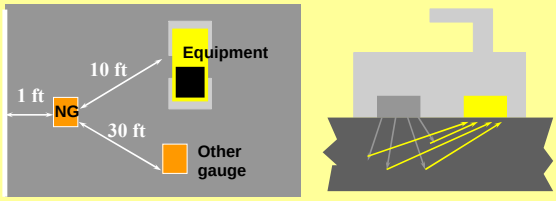
PTM 403
Determine In-Place Density Using Electrical Impedance Measurement Methods

86

87

PTM #402: Determine In-Place Density by Use of Nuclear Gauges

- Nuclear Density Gauge
- Standardization
- Location



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PTM #402: Determine In-Place Density by use of a Nuclear Gauge

- Test Site Preparation
- Standard count *daily*

- Form TR-4276B
- Operator must be licensed & gauge must be type approved by PennDOT

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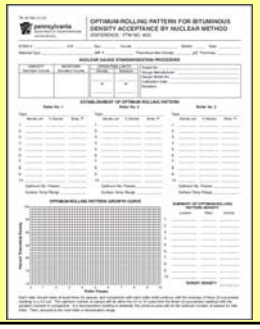
PTM #402: Determine In-Place Density by Use of Nuclear Gauges (Form CS 4276 B)

- Establishment of Optimum Rolling Pattern



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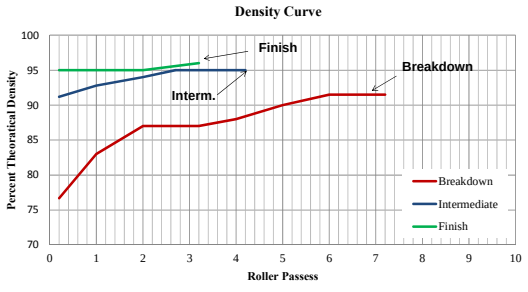
Establish Rolling Pattern



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PTM #402: Report on Compaction Density by Nuclear Method (Form CS 4276 A)

91

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PTM #403: Determine In-Place Density Using Electrical Impedance Measurement Methods

- Rapid non-destructive technique
- PennDOT approved instrument

- Calibration
- Test Site Preparation

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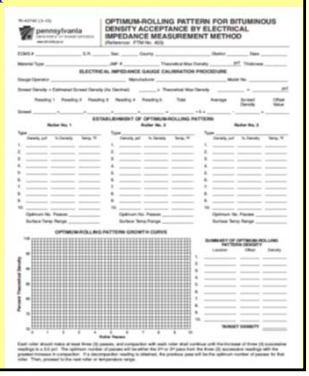
PTM #403:Determine In-Place Density Using Electrical Impedance Measurement Methods

- Use this form to record data (Form 4276C).



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PTM #403:Determine In-Place Density Using Electrical Impedance Measurement Methods

- Use this form to report the results (Appendix B of PTM 403)

94

95

Optimum Roller Pattern

- The intent is to achieve the maximum density possible under: existing conditions, material characteristics, ambient temperature and roller capabilities.
- 3 successive passes that do NOT increase density by 3 lbs./cu. ft. indicate further rolling is ineffective at that temperature with that machine

95

96

Optimum Roller Pattern

- Electrical Impedance or Nuclear gauge must be calibrated DAILY
- Readings must be taken from *same location after each pass* of the roller.
- Each roller must make AT LEAST 3 passes, record results of each pass.

96

Optimum Roller Pattern

97

- If the density increase for 3 successive passes is less than 3 lbs. /cu. ft., the optimum pass will be the one with the greatest increase of the 3 passes.
- No readings required until after 2nd pass of pneumatic tire roller.
- Record results on proper form, document ten random readings and average density.
- Should be performed DAILY, and may be required more than once per day.

97

PTM 729
Sampling Roadway Asphalt Concrete
(Revised 2013)

98

98

PTM 729
Oct 2013 12 Pages

99

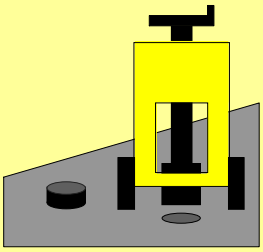
- Contains revised information on equipment, selection of sample locations, (both roadway and longitudinal joint), procedures, packaging and identification, and examples
- Updates to 2010 revisions included

99

PTM #729: Sampling Roadway Asphalt Concrete

100

Revised



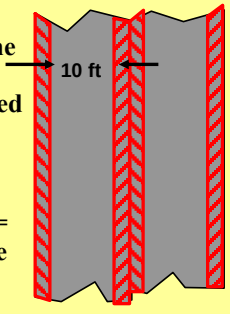
Coring

100

PTM #729: Sampling Roadway Asphalt Concrete

101

- Testable width will equal the nominal paving width less one foot from each supported edge and each unsupported edge
- Example: 12 foot paving lane: 12 feet -1 foot -1 foot = 10 feet sampling width to be used with random number table.

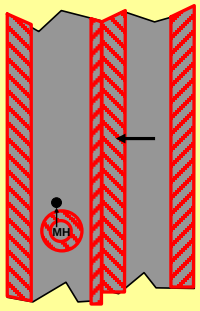


101

PTM #729: Sampling Roadway Asphalt Concrete

102

- Defines non-testable areas as one-foot from the edge of obstructions such as manholes, inlets, and utility valve covers.
- If sample location falls within, adjust location longitudinally in direction of paving to just outside the non-testable area.



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103

PTM #729: Sampling Roadway Asphalt Concrete

- **Equipment:**
  - **Powered Core drill, water cooled, equipped to core samples**
  - **Diamond drill bits of 6" size**
  - **Suitably sized boxes**
  - **A rigid plate or suitable container to hold sample without distortion after removal (Concrete cylinder molds)**
  - **Masking tape**
  - **Marking pencil or lumber crayon**

103

104

PTM 729: Sampling Roadway Asphalt Concrete

- **Incidental materials and equipment**
- **Hand-held core sample extraction tool capable of grasping and removing the core sample without damage to the core sample**

104

105

PTM #729: Sampling Roadway Asphalt Concrete

- **Random sampling using PTM #1 with one sample from each sublot**
- **Density samples to be cross referenced to corresponding loose mix acceptance (box) samples on Form TR-477.**
- **Place increment bar code sticker from form TR-447 on outside container.**
- **Secure cored samples with masking tape.**
- **Store in safe, cool place and transport in timely manner.**

105

106

PTM #729: Sampling Roadway Asphalt Concrete

- **PTM Appendix provides examples for locating samples**
  - **Example 1: Location adjustment for edges**
  - **Example 2: Location adjustment for obstructions**

106

107

PTM #729: Sampling Roadway Asphalt Concrete

4. Selection of Longitudinal Joint Incentive/Disincentive Samples

- **Samples by random sampling using PTM #1 Random Numbers, X value only**
- **Lots determined as paving progresses**
- **Full lot = 12, 500 linear feet**
- **5 sublots of 2500 feet per lot**
- **One sample from each sublot.**

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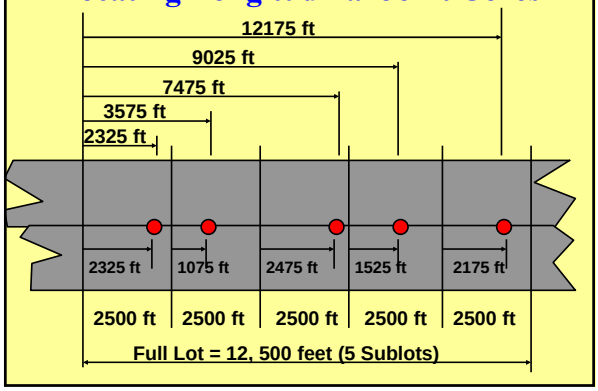
PTM #729

Locating Longitudinal Joint Cores

	X	Y	Linear Feet by Sublot	Total Lot LF
47	0.93	N/A	0.93 x 2500 ft = 2325	2325
48	0.43	N/A	0.43 x 2500 ft = 1075	3575
49	0.99	N/A	0.99 x 2500 ft = 2475	7475
50	0.61	N/A	0.61 x 2500 ft = 1525	9025
51	0.87	N/A	0.87 x 2500 ft = 2175	12175

108

PTM #729
Locating Longitudinal Joint Cores
109



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PTM #729
Locating Longitudinal Joint Cores
110

Example from PTM Appendix – Example No. 3

Sampling Sequence for LOT (12,500 linear feet)			
Sublot 1	2,325	=	Station 23+25
Sublot 2	2,500 + 1,075	=	Station 35+75
Sublot 3	5,000 + 2,475	=	Station 74+75
Sublot 4	7,500 + 1,525	=	Station 90+25
Sublot 5	10,000 + 2,175	=	Station 121+75

110

PTM #729
Location of Longitudinal Joint Cores
111

- Length of final lot is adjusted to ensure final lot has between 3 to 7 sublots (See Example #3 in PTM Appendix)
- For final sublot, use a length of 2500 feet and multiply by the x value of the random number
- If sample falls beyond actual length of joint, sublot not counted and no sample taken
- If sample falls within actual length of joint, sample taken and sublot added to final lot.

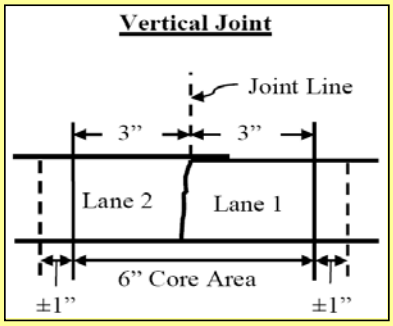
111

PTM #729
Location of Longitudinal Joint Cores
112

- Location of cores on joint
  - With vertical joints, cores centered on surface joint line
    - Center of core to be within 1 inch of joint line
  - With notch wedge joints, cores centered 6 inches or half the wedge width of the joint taper away from the joint line in direction of wedge
  - If G_{mm} of each lane differs by more than 0.050, ensure half of core is from each lane
    - If not, adjust lateral location for replacement core within 12 inches longitudinally

112

PTM #729
Location of Longitudinal Joint Cores
113



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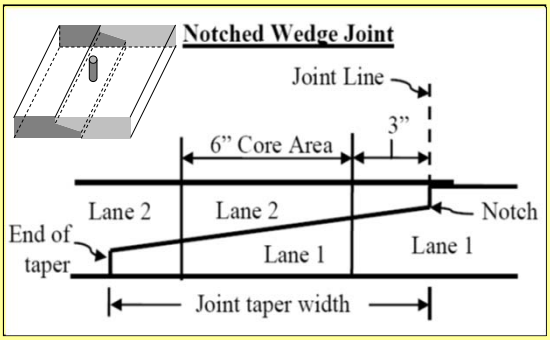
PTM #729
Location of Longitudinal Joint Cores
114



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Change 5- TR 447's for Longitudinal Joint Cores

- Cores taken from same lot with same JMF packaged and recorded on same TR447
- Cores from Different JMF's on separate TR 447.
- Cores from Paving Break > 5 days on Separate TR447

115

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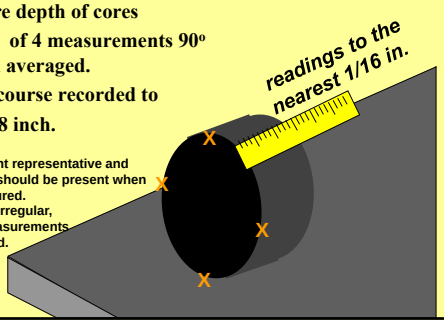
PTM #737: Measuring Thickness Of Asphalt Concrete Courses

- Section 409.3(m) requires inspector to measure depth of cores
- ***Minimum*** of 4 measurements 90° apart and averaged.
- Depth of course recorded to nearest 1/8 inch.

Note: Department representative and contractor CFT should be present when cores are measured.
If the bottom is irregular, more than 4 measurements may be averaged.



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PTM 746 Sampling Asphalt Paving Mixtures

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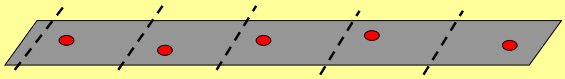
118

PTM #746: Sampling Asphalt Paving Mixtures

Revised 2011!!!!!



Location of samples determined as described in PTM 1: Probability Sampling

118

119

PTM #746: Sampling Asphalt Paving Mixtures

Revised 2013

- Revises language to reflect spec revisions
- Defines normal lot as 2500 tons with 5 sublots of 500 tons.
- Defines sampling of projects with less than 2500 tons total
  - >500 tons & <2500tons: total quantity divided into 5 sublots
  - ≤500 tons: total quantity divided into 3 sublots
- Other language changes to correlate to Pub 408 specs

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120

PTM #746: Sampling Asphalt Paving Mixtures

Revised 2013

Acceptance Sampling on the Roadway

- One sample from each sublot using PTM #1
- Equipment:
  - Flat-bottom, high sided scoop
  - Boxes approximately 3 ¾" x 4 ¾" x 9 ½" (approximately 8 lbs of material)
  - Putty knife for scraping INSIDE of scoop
  - Incidental materials & equipment

120

121

PTM #746: Sampling Asphalt Paving Mixtures Revised 2013

Acceptance Sampling on the Roadway

- Samples taken from uncompacted mix directly behind the paver (paving equipment Dec 2011)
- Each sample has a Form TR-447 for proper ID and info.
- Proper # increment barcode sticker on outside box

121

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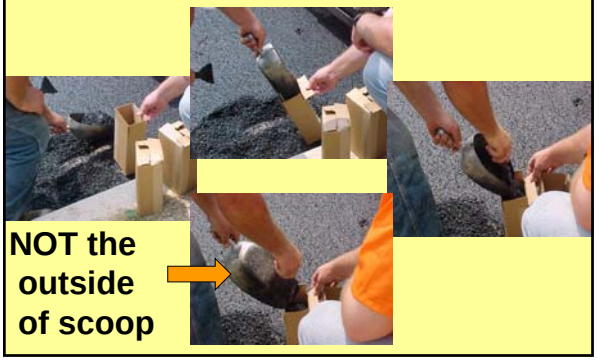
PTM #746: Sampling Asphalt Paving Material



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123

PTM #746: Sampling Asphalt Paving Mixtures Revised 2013

Acceptance Sampling on the Roadway

- Sampling scoop should pass completely through entire depth of material lift, transferring material to box, scraping any remaining fines from INSIDE scoop.
- PTM Appendix provides examples for locating samples
  - Example 1: Based on tonnage – addresses procedure with MTV
  - Example 2: Based on square yards

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PTM #746: Sampling Asphalt Paving Mixtures Revised 2013

PTM also includes:

- Sampling at the production plant under a quality control program with appropriate illustrative example
- Quality assurance sampling from hauling units with appropriate illustrative example

124

125

PTM 746 Oct 2013

- Contains new information on selection of sample locations, equipment, procedures, identification and delivery, and illustrative examples for both plant and field.

NOTE: Samples taken at a producer by use of time intervals will not directly correlate to lot/ sublot designations

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PTM 746 October 2013

- For large NMAS mixes, contractor may obtain larger size samples and then reduce in size. Here is the language in PTM 746
- 5.11: for 3/4" (19 mm) and larger NMAS mixtures, a sample larger than is required in section 4.1 may be obtained and placed on a mixing board, thoroughly mixed, formed into a flat pile and carefully quartered to provide a representative sample of the required size. Scrape the inside of the scoop at each transfer point to incorporate any fines sticking to the inside of the scoop.

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PTM 747
Determination of Distributor Application Rate in the Field

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PTM #747: Determination of Distributor Application Rate in the Field

- Calibration of distributor prior to test required
- Equipment
  - 48" Carpenter's level
  - Dipstick for tank
  - Manufacturer's certificate of calibration
- Application rate of higher temperature materials determined by correcting temperature using Bulletin 25 conversion chart

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PTM #747: Determination of Distributor Application Rate in the Field

- Procedure
  - Level tank with level on top of manhole
  - Use dipstick to measure material level in tank, calculate gallons from calibration table
  - Select test strip length according to Table 1

Table 1. Length of Test Strip	
App. Rate, gal/sq.yd.	Length of Test Strip, feet
Less than or = 0.01	1000
More than 0.01	500

Note: Dipstick should agree with gauge and be marked with serial number of distributor unit Wheel or infra-red unit on truck should agree with measured distance

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Application Rate Calculation for 60% Residue TACK or NTT/CNTT

A. Application Rate: (AR)

AR= (required residue ÷ asphalt content as a decimal)

.03 RESIDUE required /sq. yd.

AR=.03 ÷ .60 (60%) OR AR = .05 /sq.yd./

Check: .05 applied X .60 asphalt content =.03 residue per square yd

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PTM #747: Determination of Distributor Application Rate in the Field

- Procedure (continued)
  - Apply material to test strip
  - Level tank again and measure level of material with dipstick
  - Calculate application rate
  - Multiply length X width and divide by 9 to calculate square yards.
  - Divide gallons placed by square yards covered to determine Application rate.
  - Multiply Application rate by % of asphalt in tack to determine yield

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NECEPT

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Discussion

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Determining Lots & Sublots, and Sampling Locations

Contents:

Determining Lots & Sublots, and Sampling Locations

409.3(h)2.a Lots and Sublots: Table D

Re-adjustment of Lot Size & 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 previous lot, (n=5)
Less than 500 tons with a combination of one mixture acceptance sample and one core	One new sublot defined & quantity combined with previous lot, (n=6)
500 tons to less than 1000 tons without a combination of two mixture acceptance samples and two cores	One new sublot defined & quantity combined with previous lot, (n=6)
500 tons to less than 1000 tons with a combination of two mixture acceptance samples and two cores	Two new sublots defined & quantity combined with previous lot, (n=7)
1000 tons to less than 1500 tons without a combination of three mixture acceptance samples and three cores	Two new sublots defined & quantity combined with previous lot, (n=7)
1000 tons to less than 1500 tons with a combination of three mixture acceptance samples and three cores	New lot defined, (n=3)
1500 tons to less than 2000 tons without a combination of four mixture acceptance samples and four cores	New lot defined, (n=3)
1500 tons to less than 2000 tons with a combination of four mixture acceptance samples and four cores	New lot defined, (n=4)
2000 tons to less than 2500 tons without a combination of five mixture acceptance samples and five cores	New lot defined, (n=4)
2000 tons to less than 2500 tons with a combination of five mixture acceptance samples and five cores	New lot defined, (n=5)

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.

Determining Lots & Sublots, and Sampling Locations

<u>Problem 1</u> :

Part A: You are the inspector on a paving project using 1-½ inches of 9.5 mm wearing surface. The project calls for placing 3745 tons. You intend to take a combination of mixture acceptance and core samples. How many LOTS and SUBLOTS will be involved?

Part B: On the same project the length of the sublots need to be determined. The first sublot contains 500 tons. What distance will the 500 tons of HMA pave if we are placing a 12 foot wide lane at 1 ½ inches thick? We are assuming a mix density of 110 lbs/ sq.yd./ inch

Part C: Find the location on the pavement where the first box sample would be taken. The first sublot random number is 25.

Part D: Find the location on the pavement where you would take the third core sample. This will represent the third sublot. The first sublot random number is 61.

<u>Problem 2</u> :

A Contractor is placing 18000 yd^2 of Superpave HMA Wearing Course with a PG76-22, 3 to <10 million ESALS, 9.5mm mix, 1 ½" depth, 12 foot lane. Assume yield of 115 lb/ yd^2/inch of pavement.

Part A: Calculate tonnage and total number of lots and sublots.
Part B: What will be the length of each sublot?

<u>Problem 3</u> :

A Contractor is placing approximately 6500 tons of Superpave HMA Wearing Course with a PG64-22, 3 to <10 million ESALS, 9.5mm mix, 1 ½" depth, 12 foot lane over 4 days of paving. Certification by lots required. The actual daily placement is as follows:

- **1st Day: 1532.12 tons**
- **2nd Day: 1511.14 tons**
- **3rd Day: 1876.51 tons**
- **4th Day: 1532.25 tons**

Assume yield of 110 lb/yd^2/inch of pavement

Calculate total number of lots and sublots, assuming you obtained the required combination of both box and core samples on the last partial lot.

Problem 4: Paving Delay

A Contractor is placing approximately 6500 tons of Superpave HMA Wearing Course with a PG 64-22, 3 to <10 million ESALS, 9.5 mm mix, 1 ½" depth, 12 foot lane over 4 days of paving. Certification by lots required.

The actual daily placement is as follows:

- **1st Day: 1532.12 tons**
- **2nd Day: 1511.14 tons**
- **3rd Day: 1876.51 tons**
- **Delayed 7 days**
- **10th Day: 1532.25 tons**

Assume yield of 110 lb/yd^2/inch of pavement

Calculate total number of lots and sublots.

- **Assume a full combination of samples obtained on last lot at end of 3rd day.**
- **Assume not a full combination of samples obtained on the last lot of the 10th day.**

Rule #1

2500 ton or greater project quantity of ANY jmf-- divide by 500 and ROUND UP to establish the number of sub-lots. All sampling computations will be based on 500 ton increments

Completed Lots MUST have 3 sub-lots and CANNOT have more than 7 sub-lots

Lots which have only 1 or 2 sublots are **incomplete, or partially completed** and will be noted as such and tested under different criteria.

A sublot does not exist unless it has a ***combination*** of 1 loose box and 1 core

The final *sub-lot* could contain as much as 994 tons, mathematically

The final **lot** could contain as much as 3994 tons, mathematically

3750 tons ÷500 tons = 7.5 or **8 sampling locations to be computed for loose box and 8 for core**

Table D does not alter sub- lot size for computation… ALL sublots are computed in 500 ton increments

Table D applies ONLY to quantities placed AFTER the last complete 2500 ton lot *(before a ≥ 5 day break or end of project*) and regulates both sublot and lot tonnage depending on whether you **were** or **were not** able to get both a loose and a core from the quantity of material placed in the final partial sublot (Table D's-- with or without)

#2 A project quantity of ANY jmf of > 500 to < 2500 tons-- divide entire quantity by 5 and there will be 5 equal sublots

Table D does not apply

2240÷5= **5 equal sublots of 448 tons----** PTM 1 **X** value is multiplied by **448**

#3 A project quantity of ANY jmf of 500 tons or less-- divide by 3 to determine 3 equal sub-lots for core locations only. Material acceptance for Lots of 500 ton or less is by certification. Cores are an option.

Table D does not apply.

475÷3 = **3 equal sublots of 158.3 tons---** PTM 1 **X** value is multiplied by **158.3**

Commonwealth of Pennsylvania
Department of Transportation

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 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 316—FLEXIBLE BASE REPLACEMENT

316.1 DESCRIPTION—This work is replacing the existing pavement with Superpave Asphalt Mixture Design, HMA or WMA Base Course.

316.2 MATERIAL—

(a) Subbase. Section 350.2

(b) Superpave Asphalt Mixture Design.

- **HMA Base Course, 25.0 mm Mix and 37.5 mm Mix.** Section 309.2 or
- **WMA Base Course, 25.0 mm Mix and 37.5 mm Mix.** Section 311.2

(c) Asphalt Cement, PG 64-22. Section 702

316.3 CONSTRUCTION As shown on Standard Drawings RC-28M, RC-30M, as specified in Section 309 or Section 311 and as follows:

Mark the perimeter of the area to be replaced. Saw cut or mill the perimeter. Remove all material within the saw cut or milled area to the depth indicated. Compact the existing subgrade or subbase before placing the base course material. Clean all vertical surfaces of the area to be patched and coat the vertical faces with a uniform application of PG 64-22. Place the HMA or WMA in a manner that does not cause segregation and to the lift thickness indicated. Compact to the density specified by use of approved compaction equipment as per Section 108.05(c).

316.4 MEASUREMENT AND PAYMENT—Square Yard or Ton

Saw cutting, excavation, hauling and disposal, bituminous tack coat, bituminous material, and sealing of the joints are considered as incidental.

SECTION 344—FULL DEPTH RECLAMATION

344.1 DESCRIPTION—This work consists of in-place pulverizing and mixing a combination of existing roadway material layers, stabilizing additives, and imported aggregate or RAP material, as required, to specified depths and grading, and compacting the mixed materials to form a new pavement base layer upon which an asphalt overlay or a surface treatment is applied. This work is defined as full-depth reclamation (FDR), and often includes the incorporation of additional materials based on an approved FDR mix design.

344.2 MATERIAL—

(a) Reclaimed Material from Existing Roadway. Pulverize and mix existing roadway material layers, which may include bound pavement layers, aggregate subbase material, and subgrade material such that 95% of the material passes the 2-inch sieve.

(b) Aggregate.

1. General. Provide fine or coarse aggregate from approved aggregate producers listed in Bulletin 14 or provide reclaimed aggregate material (RAM) meeting the specified size (e.g., No. 57) as required by the approved mix design.

2. Fine Aggregate. Section 703.1, Type A or B.

3. Coarse Aggregate. Section 703.2, Type A, B, or C.

(c) Reclaimed Asphalt Pavement (RAP) Material from Other Roadways or Projects. Provide RAP material with 95% passing the 2-inch sieve. Process the RAP so that the final mixture conforms to Section 409.2(e).

(d) Stabilizing Additives. Provide one or more of the stabilizing additive materials listed below as included in the approved mix design. Potential additives are not limited to the materials listed below. Those listed below include references to sections with additional information.

1. Asphalt Material.

1.a Emulsified Asphalt. Section 702, Class CMS-2, SS-1h, CSS-1h, or CSS-1hPM.

2. Chemical.

2.a Portland Cement. Section 701

2.a.1 Portland Cement Slurry, Section 701 Portland Cement Slurry must be produced at a concrete plant listed in Bulletin 42, and supplied in Ready Mix Concrete Trucks approved by the DME/DMM. Other slurries must be provided in distributor and tanker trucks equipped with a recirculating pump and/or agitation system to prevent settling of the materials before application.

2.a.1.a Admixtures—Section 711.3

2.b Hydrated Lime. Section 723

2.c Fly Ash. Section 724.2

2.d Pozzolan.

2.d.1 Lime Pozzolan. Section 725

2.d.2 Pozzolan. Section 724

3. Calcium Chloride. Section 721

4. Magnesium Chloride. Use only as permissible on a project approval basis.

(e) Water. Section 720.2

(f) FDR Mix Design. Select one or more stabilizing additives based on the composition of the existing roadway materials according to Publication 242 Pavement Policy Manual. A formal design protocol should be followed to optimize the performance of the pavement section. After selecting the appropriate stabilizing additive(s), develop a mix design following the appropriate mix design procedures for the stabilizing additive(s) as follows:

Table A
Mix Design Procedure for Primary Stabilizing Additive Type

Primary Stabilizing Additive	Mix Design Procedure
Asphalt	Pub. 27 (Bulletin 27)
Chemical (Portland Cement, Fly ash, Hydrated Lime, Pozzolan**& Portland Cement Slurry)	ACI 211, Pub. 242 Appendix J
Calcium Chloride	PTM No. 106 *

*When used as the primary stabilizing material, calcium chloride should be applied as a minimum 35% solution at a rate between 0.10 to 0.15 gallons per square yard for each inch of depth reclaimed.
**Calcium oxide is used to activate the cementitious performance of pozzolan.

(g) Asphalt Material. Section 702, Emulsified Asphalt, Class AE-P, E-1 Prime, or EDP.

344.3 CONSTRUCTION—Comply with applicable environmental standards. Appropriate equipment and techniques should be used to adequately protect adjacent properties from fugitive dust or other material components of the FDR process. Dry additive will not be applied when the wind conditions, in the opinion of the site Inspector, are such that blowing additives become objectionable to traffic or adjacent property owners. Manual and/or gravity (tail gate) spreading of the additives is unacceptable.

Stabilization may be accomplished using asphalt material, Portland cement or other chemical stabilization materials, or calcium chloride consistent with recommendations of the FDR Best Practices found in Publication 242, and approved in the project mix design.

(a) Equipment. Provide the necessary equipment to pulverize reclaimed material to a maximum particle size of 2 inches in the greatest dimension, blend, shape, and compact the FDR materials.

1. Reclaimer. Provide a self-propelled, traveling rotary reclaimer or equivalent machine capable of cutting through existing roadway to depths of up to 16 inches, or as required by the design, with one pass. The equipment must also be capable of pulverizing "in-place" the existing pavement, subbase, and subgrade materials, at a minimum width of 8 feet, and mixing any added materials to the specified depth. The cutting drum must have the ability to operate at various speeds (rpm), independent of the machine's forward speed, to control oversized material and gradation.

Use a machine equipped with a computerized integral liquid proportioning system capable of regulating and monitoring the water application rate relative to depth of cut, width of cut, and speed. Connect the water pump on the machine to the water supply tanker or distributor by a hose, and mechanically or electronically interlock the flow of water with the forward ground speed of the machine. Mount the spray bar to allow the water to be injected directly into the cutting drum/mixing chamber. Provide equipment capable of mixing water, dry or liquid stabilizing additives, emulsion, and the pulverized pavement into a homogenous mixture. Keep the cutting drum fully maintained and in good condition at all times throughout the project. Equipment such as road planers or cold-milling machines designed to mill or shred the existing roadway rather than crush or fracture them is not allowed.

1.a Use equipment capable of automatically metering liquids in the mixture and ensure thorough mixing of the reclaimed materials. Use equipment that is also able to record the volumes metered.

1.b Maintain equipment as specified in Section 108.05(c).

2. Placement Equipment. Use a motor grader or another method approved by the Representative.

3. Compaction Equipment. Provide suitable compaction equipment as follows: Use a pneumatic tire roller weighing 20 tons for breakdown and intermediate rolling for 8-inch depth or less and for final compaction of reclamation greater than 8-inch depth. Use a vibratory padfoot roller when the FDR depth is greater than 8 inches. Perform finish rolling using a single or tandem steel drum static roller of 12 to 14 tons.

(b) Weather Limitations. Do not place FDR materials when air temperature falls, or is anticipated to fall, below 40F within the subsequent required 7-day cure period. Do not perform reclamation in rain, or if rain is anticipated within 2 hours of completion of the work. Cement slurry with accelerating admixtures can be used in periods of cooler temperatures with the written approval of the DME/DMM. Do not place cement slurry mixtures with accelerating admixtures when the air temperature is anticipated to fall below 35F within the first 24 hours following placement.

(c) Quality Control. Provide a QC Plan for the FDR work a minimum of 2 weeks before the start of work. Identify the equipment, personnel, and processes to be used during the work. Ensure that all equipment is operational and functional before deployment to the job site. All equipment must be properly calibrated before application. This calibration should be verified through the test strip. Operators of water and additive applicators must keep proper records of the amount of material applied and the times of application.

(d) Test Strip. Before starting full production work, construct a 300-foot test strip demonstrating the FDR process including final compaction and shaping. Verify application rates for all materials incorporated into the FRD process including stabilization materials and water. Identify and correct any aspects of the work not conforming to the contract requirements before proceeding with full production work. If aspects of the work are not found to be adequately controlled to produce the desired mixed and refinished reclaimed roadway, construct additional test strips until the necessary control is established. After completing the test strip and demonstrating that the minimum density can be achieved, determine n=1 density of the FDR according to PTM No. 402 for each 3,000 square yard lot.

(e) Reclamation.

1. Pulverization. Before the application of any stabilizing additives, pulverize the roadway to the size and depth specified. Adding Calcium Chloride during pulverization is acceptable.

2. Mixing. Combine the FDR material, aggregates (if necessary), RAP (if necessary), stabilizing additive(s), and water according to the mix design and at the mix design recommended moisture content. Maintain adequate liquids in the mixture to ensure thorough mixing of the reclaimed material, aggregates, RAP, and stabilizing additives. If conditions change, make field adjustments to obtain a satisfactory FDR material.

If slurries are used, use Ready Mix Concrete Trucks or equip the distributor and tanker trucks with a re-circulating pump and/or agitation system to prevent settling of the materials before application.

If using slurry delivered in Ready Mix Concrete Trucks, verify "cement" application rate by calculating the weight of cement contained in the mixer truck and the area covered by the slurry after discharge by the Ready Mix Truck. The cement slurry producer shall supply a written record of the amount of cement, water, and admixture with each load of cement slurry. Evenly and uniformly distribute the cement slurry, over the area of the prepared subgrade, calculated to provide the required application rate. Accelerating or retarding admixtures maybe added to the cement slurry with the written approval of the DME/DMM.

3. Compaction. Compact the FDR material to a minimum density of at least 95% of the laboratory compacted maximum density at optimum moisture content. Demonstrate that the minimum specified density can be achieved during paving of the compaction control strip. After completing the compaction control strip, as specified in Section 344.3(e)3.a and demonstrating that the minimum density can be achieved, determine n=1 density according to PTM No. 402 for each 3,000-square yard lot.

Commence rolling at the low side of the course. Leave 3 to 6 inches from any unsupported edge(s) unrolled initially to prevent distortion. Compact the entire reclaimed area using the number of uniform passes of compaction equipment determined from the control strip, ensuring that uniform density is achieved throughout.

Complete compaction of chemically stabilized reclaimed material within 4 hours of the water/additive mixing operation.

3.a Compaction Control Strip. Determine the in-place density requirements by the construction of at least one 300-foot long control strip during initial reclamation. The compaction control strip may be contained within the project startup test strip. Take nuclear density reading tests according to PTM No. 402 after each pass of the compaction equipment. Continue compaction with each piece of equipment until no appreciable increase in density is obtained by additional passes. Upon completion of compaction, make a minimum of ten tests at random locations according to PTM No. 1 to determine the average in-place density of the compaction control strip. Provide density results to the Representative for verification to the minimum density requirements specified in Section 344.3(e)3.

If the density of the compaction control strip is less than the minimum density of at least 95% of the laboratory compacted maximum density at optimum moisture content, but the base course is uniform in texture, stable, and otherwise acceptable, provide additional compaction. If additional compaction does not achieve the minimum density, construct another compaction control strip to verify that the minimum density is achievable with the FDR process and mix design in use. Take a minimum of ten tests at random locations according to PTM No. 1 to determine the average in place density of the new compaction control strip. The minimum density for the new control strip is 98% of the control strip density.

3.b Moisture Content. Verify the original moisture content of the road material to be reclaimed before starting work. Make any appropriate adjustment between the moisture content determined at the time of mix design sampling and current moisture content by adjusting the design recommended water application rate.

The moisture content for compaction must achieve the optimum moisture content as determined from the project mix design, but cannot exceed optimum by more than 3%.

4. Finishing. Shape the FDR material surface not to exceed 3/4-inch irregularity of the lines, grades and/or cross-slope of the proposed roadway. Avoid excessively working the chemically stabilized FDR material, which may detrimentally affect the ultimate strength of the stabilized layer.

5. Cure. Cure the FDR material until the 7-day strength requirement is met. Do not allow heavy traffic on the reclaimed material during the 7-day cure period. Appropriate traffic signs must be posted to prevent heavy traffic on the constructed base until completion of base curing and application of the overlay.

For chemical stabilization, maintain the reclaimed layer in a damp condition by the daily application of water to the surface, or the application of an emulsified asphalt prime material at a rate between 0.05 to 0.1 gallons per square yard, followed by a fog seal at the rate of 0.25 gallons per square yard.

The rate of curing depends on many factors. In favorable weather conditions (no rain, sunshine, low humidity, high temperature), curing can take place at a considerably faster rate. Sufficient curing and strength gain could take from 2 or 3 days to at least 2 weeks depending on the type and amount of materials used and the climatic conditions. Verify by coring or test pit that curing has occurred throughout the full depth of the FDR before the application of an overlay or wearing course.

FDR should be proof rolled with a vehicle similar to the heaviest vehicle expected in traffic, or base opening on a strength measurement of the FDR, prior to opening to traffic. Same day return to car traffic at posted safe speeds is possible. In general, the constructed base could be opened to light traffic (vehicles under 5 tons) 2 hours after completion of the base construction, with proof rolling. Roadway should be at 50% of the design optimum moisture content or 3% total moisture content, whichever is reached first, prior to overlay. No damage should be apparent at slow speed, less than 10 miles per hour. Immediately correct any such damage to the satisfaction of the Representative. Otherwise verify strength by testing.

6. Surface Tolerance. Test the completed stabilized base for smoothness and accuracy of grade, both transversely and longitudinally. Satisfactorily correct any 3,000-square yard lot where the average surface irregularity exceeds 1/2 inch under a 10-foot template or straightedge, based on a minimum of at least three measurements within the lot.

Provide a minimum final surface cross slope of 1/4-inch per foot, or as otherwise required by the project design.

(f) Maintenance and Protection of Traffic (MPT). Relocate traffic using approved traffic control devices and procedures consistent with Section 901. Provide MPT until the road can be opened to traffic as specified in Section 344.3(h).

(g) Acceptance. Acceptance will be based on each 3,000-square yard lot complying with requirements for surface tolerance as specified in Section 344.3(e)6, for density as specified in Section 344.3(e)3, and strength as follows.

Any lot failing to meet the acceptance criteria will be identified for rework. With the approval of the Representative, additional cores may be taken to determine the extent of the failing area. Once a failed area has been identified, develop and obtain approval of a new mix design. Failed areas must be reclaimed again with the additional stabilizing material, as necessary, to achieve the required acceptance criteria. Fill any core holes remaining outside the reworked area with an approved repair material listed in Bulletin 15.

Take a minimum of three samples for strength testing for each lot size of 7,040 square yards. Follow PTM 1 for selecting sample locations. Cores should be 6 inches in diameter at a diameter to length ratio of 1:1.5. If possible, a core length of at least 60% of the design reclamation depth should be tested. Also, at least one full-depth sample per project mile should be extracted. If taking this sample is not possible with the 7-day core samples, take additional cores for strength testing after a 28-day cure time. Adjust the calculation of compressive strength as affected by the aspect ratio of the cylindrical specimen according to PTM No. 606 or ASTM C 42.

1. Asphalt Stabilized FDR. Achieve a minimum indirect tensile strength of 50 pounds per square inch when tested according to Bulletin 27.

2. Chemical Stabilized FDR. Achieve an unconfined compressive strength of 300 pounds per square inch to 500 pounds per square inch in 7 days when tested according to ACI 211 for the roads to be surfaced with less than a 3-inch overlay or asphalt surface treatment. Achieve an unconfined compressive strength value of 200 pounds per square inch to 500 pounds per square inch in 7 days for roads to be surfaced with an asphalt overlay of 3 inches or greater. Material tested to strengths greater than 900 pounds per square inch may result in shrinkage cracking, and rework will be required.

(h) Opening to Traffic. Do not open the road to unlimited traffic until the specified 7-day strength has been achieved. Limited local light vehicular traffic may be allowed once the reclaimed material has obtained a stable condition. Repair any damage resulting from local traffic. Do not allow trucks to use the road until the above referenced 7-day strength has been achieved.

344.4 MEASUREMENT AND PAYMENT—Square Yard

For the stabilization method selected with the approved mix design.

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 400
FLEXIBLE PAVEMENTS

SECTION 404—EVALUATION OF BITUMINOUS PAVEMENT RIDE QUALITY AND PAYMENT OF INCENTIVE

404.1 DESCRIPTION—This work is evaluating a bituminous pavement surface profile and determining the ride-quality incentive associated with the pavement surface profile.

(a) General Requirements. Determine the ride quality of finished pavement surfaces, including overlaid bridge approach slabs and overlaid bridge decks. In the presence of the Inspector, measure the pavement surface profile according to PTM No. 428. Provide the resultant International Roughness Index (IRI) data to the Representative. The Representative will determine payment for each ride-quality lot based on the IRI.

Measure the pavement surface of the following excluded areas separate from the pavement surface profile of ride-quality lots. The Representative will not include measurements from excluded areas to determine lot incentive payment.

- Pavement surfaces not constructed as a full-depth overlay, as indicated, such as the vertical transition areas at the limits of paving and at the approaches to bridges.
- Bridge decks unless overlaid.
- Ramps less than 1,500 feet in length.
- Tapered pavement less than 12 feet wide.
- Shoulders, medians, and other pavement surfaces indicated.
- Pavement from 5 feet before and up to 5 feet after any appurtenances such as water boxes, manholes, railroad tracks, and inlets extending out into the pavement.
- Partial lots less than 100 feet.
- Roadways with a posted speed limit of 40 miles per hour or lower.
- Pavement that is not reconstructed with at least two of the following operations: profile milling, scratch course, leveling course, binder course, and wearing course, and on bridge decks only, a waterproofing membrane.

(b) Lot Size. A full lot is 528 feet of a single pavement lane. The Representative will designate lots starting at the beginning limit of paving and continuing to the ending limit of paving for each pavement lane and ramp that is 12 feet or wider. Do not include the length of excluded areas in the 528 feet.

The Representative will designate a partial lot at the ending limit of paving and at an excluded area, when the lot length is less than 528 feet. The Representative will evaluate a partial lot as a percentage of a full lot.

404.3 CONSTRUCTION—

(a) Equipment and Operator. Provide pavement surface profile measuring equipment that has been verified by the Department according to PTM No. 428. In the presence of the Inspector, calibrate the distance sensor and check the profile system calibration before each day's testing.

Provide an operator that is Department certified according to PTM No. 428.

(b) Testing.

1. Lots. Provide the traffic control and station marking necessary to accommodate testing. Remove objects and equipment from the surface and sweep the surface as necessary to remove debris. In the presence of the Inspector, determine the pavement surface profile for each lot according to PTM No. 428. At the completion of testing, immediately submit the lot IRI data, as defined in PTM No. 428, to the Representative.

2. Excluded Areas. Provide the traffic control necessary to accommodate testing. Test the entire surface of each excluded area in stages using a 10-foot straightedge. At each stage, hold the straightedge in contact with the surface and parallel to the roadway centerline and, in successive positions, test the pavement surface profile from one side of the excluded area to the other. Advance the test location to the next stage by moving the straightedge along the roadway centerline not more than 5 feet.

(c) Acceptance.

1. Lots. The Representative will compare the lot IRI to Table A in Section 404.4 to determine if the lot requires corrective action. Additionally, perform corrective action on any individual bump (must grind) where the irregularity is more than 3/16 inch when tested with a 10-foot straightedge.

2. Excluded Areas. Perform corrective action where irregularities are more than 3/16 inch when tested with a 10-foot straightedge. To improve the ride quality and at the Department's expense the Representative may require grinding of excluded areas that conform to the acceptable straightedge surface tolerances specified in Section 404.3(c).

(d) Corrective Action.

1. Do not produce a deviation, such as a ridge or valley with the adjacent pavement, of more than 3 mm (1/8 inch) when measured on the transverse profile. Correct a sufficient length of pavement to correct the pavement surface profile without producing additional high or low points. Retest the lots and excluded areas after completing corrective action. Perform additional measurements of the pavement surface profile, as necessary, for the Representative to determine which lots do not require additional corrective action. Correct surfaces to a uniform texture and cross section.

2. Perform all corrective action before testing for pavement depth. Use one or more of the following methods:

2.a. Carbide Grinding. Use carbide grinding for correcting areas 15 feet in length or less. Use grinders of the walk-behind type that have cutting heads of carbide tipped shackles, stars, or blades and have a locking depth control to produce a uniform pavement surface texture.

Provide a pavement surface texture consisting of parallel grooves between 3/32 inch and 1/4 inch wide width a "land area" between grooves of 1/16 inch and 3/16 inch. Operate the grinder by making multiple passes if necessary, with a maximum depth of any single pass of 1/8 inch. Grind longitudinally or transversely across the pavement surface.

2.b Diamond Grinding. As specified in Section 514.3 and modified as follows:

(d) Tolerance. Delete this section.

Unless otherwise approved, grind the entire lane width.

2.c Removal and Replacement. Remove the surface course of the entire pavement lane width by milling and replace at least the minimum layer depth of the specified surface course. Place more than the minimum layer depth if necessary to correct the pavement surface profile.

(e) Defective Work. A ride-quality pavement lot is defective if:

- The IRI of the lot exceeds the maximum acceptable IRI specified in Table A of Section 404.4.
- Any individual bump (must grind) exists in the lot where the irregularity is more than 3/16 inch when tested with a 10-foot straightedge.
- The surface adjacent to another ride-quality lot contains a ridge or valley of more than 1/8 inch.
- The specifications for pavement construction require removal and replacement of pavement within the ride-quality lot.

Unless the Department and Contractor agree to leave a defective lot in place as specified in Section 404.4, remove and replace defective areas and retest the ride-quality lot.

404.4 MEASUREMENT AND PAYMENT—Dollar

The proposal will include an item and a predetermined amount of money for Evaluation of Bituminous Pavement Ride Quality and Payment of Incentive. 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.

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 Ride Quality And Payment Of Incentive item as follows:

If the lot is not defective, Table A and the IRI for each lot will be used to determine the incentive payment for ride quality.

The incentive payment for a lot subjected to corrective action will be determined using Table A and the IRI for the lot after the Contractor completes corrective action.

The incentive payment for a partial lot will be determined as a percentage of a full lot.

After corrective action, the Contractor may leave a defective lot in place if the District Executive provides written approval and the Contractor accepts a $4,000 downward adjustment (rebate) of the amount paid for the lot.

Costs associated with evaluating pavement ride quality will not be paid for separately.

TABLE A
Payment Schedule for Ride Quality Incentive

SCHEDULE A	
For Expressway Work Using Three Operations	
IRI inches/mile/lot	**Amount**
≤ 35	$600
≤ 50	$300
≤ 60	$150
≤ 70 *	$0
> 70	Corrective action required
* Maximum acceptable IRI	

SCHEDULE B	
For Expressway Work Using Two Operations and Non-Expressway Work Using Two or More Operations	
IRI inches/mile/lot	**Amount**
≤ 45	$600
≤ 55	$300
≤ 70	$150
≤ 90 *	$0
> 90	Corrective action required
* Maximum acceptable IRI	

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 412—SUPERPAVE MIXTURE DESIGN, CONSTRUCTION OF PLANT-MIXED HMA/WMA 6.3 MM THIN ASPHALT OVERLAY COURSES

412.1 DESCRIPTION—This work is the construction of a thin lift wearing course of plant-mixed, dense-graded HMA/WMA asphalt concrete with 6.3 mm Nominal Maximum Aggregate Size (NMAS), placed on a prepared surface.

412.2 MATERIALS—Section 409.2 with additions and modifications as follows:

(a) Bituminous Material.

1. Virgin Mix. Furnish PG 76-22, conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder, AASHTO M 320 or PG 64E-22, conforming to the requirements of Standard Specifications for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test, AASHTO M 332, 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.

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 approved producers and sources listed in Bulletin 14. Furnish aggregate that conforms to the quality requirements for Superpave Asphalt Mixture Design as specified in Bulletin 27 with modifications as specified in Section 412.2. 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.

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.

All manufactured sand fine aggregates used in NMAS 6.3 mm mixtures must be from a source that has a coarse aggregate SRL rating listed in Bulletin 14 as specified. Manufactured sand fine aggregate must be manufactured from the same parent material(s) as the Bulletin 14 listed coarse aggregate, and will have the same SRL rating as the listed coarse aggregate.

All natural sand fine aggregates, and manufactured sand fine aggregates without a coarse aggregate from the same source with an SRL rating listed in the Bulletin 14 used in NMAS 6.3 mm mixture must be submitted to the LTS for SRL determination.

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

- Abrasion, Maximum Percent as specified in Bulletin 27, Chapter 2A, Table 5A
- Flat and Elongated Particles in Coarse Aggregate maximum percent as specified in ASTM D4791using material retained on the No. 4 sieve, Maximum 10 percent for 1:5 ratio, and Maximum 20 percent for 1:3 ratio.
- Crushed Fragments, Minimum Percent, as specified in AASHTO M 323, Table 5, for Fractured Faces, Course Aggregate using the material retained on the No. 4 sieve.

The coarse aggregate must satisfy specified SRL requirements. Do not use coarse aggregate or anti-skid aggregate in the mixture until the quality, type, and SRL, are determined.

(c) Recycled Asphalt Material. Do not use Reclaimed Asphalt Pavement (RAP) or Recycled Asphalt Shingles (RAS) in the 6.3 mm HMA Wearing Course.

(d) Filler. Follow Section 703.1(c)1. Do not use fly ash if the design traffic is greater than or equal to 3 million Equivalent Single Axle Loads (ESALs). Hydrated lime is allowed as a filler, and may constitute up to 2 percent of the weight of total dry aggregate unless otherwise shown on the plans. Provide hydrated lime that conforms to the requirements of ASTM C977.

(e) Mixture Composition.

1. Virgin Material Mixtures. Design 6.3 mm NMAS mix that meets all Department requirements. Size, uniformly grade, and combine aggregate fractions, bituminous material, and an approved WMA Technology when WMA is indicated in proportions to develop a JMF that conforms to the material, gradation, and volumetric Superpave Asphalt Mixture Design requirements as specified in Bulletin 27, Chapter 2A, except as modified in Table A.

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.

Submit a complete copy of the JMF, including a Form TR-448A 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 on the TR-448A. Provide the calibration factors (C_f for both asphalt content and 75 µm (No. 200) sieve) required by PTM No. 757 with the JMF on the TR-448A. Do not start mixture production until after the DME/DMM reviews the JMF.

Submit a completely new JMF, including a new Form TR-448A, with a change in material sources or if a new JMF is necessary to produce a mixture conforming to this specification.

TABLE A
Mix Design Requirements for Thin Lift 6.3 mm HMA Wearing Course

AGGREGATE GRADATION REQUIREMENTS, PERCENT PASSING	
Sieve Size	**Min. – Max.**

9.5 mm (3/8 inch)	100 Min.
6.3 mm (1/4 inch)	90-100
4.75 mm (No. 4)	0-85
2.36 mm (No. 8)	37-55
300 µm (No. 50)	8-25
75 µm (No. 200)	3-10
VOLUMETRIC DESIGN REQUIREMENTS	
Design Gyrations (N_{design}) for All Specified Ranges of Design ESALs	75
Voids in Mineral Aggregate (VMA), Min. %, for All Specified Ranges of Design ESALs	16.5
Design Air Voids (V_a), %, for All Specified Ranges of Design ESALs	3.5-4.0
Binder Draindown (AASHTO T 305) for mixture with greater than 7.0% Asphalt Content	0.3%
Binder Grade for All Specified Ranges of Design AASHTO M 320 or AASHTO M 332	PG 76-22 or PG 64E-22

1.a Producer QC Plan. Section 409.2(e)1.a

1.b Plant Technicians. Section 409.2(e)1.b

1.c Annual JMF Verification. Section 409.2(e)1.c except conform to the single and multiple sample tolerances in Section 412.2(e)1.d Tables B and C. 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.1 Apparent Moisture Content. Section 409.2(e)1.d.1

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 B. 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 B. After obtaining five or more test results, determine compliance with the multiple sample tolerances in Table B 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.

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 is 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 B. 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. Section 409.2(e)1.d.4

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. In case WMA is used, follow Section 411 for specific temperature requirements and the acceptable temperature range.

Produce a mixture with volumetric properties conforming to the tolerances of Table C. 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 R35 and as specified in Bulletin 27.

TABLE B
Composition Tolerance Requirements of the Completed Plant Mix

		Single Sample (n = 1)	Multiple Samples (n ≥ 3)
Gradation			
Passing 6.3 mm (1/4 inch) to 300 µm (No. 50) Sieves (Inclusive)		±6%	±4%
Passing 75 µm (No. 200) Sieve		±3.0%	±2.0%
Asphalt Content			
6.3 mm HMA		±0.6%	±0.4%
Temperature of Mixture (F)			
Class of Material	**Type of Material**	**Minimum**	**Maximum**
PG 76-22 or PG 64E-22 (HMA/WMA)	Asphalt Cement	285	330
Job-Mix Tolerance Requirements for Combined Hot Bin Gradations			
Gradation		**Single Sample (n = 1)**	
Passing 6.3 mm (1/4 inch) to 300 µm (No. 50) Sieves (Inclusive)		±4%	
Passing 75 µm (No. 200) Sieve		±3.0%	

TABLE C
Volumetric Tolerance Requirements of the Plant Mixed, Laboratory Compacted Mixture

	Single Specimen (n = 1)	Multiple Specimens (n ≥ 2)
Air Voids at N_{design} (V_a) from Target	±2.0%	±1.5%
Minimum VMA %	16.0	-

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 6.3 mm (1/4 inch) sieve, 2.36 mm (No. 8) sieve, 300 µm (No. 50) sieve, 75 µm (No. 200) sieve, or asphalt content are not within the tolerances in Table B.
- 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 B.
- QC test results on a single specimen (n=1) or on multiple specimens (n≥2) are not within the tolerances in Table C.
- Independent assurance (IA) or QA sample results tested at the producer's plant are not within the tolerances of Tables B or C.

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. If less than three samples are tested for mixture composition, determine conformance with Table B by comparing each result to the multiple sample tolerances. If the mixture does not conform to the single and multiple sample tolerances in Table B 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 Section 409.2(f) Table C.

2. Draindown Sensitivity. For mixtures with greater than 7 percent total asphalt content determine the driandown sensitivity of the mixture using AASHTO T 305 at the maximum mixture temperature listed in Table B minus 5F. Use Fibers to reduce binder draindown if draindown exceeds the requirements of Table A. Use stabilizer types specified in Section 419.2(d) as needed to address draindown.

(f) Mixture Acceptance. Section 409.2(f) except as follows:

1. General. The Department will accept the mixture according to the certification acceptance in Section 412.2(f)2 or lot acceptance in Section 412.3(h)2.

2. Certification Acceptance. Acceptance by certification is appropriate for the following applications:

- Scratch Courses, Leveling courses and driveway adjustments.
- Mixtures used by Department maintenance forces.
- Mixtures purchased by local municipal governments.
- Mixture placed in quantities less than 350 tons in a continuous placement operation unless otherwise directed by the Representative.
- Other conditions, or applications as approved by the Representative.

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 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.

(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) 6.3 mm Mixture use with Membrane Systems Specified in Section 467 or Section 680. Do not use 6.3 mm wearing course paving mixture for material placed on top of membrane systems.

412.3 CONSTRUCTION—Section 409.3 with additions and modifications as follows:

(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. The QC Plan shall describe the construction equipment and methods necessary to construct and test the bituminous concrete courses as specified in Section 412.3. For WMA mixes, additionally 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 6.3 mm wearing course 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. No exceptions to paving weather limitations will be allowed unless approved in writing by the District Executive. Do not place bituminous paving mixtures when surfaces are wet, 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.

1. Paving Season Extensions. Section 409.3(b)1. With the following addition:

If an exception to the Weather Limitation dates is approved by the District Executive for 6.3 mm wearing course, the minimum surface temperature of 50F, and an air temperature of 40F will be strictly enforced and compaction of the asphalt material completed as quickly as possible.

(c) Bituminous Mixing Plant. Section 409.3(c). With the following addition:

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. Batch Plant. Section 409.3(c)1. With the following addition:

For WMA mixtures, 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 Section 411.2(e) 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. With the following addition:

For WMA mixtures, produce a completed mixture that is within the mixture temperature range recommended by the Technical Representative or manufacturer, and Section 411.2(e) 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.

(d) Hauling Equipment. Section 409.3(d)

(e) Paving Equipment. Section 409.3(e)

(f) Rollers. Use an adequate number steel-wheeled rollers, each weighing a minimum of 10 tons and as specified in Section 108.05(c)3 to keep up with the paving operation. 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 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) Preparation of Existing Surface. Section 409.3(g) with the following modification:

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 power broom. Remove all thermoplastic pavement markings. If practical, do not allow traffic on the existing surface after cleaning, to prevent contamination.

Before placing a wearing course, correct irregularities in the binder course. Repair potholes and gouges greater than 1 inch in depth. Fill and seal all pavement cracks or joints that exceed 1/8 inches in width. Use fillers and sealants conforming to PennDOT specifications.

Paint all existing vertical surfaces of curbs, structures, gutters, and pavements that will be in contact with bituminous mixtures with a uniform coating of bituminous material, Emulsified Asphalt, Class SS-1h, CSS-1h or of the class and type designated for the bituminous course.

Before overlaying existing surfaces, apply a tack coat to the clean surface according to Section 460. Allow adequate time for tack to break completely prior to placing any material.

(h) Spreading and Finishing. Section 409.3(h) with the following modification:

1. General Requirements.

1.a Placing. Unless otherwise allowed, deliver, place, and compact 6.3 mm paving mixtures during daylight hours. Ensure the mixture does not contain lumps of cold material. Deliver and place 6.3 mm paving mixtures at the laying temperatures specified in Table B.

Utilize a Material Transfer Vehicle (MTV) as specified in Section 108.05(c)5 for 6.3mm paving mixtures unless otherwise approved by the Representative.

1.b Spreading and Finishing. Section 409.3(h)1.b with the following addition:

Plan and schedule operations to minimize hand work of 6.3 mm paving mixtures.

1.c Field Technician. Section 409.3(h)1.c

2. Mixture Lot Acceptance. Section 409.3(h)2 with the following modification:

2.a Lots and Sublots. 409.3(h)2.a.

2.b Mixture Acceptance Samples. Section 409.3(h)2.b and add the following to the end of the first paragraph:

If a representative mixture acceptance sample cannot be obtained directly behind the paver, the loose mixture acceptance sample for each sublot may be taken from the paver hopper or from the paver screed representing the sample sublot location. Determine the approved mixture acceptance sample collection method for loose mixture acceptance samples at the preconstruction or prepaving meeting.

2.c Mixture Acceptance Sample Testing. LTS Testing will be utilized unless otherwise indicated in the proposal.

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 minimum sample size for PTM No. 757 is 1000 grams when 6.3 mm mix is used. 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 412.4(a)2.

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 ($n \geq 3$) tolerances in Table C 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. Section 409.3(h)3.

4. Flushing. Section 409.3(h)4.

(i) Compaction. Begin rolling immediately after placement of mixture. Compact the 6.33 mm paving mixture to achieve the optimum rolling pattern requirements and to eliminate all roller marks. 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 412.3(f). Satisfactorily correct displacement resulting from reversing roller directions and other causes. Do not use pneumatic-tire rollers.

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.

Remove areas that are loose, broken, mixed with dirt, or show an excess or deficiency of bituminous material. Replace removed mixture with fresh, hot 6.3 mm paving mixture and compact the mixture even with the surrounding pavement surface.

(j) Mat Density Acceptance. The Department will accept the mat density based on non-movement and optimum rolling pattern.

1. Optimum-Rolling Pattern. With the Representative and the Contractor's certified HMA field technician present, determine density with an approved nuclear gauge according to PTM 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, follow the control strip technique specified in PTM No. 402 to construct at least one control strip to establish the optimum rolling pattern for each course. Document readings using the forms provided in PTM No. 402 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 construct a new control strip to verify the optimum rolling pattern.

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.

(k) Joints. Section 409.3(k)

(l) Surface Tolerance. Section 409.3(l)

(m) Tests for Depth: Wearing Courses. Section 409.3(m)

(n) Protection of Courses. Section 409.3(n)

(o) Defective Work. Section 409.3(o)

412.4 MEASUREMENT AND PAYMENT -

(a) Standard 6.3mm HMA/WMA Construction.

1. HMA/WMA Courses.

1.a Thin Lift 6.3 mm HMA/WMA Wearing Course. Square Yard or Ton

1.b Thin Lift 6.3 mm HMA/WMA Wearing Course (Scratch). Ton

2. Bituminous Tack Coat. Section 460.4

3. Mixture Acceptance by Certification and Density Acceptance by Non-Movement, Optimum-Rolling Pattern. The Representative will pay at the contract unit price, adjusted according to Table D. 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 and percent passing the 75 μm (No. 200) sieve are both 85%.

TABLE D
Contract Unit Price Adjustments - Mixture Acceptance by Certification

Mixture NMAS	Test Criteria	Test Value		Payment Factor Percentage
Asphalt Content				
6.3 mm	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
6.3 mm	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%	*
Gradation				
		Single Sample (n=1)	Multiple Samples (n≥2)	
6.3 mm	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%	*
Mat Density				
6.3 mm	Non-Movement	Section 409.3(j)2.		100
	Optimum-Rolling Pattern	Section 409.3(j)3.		100

* Defective pavement. Remove and replace or, when permitted by the District Executive in writing, leave in place and the Department will pay 70% 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 separately determined for material placed before and after the corrective action.

4. Mixture Acceptance by Lot and Density Acceptance by Optimum Rolling Pattern. The Department will pay on a lot-by-lot basis at the contract price, adjusted for Payment Factor Percentages as specified in Table E. 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 F.

TABLE E
Contract Unit Price Adjustments - Mixture Acceptance by Lots

Mixture NMAS	Test Criteria	Test Value	Payment Factor Percentage

Asphalt Content			
6.3 mm	Acceptance Sample Testing	All individual sublot acceptance sample test results for the lot (n=1) are within ± 0.6% and the lot average (n≥3) is within ± 0.4%*	100
		Percent Within Tolerance if any individual sublot acceptance sample test result for the lot is not within the n=1 tolerances or the lot average is not within the n≥3 tolerances listed above.	Section 409, Table K
Gradation			
6.3 mm	Acceptance Sample Testing for % Passing 75µm (No. 200) Sieve	All individual sublot acceptance sample test results for the lot (n=1) are within ± 3.0% and the lot average (n≥3) is within ± 2.0%*	100
		Percent Within Tolerance if any individual sublot acceptance sample test result for the lot is not within the n=1 tolerances or the lot average is not within the n≥3 tolerances listed above.	Section 409, Table K
Mat Density			
6.3 mm	Optimum-Rolling Pattern	Section 412.3(j)2	100
* The Department may elect to randomly select and test only one sublot acceptance sample from each lot to determine conformance to the specifications. If only one sublot acceptance sample is tested, tighter tolerances will be used to determine 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 acceptance samples from the lot will be tested to determine the payment factor percentage according to this table.			

TABLE F
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, %	
6.3 mm	-0.4	+0.4
	Percent Passing the 75 µm (No. 200) sieve from JMF Value, %	
6.3 mm	-2.0	+2.0

4.a Payment. Section 409.4(a)4.a.

4.b Dispute Resolution. Section 409.4(a)4.b. Except drill two 6-inch diameter cores at each approved resampling location instead of only one.

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 460—BITUMINOUS TACK COAT

460.1 DESCRIPTION—This work is the conditioning and treating of an existing surface with an application of bituminous bonding material.

460.2 MATERIAL—

(a) Bituminous Material. One of the following as specified in Section 702. Submit a Certificate of Compliance as specified in Section 106.03(b)3 and a Bill of Lading as specified in Section 702.1(c) to the Representative indicating the asphalt residue content (ARC) of the material being used. If the bituminous material is stored for 30 days or longer after certification, resample and retest the bituminous material at no expense to the Department to determine if it meets Bulletin 25 specification requirements.

TABLE A
Bituminous Materials

Class of Material	Type of Material	Application Temperature F	
		Minimum	Maximum
TACK	Anionic or Cationic Emulsified Asphalt	90	150
NTT/CNTT	Anionic or Cationic Emulsified Asphalt	140	180

(b) Fine Aggregate (For Blotting). Section 703.1

460.3 CONSTRUCTION—

(a) Conditioning Existing Surface. Section 409.3(g).

(b) Application of Bituminous Material. Use a distributor designed, equipped, calibrated, maintained, and operated to apply material uniformly on surfaces with varying widths and up to 15 feet wide. Provide a distributor capable of maintaining a uniform distributing pressure and controlling the application rate (AR) within a tolerance of 0.02 gallon per square yard. Provide a distributor equipped with a tachometer, pressure gauges, accurate volume-measuring devices or a calibrated tank, a thermometer for measuring temperatures of tank contents, a power-operated pump, and full circulation spray bars with lateral and vertical adjustments. Provide nozzles sized in accordance with manufacturer's recommendations for the material selected for application. In the field, determine the distributor's application rate according to PTM No. 747.

The Contractor may use hand-spraying equipment in areas inaccessible to the distributor.

Apply tack coat at an application rate, approved by the Representative, to leave a uniform asphalt residual rate within the ranges per surface type according to Table B. Identify the application rates and the residual rates on the Paving Operation QC Plan and review the QC plan application rates and residual rates with the Representative at the Preplacement Meeting.

TABLE B
Uniform Asphalt Residual Rates by Surface Type

Surface Type	Uniform Asphalt Residual Rates (RR) (gallons per square yard)
New Bituminous Paving	0.03 to 0.05
Existing Bituminous Paving	0.04 to 0.07
Milled Surface (Bituminous & Portland Cement Concrete)	0.04 to 0.08

Portland Cement Concrete	0.04 to 0.07

The application rate to achieve a uniform asphalt residual rate can be determined using the following equation:

AR = (RR / ARC)

AR = Application Rate, (gallons per square yard); the amount of emulsified asphalt sprayed by the distributor truck.

RR = Residual Rate; (gallons per square yard); the amount of emulsified asphalt remaining on the surface after it has broken and set.

ARC = Asphalt Residue Content; (% divided by 100); the percentage amount of asphalt in the emulsified asphalt. Provided on the Bill of Lading and expressed as a decimal.

When paving operations begin, apply tack coat on a 100-linear foot minimum test section on the project for each paving course. Apply tack coat at the distributor's application rate to achieve the proposed residual rate within the ranges listed in Table B. Adjust distributor application rate and spray bar height to obtain a uniform surface coverage. Review adequacy of the tack coat coverage with the Representative before to continuing with the tack coat application.

Apply the tack coat only when the air temperature is 40F and rising and when the existing surface is dry. Prior to each paving course, apply the tack coat at an application rate to be within ranges of the uniform asphalt residual rate for the surface type according to Table B. Uniformly distribute the tack coat over the surface. Extend the tack coat a minimum of 6 inches beyond the longitudinal joint of the paving course being placed.

Correct all uncoated or lightly coated areas as directed to the Representative's satisfaction. At designated locations, correct areas with an excess of bituminous material by covering the area with sufficient dry fine aggregate to blot up or remove excess tack coat.

Allow the tack coat to break and set, without being disturbed. Do not begin paving until the Representative determines the tack coat has cured to the point that tracking is minimized.

(c) Protection of Treated Surface. Maintain and protect the treated surface against damage. Repair damaged areas to the Representative's satisfaction before placing the next pavement course.

460.4 MEASUREMENT AND PAYMENT—

(a) Area Basis. Square Yard

(b) Material Used Basis. Gallon

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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LABORATORY TESTING SECTION

Method of Test for

DETERMINING IN-PLACE DENSITY AND MOISTURE CONTENT OF CONSTRUCTION MATERIALS BY USE OF NUCLEAR GAUGES

This PTM is a modification of ASTM D2950 (for Bituminous Concrete) and AASHTO T 310 (for Soils and Granular Material, Type 1). The full standards are available, respectively, from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428 (www.astm.org) and the 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 ASTM D2950 are as follows:

8. STANDARDIZATION AND REFERENCE CHECK (FOR BITUMINOUS CONCRETE)

8.2 The gauge standardization procedure shall be conducted and documented on Form TR-4276B before establishing an optimum-rolling pattern.

9. PROCEDURE- OPTIMUM-ROLLING PATTERN (FOR BITMINOUS CONCRETE)

9.1 Purpose- The objective of the optimum-rolling pattern is to obtain the maximum density attainable under existing field conditions and to employ this value as a target or standard for measurement of compaction compliance for the specified work.

9.2 Establishment of Optimum-Rolling Pattern

9.2.1 Enter into the gauge the theoretical maximum density (pcf) from the job mix formula for the bituminous material being placed.

9.2.2 The thickness of the course shall be the same as specified in the contract. Select a location that would be a convenient test site between roller passes. During compaction, the nuclear gauge operator shall take a surface density reading and surface temperature at the selected location after each pass of the roller. A pass is defined as one coverage of the entire roller. The counting period for each reading shall be one (1) minute, unless the area is too small to effectively compact without significant delay. In such cases, the readings may be reduced to 1/2 or 1/4 minute. Each roller shall make at least three (3) passes, and compaction with each roller shall continue until the increase of three (3) successive readings is $\leq$ 3.0 pcf. The optimum number of passes for each roller will be either the 2nd or 3rd pass from the three (3) successive readings with the greatest increase in compaction. If a decompaction reading is obtained, the previous pass will be the optimum number of passes for that roller. Then, proceed to the next roller or

temperature range. Record all density values and all surface temperatures and plot the optimum-rolling pattern growth curve for each roller.

NOTE 8- When a pneumatic-tire roller is used, nuclear density readings shall not be taken until after the second pass with this piece of equipment.

9.3 Summary of Optimum-Rolling Pattern Density

9.3.1 Compact the entire course according to the optimum-rolling pattern. After compaction is complete, select an area of at least 400 square yards, when practical, containing ten (10) random locations selected according to PTM No. 1 within this area. At each location, at least one (1) surface density (backscatter) reading shall be taken and documented. The counting period must be one (1) minute for each of these readings. Determine the average of the ten (10) readings and document this value as the target density.

11. REPORT

11.1 Complete Form TR-4276B to document an optimum-rolling pattern for bituminous density acceptance by nuclear method.

TR-4276B (3-15)

pennsylvania
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www.dot.state.pa.us

OPTIMUM-ROLLING PATTERN FOR BITUMINOUS DENSITY ACCEPTANCE BY NUCLEAR METHOD

(REFERENCE: PTM NO. 402)

ECMS # _____ S.R. _____ Sec. _____ County _____ District _____ Date _____

Material Type _____ JMF # _____ Theoretical Max Density _____ pcf Thickness _____

NUCLEAR GAUGE STANDARDIZATION PROCEDURE

DENSITY Standard Counts	MOISTURE Standard Counts	OPERATING LIMITS Density	OPERATING LIMITS Moisture
		_____ to _____	_____ to _____

Tested By _____
Gauge Manufacturer _____
Gauge Model No. _____
Calibration Date _____
Remarks:

ESTABLISHMENT OF OPTIMUM-ROLLING PATTERN

Roller No. 1

Type _____

	Density, pcf	% Density	Temp, °F
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Optimum No. Passes _____
Surface Temp Range _____

Roller No. 2

Type _____

	Density, pcf	% Density	Temp, °F
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Optimum No. Passes _____
Surface Temp Range _____

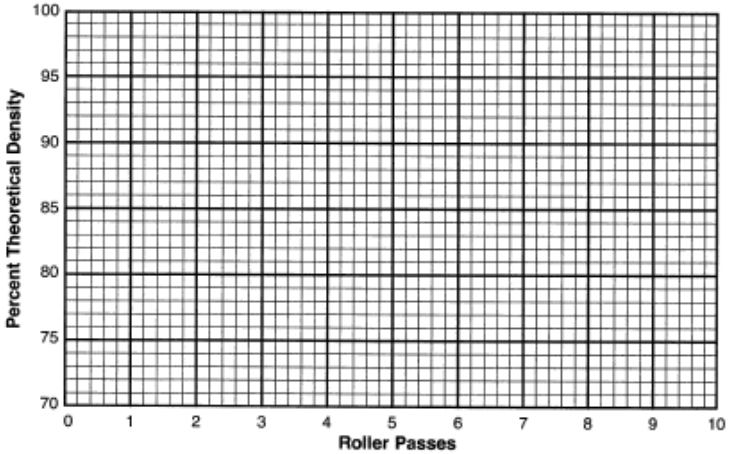
Roller No. 3

Type _____

	Density, pcf	% Density	Temp, °F
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Optimum No. Passes _____
Surface Temp Range _____

OPTIMUM-ROLLING PATTERN GROWTH CURVE



SUMMARY OF OPTIMUM-ROLLING PATTERN DENSITY

	Location	Offset	Density
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

TARGET DENSITY _____

Each roller should make at least three (3) passes, and compaction with each roller shall continue until the increase of three (3) successive readings is ≤ 3.0 pcf. The optimum number of passes will be either the 2nd or 3rd pass from the three (3) successive readings with the greatest increase in compaction. If a decompaction reading is obtained, the previous pass will be the optimum number of passes for that roller. Then, proceed to the next roller or temperature range.

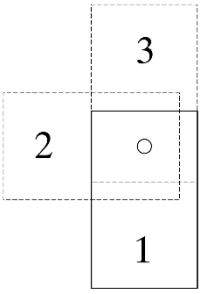
The modifications to AASHTO T 310 are as follows:

8. STANDARDIZATION (FOR SOILS AND GRANULAR MATERIAL, TYPE 1)

8.2.4 The gauge standardization results shall be documented on Form TR-4276A. Standardization for Troxler manufactured gauges can be performed using PTM No. 418 or AASHTO T 310. All other gauges should be standardized using AASHTO T 310

9. PROCEDURE

9.5.9 Secure and record three (3) one (1) minute readings. Rotate the gauge about the axis of the probe 90° in the same direction between readings. Average the three (3) readings to obtain an average density value for the test location.



11. REPORT

11.1 Complete Form TR-4276A to document all compaction density tests by nuclear method.

TR-4276A (3-15)

pennsylvania
DEPARTMENT OF TRANSPORTATION
www.dot.state.pa.us

REPORT ON COMPACTION DENSITY BY NUCLEAR METHOD

(Reference: PTM No. 402)

Fill Out Completely. Original to be retained with project records. Remit copy to District Office

ECMS # _____ S.R. _____ Sec. _____ County _____ District _____ Date _____

TYPE OF CONSTRUCTION: ☐ Embarkment ☐ Subgrade ☐ Pipe Backfill ☐ Other _____
(check one type only)

1. Test No.						
2. Time of Test						
3. Type of Material						
4. Source of Material						
5. Specific Gravity of Material (SG)						
6. Station						
7. Offset						
8. Subgrade Elevation, ft.						
9. Test Elevation, ft.						
10. Lift Height, in.						
11. Source Rod Position						
12. Target Density (Proctor), pcf						
13. Optimum Moisture, %						
14. % Passing 3/8" Sieve						
15. % Passing No. 200 Sieve						
16. Minimum % Compaction Required						
17. % of Compaction of Test						
18. Dry Density, pcf (DD)						
19. Wet Density, pcf (WD)						
20. Moisture, pcf (M)						
21. % Moisture (M%)						
22. Density Count (Shift + Counts)						
23. Moisture Count (Shift + Counts)						
24. Zero Air Voids Formula Check (Y/N)						
25. (P)ASS or (F)AIL						

DENSITY Standard Counts	MOISTURE Standard Counts

OPERATING LIMITS	
Density	Moisture
_____ to _____	_____ to _____

Tested By _____
Gauge Manufacturer _____
Gauge Model No. _____
Calibration Date _____
Remarks:

Zero Air Voids Formula

$$\frac{62.4}{DD} - \frac{1}{SG} \geq M\%$$

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LABORATORY TESTING SECTION

Method of Test for

DETERMINING IN-PLACE DENSITY OF BITUMINOUS CONCRETE USING ELECTRICAL IMPEDANCE MEASUREMENT METHODS

This PTM is a modification of AASHTO T-343. The full standard is available from the American Association of State Highway and Transportation Officials, 444 N. Capitol Street, N.W., Suite 249, Washington, D.C. 20001 (www.transportation.org).

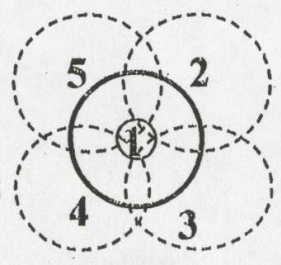
The modifications to AASHTO T-343 are as follows:

3. SIGNIFICANCE

3.2 The density results obtained by this test method are relative and require a screed calibration method according to Section 7.4.

4. INTERFERENCES

4.2 This test method exhibits spatial bias in that the instrument is most sensitive to the density of the material in closest proximity to the center of the instrument sensor. Oversized aggregate particles in the center of the sensor path may cause variations in density readings. The average of at least 5 measurements at each test location is required.



5. APPARATUS

5.4 The device shall include the internal circuitry suitable for automatically averaging a number of individual measurements to obtain a mean value.

7. CALIBRATION PROCEDURE

7.2 The device shall be calibrated on the bituminous mat at compaction temperature ranges allowing subsequent readings to be taken as paving progresses at this temperature range.

7.4 All data used for calibration shall be documented on Form TR-4276C before establishing an optimum-rolling pattern. Calibrate the device following the screed calibration method outlined below:

7.4.1 This screed calibration method utilizes the percent compaction obtained by the screed to calculate a starting density. This method requires the operator to estimate the percent compaction obtained by the screed; routinely this number is 75 to 85 percent of the theoretical maximum density (pcf). Operator experience will contribute to the accuracy of the compaction estimate and the success of this method.

7.4.2 Enter into the device the theoretical maximum density (pcf) from the job mix formula for the bituminous material being placed.

7.4.3 Estimate the percent compaction obtained by the screed.

7.4.4 Multiply the estimated percent compaction obtained by the screed, in decimal form by the theoretical maximum density of the material. Example: The estimated screed compaction is 81%, 0.81; the theoretical maximum density is 154 pcf. The gauge should read 124.7 pcf behind the screed (0.81 × 154 pcf = 124.7 pcf).

7.4.5 Compute the average of five (5) density readings of the mixture exiting the screed and offset the device to obtain the reading calculated in Section 7.4.4. Follow the manufacturer's specific recommendations to input the offset.

8. PROCEDURE OF OPERATION

8.4 The objective of the optimum-rolling pattern is to obtain the maximum density attainable under existing field conditions and to employ this value as a target or standard for measurement of compaction compliance for the specified work.

8.5 Establishment of Optimum-Rolling Pattern

8.5.1 The thickness of the course shall be the same as specified in the contract. Select a location that would be a convenient test site between roller passes. During compaction, the operator shall take a surface density reading and surface temperature at the selected location after each pass of the roller. A pass is defined as one coverage of the entire roller. Each roller shall make at least three (3) passes, and compaction with each roller shall continue until the increase of three (3) successive readings is $\leq$ 3.0 pcf. The optimum number of passes for each roller will be either the 2nd or 3rd pass from the three (3) successive readings with the greatest increase in compaction. If a decompaction reading is obtained, the previous pass will be the

optimum number of passes for that roller. Then, proceed to the next roller or temperature range. Record all density values, all surface temperatures, and plot the optimum-rolling pattern growth curve for each roller.

NOTE 1- When a pneumatic-tire roller is used, density readings shall not be taken until after the second pass with this piece of equipment.

8.6 Summary of Optimum-Rolling Pattern Density

8.6.1 Compact the entire course according to the optimum-rolling pattern. After compaction is complete, select an area of at least 400 square yards, when practical, with ten (10) random locations being selected according to PTM No. 1 within this area. At each location, at least one (1) surface density reading shall be taken and documented. Determine the average of the ten (10) readings and document this value as the target density.

9. RECORDING RESULTS

9.1 Complete Form TR-4276C to document an optimum-rolling pattern for bituminous density acceptance by the electrical impedance measurement method.

TR-4276C (3-15)

pennsylvania
DEPARTMENT OF TRANSPORTATION
www.dot.state.pa.us

OPTIMUM-ROLLING PATTERN FOR BITUMINOUS DENSITY ACCEPTANCE BY ELECTRICAL IMPEDANCE MEASUREMENT METHOD

(Reference: PTM No. 403)

ECMS # _____ S.R. _____ Sec. _____ County _____ District _____ Date _____

Material Type _____ JMF # _____ Theoretical Max Density _____ pcf Thickness _____

ELECTRICAL IMPEDANCE GAUGE CALIBRATION PROCEDURE

Gauge Operator _____ Manufacturer _____ Model No. _____

Screed Density = Estimated Screed Density (As Decimal) _____ × Theoretical Max Density _____ = _____ pcf

	Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Total	Average	Screed Density	Offset Value
Screed	_____	+ _____	+ _____	+ _____	+ _____	= _____	÷ 5 = _____	- _____	= _____

ESTABLISHMENT OF OPTIMUM-ROLLING PATTERN

Roller No. 1

Type _____

	Density, pcf	% Density	Temp, °F
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Optimum No. Passes _____

Surface Temp Range _____

Roller No. 2

Type _____

	Density, pcf	% Density	Temp, °F
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Optimum No. Passes _____

Surface Temp Range _____

Roller No. 3

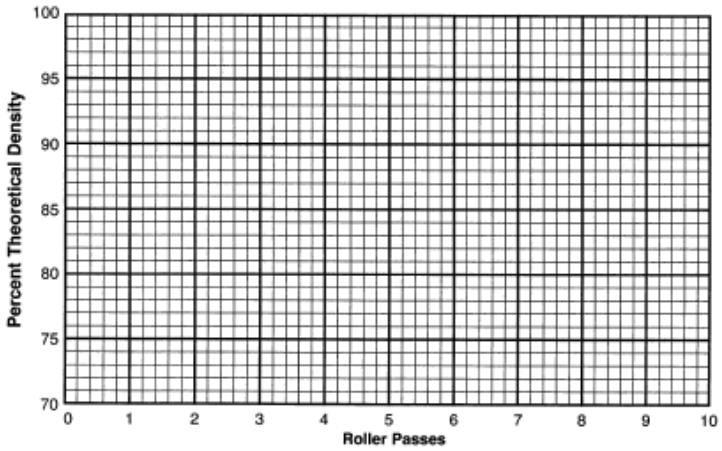
Type _____

	Density, pcf	% Density	Temp, °F
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Optimum No. Passes _____

Surface Temp Range _____

OPTIMUM-ROLLING PATTERN GROWTH CURVE



SUMMARY OF OPTIMUM-ROLLING PATTERN DENSITY

	Location	Offset	Density
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

TARGET DENSITY _____

Each roller should make at least three (3) passes, and compaction with each roller shall continue until the increase of three (3) successive readings is ≤ 3.0 pcf. The optimum number of passes will be either the 2nd or 3rd pass from the three (3) successive readings with the greatest increase in compaction. If a decompaction reading is obtained, the previous pass will be the optimum number of passes for that roller. Then, proceed to the next roller or temperature range.

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Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 428
March 2019
14 Pages

ASSET MANAGEMENT DIVISION

Method of Test for

MEASURING PAVEMENT PROFILE USING A LIGHT WEIGHT PROFILER

1. SCOPE

1.1 This test method covers the measurement of pavement profile and roughness using a Light Weight Profiler by driving the profiler longitudinally over the pavement.

1.2 This test method covers the determination of the pavement ride quality from the longitudinal profile, in the form of the International Roughness Index (IRI), for acceptance and payment.

1.3 This test method covers the calibration verification procedures and it outlines the procedures for collecting Light Weight Profiler data on paving projects.

1.4 This test method covers the submission requirements for projects with a ride quality specification.

2. REFERENCED DOCUMENTS

2.1 NCHRP Report 228, Calibration of Response-Type Road Roughness Measuring Systems

2.2 ASTM Standards

2.2.1 E950/E950M, Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer-Established Inertial Profiling Reference

2.2.2 E1926, Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements

2.2.3 E2560, Standard Specification for Data Format for Pavement Profile

2.3 AASHTO Standards

2.3.1 R 56, Standard Practice for Certification of Inertial Profiling Systems

2.3.2 R 57, Standard Practice for Operating Inertial Profiling Systems

2.4 PennDOT Publications and Forms

2.4.1 Publication 408, Specifications

2.4.2 Publication 589, Light Weight Profiling System Calibration Verification and Operator Certification Program Manual

2.4.3 Publication 2, Project Office Manual, Section B.6.23, Verification Process for Ride Quality of Newly Constructed Pavements

2.4.4 Form M-7, Contractor IRI Data Collection Form

3. TERMINOLOGY - DESCRIPTION OF TERMS SPECIFIC TO THIS PTM

3.1 International Roughness Index (IRI) - A scale for roughness based on the response of a generic motor vehicle to roughness of the road surface. IRI was developed as a reference measure by The World Bank, and is based on a quarter-car simulation as described in NCHRP Report 228. IRI is determined by obtaining a suitably accurate measurement of the profile of the road, processing it through an algorithm that simulates the way a reference vehicle would respond to the roughness inputs, and accumulating the suspension travel.

3.2 Excluded Area - An area that is not included in the measurement, used to determine lot payment.

3.3 Light Weight Profiler System (LWP) - An inertial profiler that is relatively lightweight (golf cart, ATV, etc.) compared with high-speed profilers. It is often operated much more slowly than prevailing traffic speed.

3.4 Raw (Unfiltered) Binary Data – Inertial profiler output files that have not been filtered and are saved in binary, encrypted form. Profiler manufacturers use various file extensions to save the profile, speed and elevation data which are required for the data to be reprocessed as the user needs. Refer to your profiler's manufacturer for questions regarding your equipment's raw binary output files.

3.4.1 Engineering Research Division (ERD) – A file format developed within the Engineering Research Division of the University of Michigan Transportation Research Institute (UMTRI). ERD is the standard file format used by ProVAL, an engineering software application that allows users to view and analyze longitudinal pavement profiles.

3.4.2 Pavement Profile Standard File Format (PPF) – A binary based file format created for ProVAL, an engineering software application that allows users to view and analyze longitudinal pavement profiles. The ASTM International profile data file specification, E2560, is based on this format.

4. APPARATUS

4.1 The Light Weight Profiling System must be an all-terrain or golf-cart type vehicle equipped with various hardware and software that together allow the measurement and recording of the longitudinal profile of a traveled wheel track and the reference distance traveled along the traveled wheel track.

4.2 The equipment and software will produce an IRI in English units (inches/mile) for 0.10 mile intervals conforming to ASTM E1926 and meet the requirements of Appendix A, Generic Specification for Light Weight Profiling System.

4.3 Must be certified for use on PennDOT projects described in Section 6.

5. REPAIR AND ADJUSTMENT OF LIGHT WEIGHT PROFILER

5.1 Major component repairs or replacement that would require recertification of the inertial profiler include, but are not limited to, the following:

5.1.1 the accelerometer and its associated hardware,

5.1.2 the non-contact height sensor and its associated hardware,

5.1.3 the distance measuring instrument, or

5.1.4 any printed circuit board necessary for the collection and processing of raw sensor data of the LWP and IRI.

6. ACCEPTANCE

6.1 This section provides minimum certification requirements for LWP devices and operators.

6.1.1 Prior to testing, the LWP device will be checked to verify that it has been calibrated and is operating properly.

6.1.1.1 Verification/certification will be done in accordance with Publication 589.

6.1.1.2 Accepted profilers are designated with a decal that is valid until June 30 of the following calendar year provided no changes are made to the equipment or software. The decal must adhere to the outside of the LWP in clear view.

6.1.1.3 Additional reverification/recertification of profilers or operators may be required, due to repairs, replacements, and/or upgrades to the profiler's hardware or software, or questionable results and/or practices on a construction project.

6.1.2 The LWP operator must be certified. Certified operators will receive individual certification cards that are valid for up to three calendar years.

6.1.3 The operator of a certified LWP must use the same software version and settings on PennDOT projects that were used during the profiler certification. A copy of these settings may be obtained by contacting the Roadway Inventory and Testing Unit or by viewing the Roadway Inventory and Testing Unit's website at http://www.penndot.gov/ProjectAndPrograms/ResearchandTesting/RoadwayManagementandTesting/Pages/Light-Weight-Profiler-Certifications.aspx#.VmsrSqMo670.

6.1.4 Changes to the software version may result in the need for reverification or recertification of the profiler.

7. PROJECT SITE VERIFICATION

7.1 The Department shall certify all light weight profilers and operators prior to testing.

7.2 The Project Engineer (or designee) will approve the operator and equipment for project level testing by verifying the equipment and software information on the PennDOT issued decal and by verifying the operator has a current PennDOT issued certification card. The operator and equipment information shall be documented by the Project Engineer (or designee) on the Form M-7. A list of approved contractor operators and approved equipment is posted on the Bureau of Maintenance and Operations, Asset Management Division, Pavement Testing and Asset Management Section, Roadway Inventory and Testing Unit's webpage.

7.3 The following daily verification procedure is required for all testing. Although the specific steps to complete the verifications will vary in accordance with the manufacturer's recommendations, the basic procedures will not change. The results of the verification checks shall be documented in a log. The Project Engineer (or designee) shall verify the profiler meets the following requirements:

7.3.1 Longitudinal Verification (Distance)

7.3.1.1 The longitudinal calibration will be a straight roadway test section at least 528 feet in length. This distance shall be measured accurately within ± 0.1% using a steel measurement tape or electronic measuring device.

7.3.1.2 Verify the tire air pressure on the wheels of the apparatus daily and maintain per the vehicle manufacturer's recommendations.

7.3.1.3 Warm up the LWP's tires and electronic systems in accordance with the manufacturer's recommendations.

7.3.1.4 If the LWP's distance measuring subsystem measures the length of the test section to within 0.1% of its actual length, no additional verification is necessary.

7.3.1.5 If the LWP's distance measuring subsystem fails to measure the length of the test section to within 0.1% of its actual length, the calibration shall be adjusted according to the manufacturer's guidelines and the longitudinal verification repeated.

7.3.1.6 No more than one single certified operator is to occupy the profiler during verification/calibration.

7.3.1.7 If the LWP fails to meet these requirements, the LWP will be deemed to be not certified and prohibited from use on PennDOT projects until it is recertified.

7.3.1.8 A printed copy of the distance calibration must be submitted to the PennDOT representative each day prior to taking any measurements.

7.3.2 Laser Height Verification (Block Test)

7.3.2.1 Laser height verification must be performed in accordance with AASHTO R 57-14 or the manufacturer's recommended procedures each day the LWP device is in use.

7.3.2.2 The block sensor tests are run after the profiler has reached operational stability as defined and specified by the manufacturer. This test should be performed on a flat level area. Its purpose is to check the height measurements, in inches, from the height sensor(s) of the LWP using blocks of known heights. During the test, do not lean on the LWP or cause it to move in any way. At a minimum, two base plate and three varying measurement plate (typically 0.25, 0.5 and 1 inch) readings will be needed. The absolute difference should be less than or equal to 0.01 inch for each gauge block.

7.3.2.2.1. Center the base plate under the height sensor of the LWP and allow the system to take height measurements.

7.3.2.2.2. Center a 0.25-inch block underneath the height sensor on top of the base plate and record the height measurement.

7.3.2.2.3. Replace the 0.25-inch block from the base plate with a 0.50-inch block and record the height measurement.

7.3.2.2.4. Replace the 0.50-inch block from the base plate with a 1.0-inch block and record the height measurement.

7.3.2.2.5. Remove the 1.0-inch block leaving only the base plate and record the height measurement. The profiler's height measurement subsystem returns to zero.

7.3.2.2.6. If the tests fail to meet these requirements, the LWP will be deemed to be not certified and prohibited from use on PennDOT projects until it is recertified.

7.3.2.2.7. A printed copy of the laser height verification results must be submitted to the PennDOT representative each day prior to taking any measurements.

7.3.3 Vertical Verification (Bounce Test)

7.3.3.1 A bounce test in accordance with AASHTO R 57-14 or manufacturer's equivalent must be performed each day the LWP device is in use, prior to taking any measurements.

7.3.3.2 With the base plates in position simultaneously under both wheel path sensors, place the LWP in an operating mode that simulates longitudinal movement and initiate profile data collection. Allow the profiler to collect a minimum of 828 feet (includes a 300-foot lead-in) of static profile with the LWP as motionless as possible.

7.3.3.3 Sensor(s) should be moved vertically for a total displacement of approximately 1 to 2 inches keeping the sensors as close to perpendicular to the surface as possible during this movement. The bouncing must continue until a minimum of 528 feet of simulated distance has been traveled.

7.3.3.4 After a minimum of 528 feet of bounce profile is collected, allow the profiler to collect an additional minimum of 828 feet (includes a 300-foot lead-out) of static profile with the LWP as motionless as possible.

7.3.3.5 When reviewing the analysis results, the first and last (static) 528-foot segments shall not exceed 3 inches per mile, while the IRI for the middle (bouncing) segment shall not exceed 8 inches per mile for the bounce test. If the computed IRI values exceed 3 inches per mile for the static test and/or exceed 8 inches per mile for the bounce test, then the manufacturer's recommendations for performing sensor operational checks shall be followed. The static bounce test shall be repeated.

7.3.3.6 If the tests fail to meet these requirements, the LWP will be deemed to be not certified and prohibited from use on PennDOT projects until it is recertified.

7.3.3.7 A printed copy of the bounce test results must be submitted to the PennDOT representative each day prior to taking any measurements.

7.3.4 Accelerometer Verification

7.3.4.1 Accelerometer verification must be performed in accordance with the manufacturer's recommended procedures each day the LWP device is in use, prior to taking any measurements. The tolerance for the accelerometer verification must meet the manufacturer's requirements.

7.4 The operator will check that all sensor positions are displaying correctly, and verify that sensor collection rates are properly set. All such constants or factors must be automatically set and stored during calibration/verification procedures.

7.5 A calibration verification log, in accordance with AASHTO R 56, is to be kept with the inertial profiler to provide a verification of calibration history. The results of the routine bounce tests, block checks, accelerometer and distance verification runs shall also be included in this log. If the log is electronic, a backup copy shall be kept in a secure location.

8. PROCEDURE

8.1 Startup and initialization.

8.1.1 Clean the roadway path of all debris and other loose material before measuring.

8.1.2 Perform all necessary start up procedures.

8.1.3 Verify that distance measurement, sensors, and accelerometers are properly calibrated. Perform all necessary calibration procedures, as specified in Section 7, and as per equipment manufacturer procedures. Save all values.

8.1.4 Check that all sensor positions are displaying correctly, and verify that sensor collection rates are properly set.

8.1.5 Enter the location identification information (all data collected must have this information printed on all output files), and define the direction of traffic for the pavement to be tested.

8.1.6 Collect measurements in the direction of traffic. When using a LWP that collects a single wheel path per pass, take care to ensure that the measurements from each wheel path in a travel lane start and stop at the same longitudinal locations.

8.2 Sampling

8.2.1 Pavement profiles must be taken in the wheel paths of each lane. The first profile must be approximately 3 feet from and parallel to the outside edge of pavement, and the second profile must be approximately 5.75 feet from the first profile, or as directed by the Project Engineer.

8.2.2 Measure profiles to the limits of the pavement areas, as specified. As per Publication 408, sampling areas must be designated as lots, and excluded areas must be defined and measured separately (measure profiles of the excluded areas to their limits).

8.2.3 Only a single certified operator is to occupy the profiler during sampling. The weight of additional passengers, including Department personnel, may adversely affect results and is not permissible.

8.3 Data collection

8.3.1 Position the LWP to a point where the testing speed can be reached before testing begins. A 100-foot lead-in section of roadway is required to eliminate all error through filtering in the program that processes the data. This lead-in section should be located immediately before the section of pavement being tested. When this is not possible, then crop the beginning of the run until the LWP has reached testing speed and the systems have had a chance to stabilize, or add a minimum of 100-foot lead-in and/or lead-out through the report program to account for speed adjustments and system stabilization.

8.3.2 Verify that all software and hardware is ready to collect data. Start the data collection system.

8.3.3 The LWP shall remain stationary for approximately 1 minute for the system filters to stabilize.

8.3.4 Start the LWP moving and initiate testing when the LWP reaches testing speed.

8.3.5 If targeting is used, allow the target to reset the system at test start and finish.

8.3.6 Continue testing at a consistent speed until the test end point is passed. A lead-out may be used in accordance with the profiler manufacturer's operating requirements.

8.3.7 Terminate the test after the test end point is passed, or allow targeting to terminate the test.

8.3.8 End data collection and save the file. It is recommended to save all data, and then delete unwanted data later, rather than abort the file save mode.

8.3.9 If applicable, mark where the total file may be broken into smaller files for analysis.

8.3.10 Upon completion of a sampling path, make ending notations and review the test for reasonableness. Repeat the procedure, driving the LWP in the same direction for successive sampling paths for a given section of pavement. Test each sampling path only once. Additional profiles may be taken to define the limits of an out-of-tolerance surface variation.

8.3.11 Measure IRI for excluded areas separately.

9. WEATHER LIMITATIONS

9.1 Collect data only when the temperature and weather conditions are within the operating range recommended by the manufacturer of the light weight profiler.

9.2 Data collection is not permitted during precipitation.

9.3 Data collection is not permitted when standing water is present on the pavement.

10. SUBMITTALS

10.1 All test results shall be reported in English units (inches/mile).

10.2 Test values shall be reported to one digit to the right of the decimal in accordance with conventional rounding procedures.

10.3 Provide a summary printout of the IRI value calculated for each pass as generated by the equipment performing the test, within 24 hours of the conclusion of each test. IRI shall be calculated using a quarter-car simulation as outlined in NCHRP Report 228.

10.4 As a minimum, the following information must be printed from the inertial profiler for the interpreted output:

10.4.1 Date and time of day

10.4.2 Operator and equipment identification

10.4.3 Weather conditions: temperature, cloud cover, and wind

10.4.4 Surface description: type of pavement and condition

10.4.5 Location and description of section: Job ID, lot, lane, wheel path, beginning and ending stationing, and direction measured

10.4.6 Lot length

10.4.7 Software version: both the LWP and the reporting software

10.4.8 Data filter settings

10.4.9 High-pass filter setting = 100 feet

10.4.10 Lot IRI value: the average of the IRI values for the two wheel paths for each lot will be the IRI for the lot

10.4.11 IRI values for excluded areas

10.5 Supply the necessary raw (unfiltered) binary data files, PennDOT Form M-7, and a copy of the operator's certification card for all projects. Provide a USB flash drive or CD that contains the raw (unfiltered) binary data for each wheel path, so that PennDOT may perform verification analysis. Each pass shall be clearly labeled to include county, state route, project number, lot number, and wheel path. The data file must be in ERD or PPF format.

APPENDIX A

GENERIC SPECIFICATION FOR LIGHT WEIGHT PROFILING SYSTEM

The purpose of this specification is to define the requirements for a Light Weight Profiling (LWP) System that can be used to collect roadway surface data for determining the roughness and profile of roads. The following items are required:

1. The computer-based system, with its profile sensing system described must be capable of the following:

    (1) interfacing with the operator

    (2) controlling the tests

    (3) measuring the necessary resultant test signal data

    (4) recording the resultant test data on USB flash memory drive, Compact Disc (CD) or Digital Versatile Disc (DVD)

    (5) calculating and storing profile, roughness, and distance values

    (6) displaying the stored data

    (7) printing the stored data upon operator request

2. The LWP operational system must be an all-terrain or golf-cart type vehicle equipped with various hardware and software that together allows the measurement and recording of the longitudinal profile of a traveled wheel track and the reference distance traveled along the traveled wheel track. The longitudinal profile must be measured using a concept where three transducers are used. These transducers include:

    (1) non-contact height measurement (sensor) subsystems, capable of measuring the height from the mounted sensor face to the surface of the pavement under test.

    (2) an inertial reference (accelerometer) subsystem, capable of measuring the movement of the LWP vehicle as it traverses the pavement under test.

    (3) a distance measuring subsystem which provides a reference measurement of the vehicle as it traverses the pavement, verified accurate to within 1 foot per 0.20 mile of actual distance traveled.

3. The data must be saved and recorded so that road profiles obtained with this system must be independent of the measuring speed and the type of vehicle used. The LWP must:

    (1) include hardware and software capable of producing and storing inertial profiles by combining the data from the inertial referencing subsystem, the distance subsystem, and the height measurement subsystem.

(2) be capable of measuring and storing profile elevations at 1-inch intervals or less and outputting in ERD or PPF format.

(3) have the capability of summarizing the profile elevation data into summary roughness statistics over a section length equal to 0.1 mile (the summary roughness statistic is the International Roughness Index (IRI) for each longitudinal path profiled). In addition, profile plots must be capable of being displayed and printed during post processing.

(4) have design to allow field calibration and verification of calibration for the distance measurement (horizontal) subsystem and the height measurement (vertical) subsystem as required by agency standards.

4. The roughness value must be calculated using the standardized International Roughness Index (IRI). In addition to the normal IRI unit value the system must also provide an "inches/mile" statistic. The IRI was developed as a reference measure by The World Bank, and is based on a quarter-car simulation as described in NCHRP Report 228. This value must conform to the requirements of ASTM E950/E950M. IRI measures obtained from this system must match those obtained from other valid profilometers, and also IRI measures obtained using agency approved ground truth devices. A plot of roughness using any base length for averaging must also be reproducible. The above roughness results must be displayable on the system screen, printed on a printer or written into an electronic file format for processing.

5. The profile system hardware and software for collecting and processing the data obtained in real time in conjunction with the post processing software must have as a minimum the following capabilities:

   (1) profile computation

   (2) IRI computation

   (3) high-pass filtering

   (4) low-pass filtering (smoothing)

   (5) height sensor error checking

6. The system must be capable of calculating, displaying, and storing the average roughness value obtained from the stored data. Additionally, the system must be capable of putting the accumulated roughness test results through mathematical equations and printing results when enabled by the operator. These options must be done in real time or in post processing. The system must be capable of performing all required post processing operations.

7. The test software must activate the testing using the timing and control parameters stored by the test control setup software.

   (1) The operational system through the Distance/Data Acquisition Subsystem (DAS) must provide all interfaces to collect data to derive distance, speed, and profile from the transducers mounted on the vehicle; activate the tests; derive distance and location information from the transmission mounted distance transducer; process operator inputs from the keyboard signaling that the test vehicle has encountered a significant

feature; and pass information on about the feature and its location to the processing unit for display and logging.

(2) The software must monitor the signals to verify that the testing is being performed properly and indicate detectable errors.

(3) The test software must receive, display, and store raw data received from the vehicle mounted transducers at corresponding distances and test speeds.

8. An optical encoder must be mounted on the vehicle to produce a pulse for units of distance traveled by the vehicle on the roadway. The DAS must accept these pulses and, in combination with the DAS software, must determine the distance traveled and vehicle speed.

9. The operational system software must allow the operator to perform a distance sensor calibration and use the calculated Distance Calibration Factor (DCF) to perform the operational distance measurements. The calibration software must also allow the operator to save the calculated DCF. The operator must only enter the distance traveled in feet, meters, kilometers, or miles and not make any calculations to determine the DCF. Five feet per mile (or 1 foot per 0.20 mile), accuracy is required.

    (1) The calibration software must also allow the operator to perform a profile system calibration. The values determined in calibration must be stored and recorded as above for use in the calculation.

10. The reference height of the vehicle above the pavement must be obtained through a laser or infrared module as required. The sensor must be totally enclosed in a case that may be sealed during bad weather or when not in use. The sensor must be formed in a manner so that it may be mounted on a vehicle approximately 1 foot above the pavement surface. The laser or infrared module shall be equivalent to a Selcom sensor, which has a resolution of 0.001 inch. The sensor must provide continuous coverage of the roadway. The sensor module must send an infrared beam to the pavement and sample the height value at a rate of 16,000 times per second. The sample data must be averaged and stored referenced to time and/or distance so that the data may be processed into transverse profile data or aligned with the accelerometer data to provide a longitudinal profile.

11. The displacement of the vehicle in the vertical direction used to calculate position shall be sensed using an accelerometer. The DAS must provide hardware and software to amplify and filter/integrate the signal as required to obtain the data required for storage and for further post processing of the required data.

12. The vehicle will be equipped with infrared sensors to allow the operational system to perform system functions (start test, end test, reset DMI value, etc.) without operator intervention when using roadside targets.

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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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Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 729
October 2013
14 Pages

LABORATORY TESTING SECTION

Method of Test for

SAMPLING ROADWAY BITUMINOUS CONCRETE

1. SCOPE

1.1 This method covers the procedure for sampling of bituminous paving mixtures taken from the finished pavement for determination of the characteristics of the compacted mixture. Alternative methods of sampling may be found in AASHTO T- 230.

CORING OF BITUMINOUS CONCRETE

2. EQUIPMENT

2.1 Powered core drill, water cooled, equipped to core cylindrical samples.

2.2 Diamond drill bit of six (6) inch size.

2.3 Incidental materials and equipment.

2.4 Hand-held core sample extraction tool capable of grasping and removing a drilled cylindrical pavement core sample from the pavement without damage to the core sample.

2.5 A rigid plate or a suitable container large enough to hold the sample without distortion after it is removed from the pavement.

2.6 Masking tape

2.7 A marking pencil or lumber crayon.

3. SELECTION OF ACCEPTANCE SAMPLES

3.1 Density acceptance of the bituminous mixture from the roadway shall be on the basis of test results from consecutive probability samples for each Lot. One probability sample shall be taken from each Sublot. Samples are to be selected by means of a stratified random sampling plan. Refer to Illustrative Examples No. 1 & No. 2 in the Appendix of PTM No. 746 for examples of how to select samples using a stratified random sampling plan for pavement courses. Density acceptance samples must be cross referenced to a corresponding mixture acceptance sample on Form TR-447.

3.2 The testable sampling width is determined by taking the nominal paving width and subtracting one (1) foot from each edge (supported and/or unsupported edges). Refer to Illustrative Example No. 1 in the Appendix of this PTM.

3.3 Areas within one (1) foot from the edge of obstructions to normal paving such as manhole covers, inlets, and utility valve covers are considered non-testable areas for core sampling. When a sample location falls within a non-testable area, adjust the location of the core sample longitudinally in the direction of paving to a location at the edge of the non-testable area. Refer to Illustrative Example No. 2 in the Appendix of this PTM.

4. SELECTION OF LONGITUDINAL JOINT INCENTIVE/DISINCENTIVE SAMPLES

4.1 Incentive/Disincentive samples shall be taken on the basis of consecutive probability samples for each Lot. Lots shall be established as specified in Pub. 408, Section 405. One probability sample shall be taken from each Sublot. Samples are to be selected by means of a stratified random sampling plan. Refer to Illustrative Example No. 3 in the Appendix of this PTM for an example of how to select samples using a stratified random sampling plan. Each joint core will be comprised of portions of two lanes, with the potential for two different JMFs within each core. All cores within a lot having the same JMF combination shall be included on one TR-447 (except work stoppages of greater than five (5) days which will require the first portion of the lot to be included on one TR-447 with the remaining portion of the lot to be included on a second form when work continues). The theoretical maximum specific gravity value to place on Form TR-447 will be the overall average of each core's average value. Sublots with different JMF combinations or work stoppages of more than five (5) days will require a separate Form TR-447. Refer to Illustrative Example No. 4 in the Appendix of this PTM for an example of how to evaluate JMF combinations and arrive at the proper theoretical maximum specific gravity.

4.2 A core sample taken from a longitudinal vertical joint shall be centered on the line where the joint between the two adjacent lifts abut at the surface as illustrated on the next page. The center of all vertical joint cores shall be within one (1) inch of this joint line. A core sample taken from a longitudinal notched wedge joint shall be centered six (6) inches or one-half the width of the joint taper away from the joint line in the direction of the wedge as illustrated on the next page. When the two lanes forming the longitudinal joint have daily theoretical maximum specific gravity values differing by more than 0.050, examine each longitudinal joint core sample to ensure that approximately one-half of the longitudinal joint core sample is from each lane. If the materials in the longitudinal joint core are unbalanced, adjust the location of the core drill relative to the joint line to ensure approximately equal material. Take a replacement sample at a location within twelve (12) inches longitudinally of the original sample location.

Vertical Joint

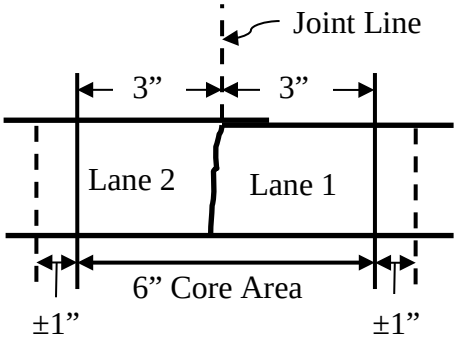


Figure not to scale

Notched Wedge Joint

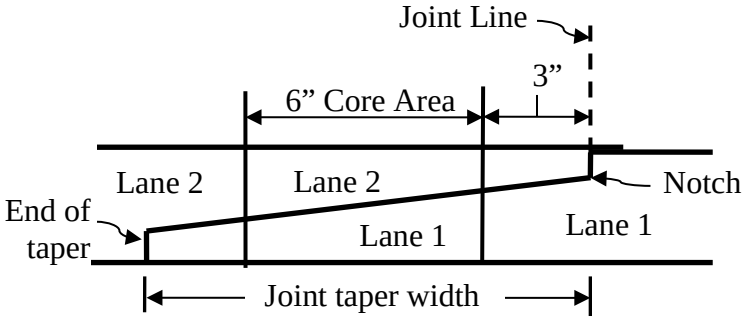


Figure not to scale

5. PROCEDURE

5.1 In the presence of the Department Representative, core and identify the density acceptance samples as specified in Pub. 408, Section 409.

5.1.1 With the powered core drill, drill core samples to the specified diameter and to a depth sufficiently below the depth of the pavement course to be sampled. Ensure sufficient water is dispersed through the core drill during drilling to keep the drill bit and core sample cool enough to prevent damage to the bit and sample. Carefully and slowly lower the drill bit to the surface of the pavement course at the start of drilling to prevent the drill bit from moving and to obtain a smooth clean initial drill cut at the surface of the core sample. After drilling to a sufficient depth, carefully raise the core drill bit to prevent any damage to the core sample.

5.1.2 Carefully dislodge or break the core sample away from the underlying pavement layer. Do not distort, bend, crack, damage or physically change the physical condition of the core sample during this operation.

5.1.3 Using a hand-held core sample extraction tool, carefully grasp and remove the core sample from the pavement. Do not distort, bend, crack, damage or physically change the physical condition of the core sample during removal from the pavement.

5.1.4 Immediately after removing the core sample from the pavement, wash off the core sample with water to remove the fine material generated from the drilling operation. Air dry or towel dry the core sample sufficiently to allow identification of the Lot and Sublot number on each core sample by using a marking pencil or lumber crayon.

5.1.5 If a core sample includes materials other than the material or pavement course to be tested, clearly show and mark with a marking pencil or lumber crayon the section(s) of each core sample to be discarded. Core samples suspected of including more than one material and not clearly showing the section to test, and the section(s) to discard, will be considered non-conforming samples and will not be tested by the Laboratory Testing Section (LTS) until the section to test is identified.

5.2 Once the core sample has been obtained and identified as outlined in Section 5.1, the Department Representative will take immediate possession of the core sample and store it in a proper environment while awaiting packaging and delivery. Overheating or impact can damage core samples and prevent accurate test results.

5.3 After the Lot is completed or has been terminated, the Department Representative will perform the following:

5.3.1 Complete a Form TR-447 for proper Lot identification. In the event that both 9.5 mm and 12.5 mm materials are incorporated in the same joint cores, use the 12.5mm mix to identify the material class.

5.3.2 Place the appropriate Bar Code Sticker from Form TR-447 on each core sample (Bar Code Sticker Axxxxxx-1 on the core sample for Sublot 1, etc.). For core samples identifying materials other than the material or pavement course to be tested as outlined in Section 5.1.5, place the appropriate Bar Code Sticker from Form TR-447 on the section of each core sample to be tested.

5.3.3 Package the pavement cores in a suitable container.

5.3.3.1 Plastic concrete cylinder molds have proven to be satisfactory and convenient containers for shipping core samples. Core samples placed in plastic concrete cylinder molds shall be cushioned /separated with crumpled newspaper. If other containers are used, such as, 6-inch diameter PVC plastic pipes, they shall not exceed 24 inches in length and shall not weigh more than 50 lbs. when packaged with core samples. Place an unused bar code sticker from Form TR-447 on the outside of all containers.

5.3.3.2 Secure the ends of the core sample containers with masking tape.

5.3.4 Deliver the core samples to a Department pick-up point within three (3) days for shipment to the LTS.

APPENDIX

Illustrative Example No. 1 – Adjustment for Edges

Using the parameters of Illustrative Example No. 2 in the Appendix of PTM No. 746, for a normal Lot of 2,500 tons with five (5) Sublots of 500 tons each, the following sampling plan was developed for density core samples. The Lot length is 22,727 ft. and the Sublot length is 4,545.4 ft. This example is for a 12 ft. lane width placed next to a previously placed lane. Therefore, there is one supported edge at the centerline longitudinal joint and one unsupported edge longitudinally at the shoulder joint.

A typical random plan would be similar to the following:

The testable sampling width would be:
12 ft. - 1 ft. (supported Left edge) - 1 ft. (unsupported Right edge) = 10 ft.

RANDOM NUMBER			LENGTH	WIDTH OF PAVEMENT
	X	Y	X	Y
#17	.08	.70L	.08 x 4545.4 ft. = 364 ft.	.70 (10 ft.) = 7.00 ft. L
#18	.67	.68L	.67 x 4545.4 ft. = 3045 ft.	.68 (10 ft.) = 6.80 ft. L
#19	.83	.97R	.83 x 4545.4 ft. = 3773 ft.	.97 (10 ft.) = 9.70 ft. R
#20	.54	.58R	.54 x 4545.4 ft. = 2455 ft.	.58 (10 ft.) = 5.80 ft. R
#21	.82	.50R	.82 x 4545.4 ft. = 3727 ft.	.50 (10 ft.) = 5.00 ft. R

Note: The “X” value equals the station
The “Y” value has been corrected for the non-testable edge conditions

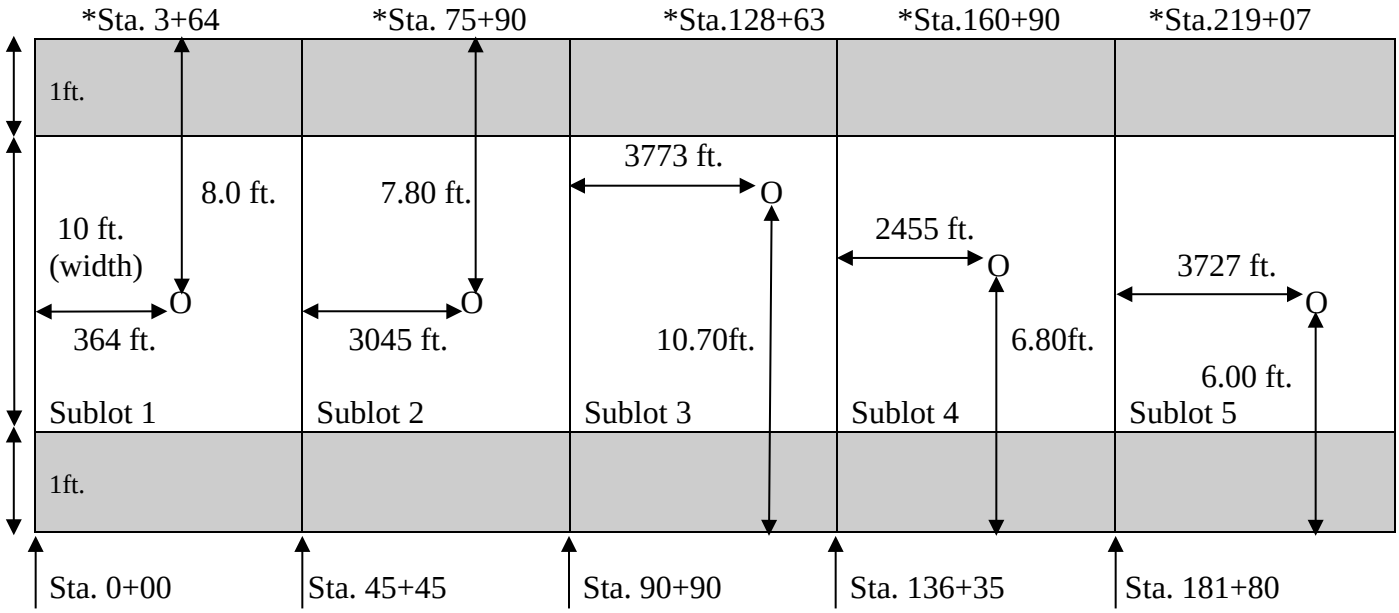
The sampling for the Lot (22,727 ft. in length) would be:

Sta. 3+64 7.00 ft. from lt. edge + 1 ft. for supported edge = 8.00 ft. from lt. edge of lane
Sta. 75+90 6.80 ft. from lt. edge + 1 ft. for supported edge = 7.80 ft. from lt. edge of lane
Sta. 128+63 9.70 ft. from rt. edge + 1 ft. for unsupported edge = 10.70 ft. from rt. edge of lane
Sta. 160+90 5.80 ft. from rt. edge + 1 ft. for unsupported edge = 6.80 ft. from the rt. edge of lane
Sta. 219+07 5.00 ft. from rt. edge + 1 ft. for unsupported edge = 6.00 ft. from the rt. edge of lane

*Note: Refer to Illustrative Example No. 2 in the Appendix of PTM No. 746 for the beginning and ending stations of the Lot and each Sublot. Each density acceptance sample must have a corresponding mixture acceptance sample.

Illustrative Example No. 1: Adjustment for Edges (continued)

Centerline Longitudinal Joint (supported edge)

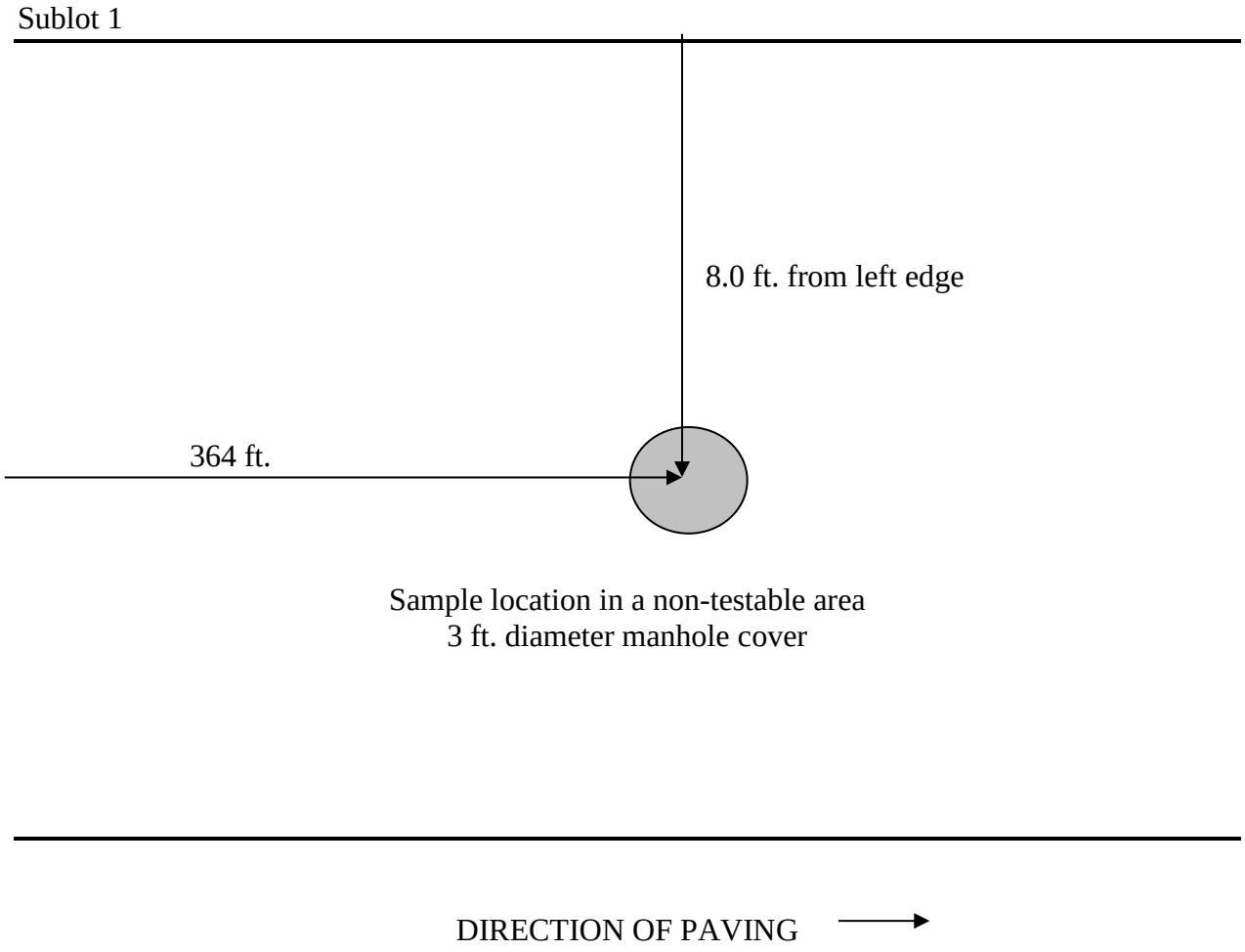


Shoulder Joint (unsupported edge)

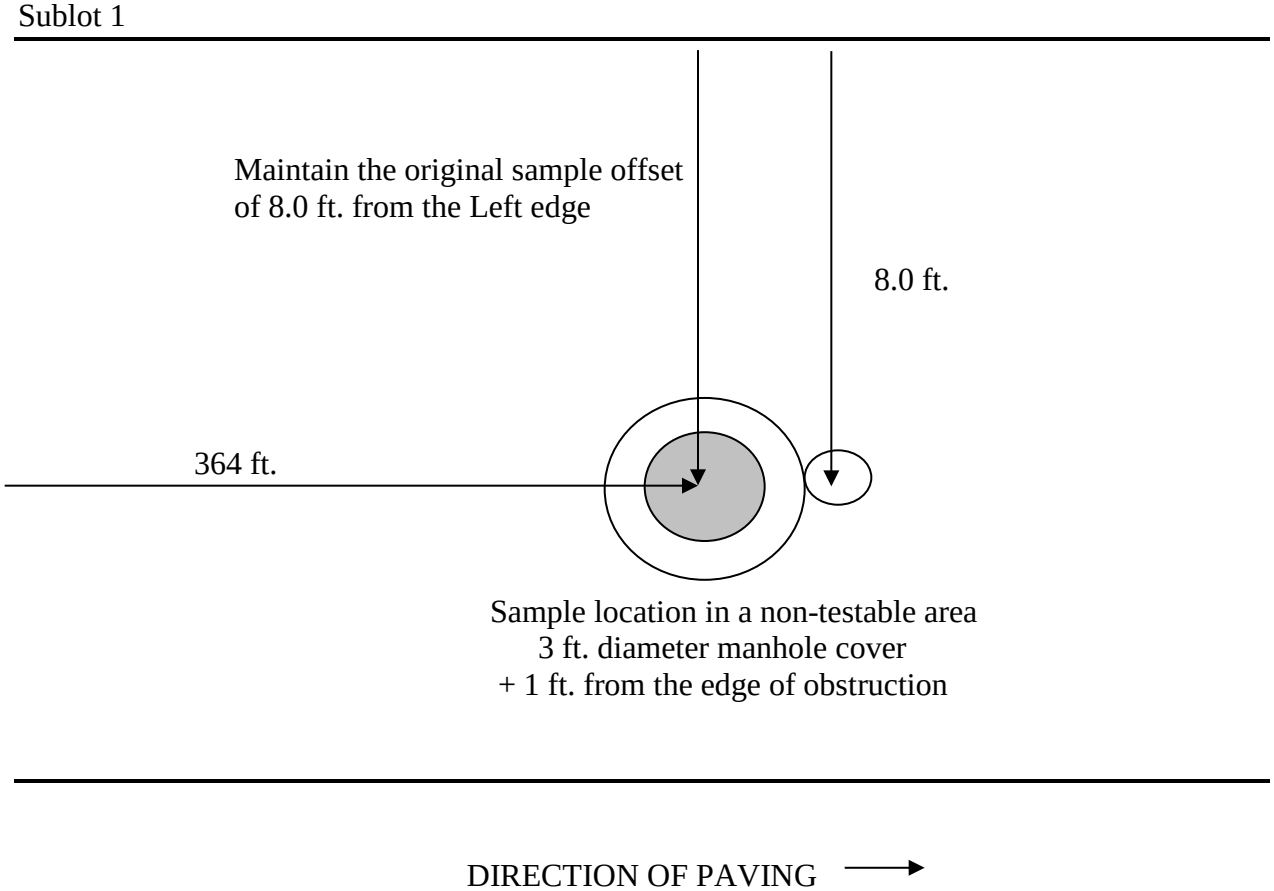
DIRECTION OF PAVING ⟶

Note: Drawing not to scale

Illustrative Example No. 2: Adjustments for Obstructions



Illustrative Example No. 2: Adjustments for Obstructions (continued)



Note: Maintain the original transverse co-ordinate of the sample. In this illustration the transverse co-ordinate of 8.0 ft. from the Left edge is maintained. The longitudinal co-ordinate is adjusted in the direction of paving to a location just outside the non-testable area (refer to Section 3.3 for the definition of non-testable areas). If the adjusted location also falls into another non-testable area or outside the sublot, move the core back longitudinally to the other side of the obstruction.

Illustrative Example No. 3: Longitudinal Joint Samples

A paving project 21,000 feet in length for a two lane roadway consists of four paving lanes on the surface course (left and right shoulders, left and right travel lanes). The density for all four paving mats is being accepted via pavement cores. This results in three eligible longitudinal joints for joint pavement cores.

Example Pavement Project Information

Length of Project Paving	21,000	linear feet
Number of Eligible Joints	3	(2 shoulder joints, 1 centerline joint)
No. of Lots at 12,500 linear feet	5	(21,000 ft. x 3 joints /12,500 ft. per lot)
No. of Sublots in each Lot	5	(potentially 6 for the final lot)
Length of each Sublot	2,500	linear ft. (last sublot varies in length)

Lot and Sublot Determination

Lots are determined as paving progresses. Select at random a series of five (5) consecutive numbers from PTM No. 1, Table 1 for the first Lot. Multiply the length of each Sublot by the two place decimal value "X" to obtain the sample location within that Sublot.

RANDOM NUMBER			LINEAR FEET BY SUBLOT
	X	Y	
#47	.93	N/A	.93(2,500 ft.) = 2,325 ft.
#48	.43	N/A	.43(2,500 ft.) = 1,075 ft.
#49	.99	N/A	.99(2,500 ft.) = 2,475 ft.
#50	.61	N/A	.61(2,500 ft.) = 1,525 ft.
#51	.87	N/A	.87(2,500 ft.) = 2,175 ft.

The sampling sequence for the Lot (12,500 linear feet) shall be:

Sublot 1	2,325 = Sta.	23+25
Sublot 2	2,500 + 1,075 = Sta.	35+75
Sublot 3	5,000 + 2,475 = Sta.	74+75
Sublot 4	7,500 + 1,525 = Sta.	90+25
Sublot 5	10,000 + 2,175 = Sta.	121+75

1. Core samples shall be cut at the above stations to obtain the five (5) Sublot samples for calculating the incentive/disincentive value for Lot 1.

2. Repeat the same operation for Lots 2 through 5 using other randomly selected starting points for numbers under Column X.

Illustrative Example No. 3: Longitudinal Joint Samples (continued)

3. Calculate the sample for the final anticipated Sublot, use a length of 2,500 linear feet and multiply by the random number. If the resulting sample location falls beyond the actual length of joint, then the Sublot will not be counted and no sample will be taken. If the sample location falls within the actual length of joint, then the sample will be taken and the Sublot will be added to the final Lot.

Based on the sketch on the next page, since the centerline joint was the first joint paved, Lot 1 will come from the centerline joint. Each Lot will follow as paving progresses thereafter, consisting of 12,500 feet per Lot.

Final Lot Determinations:

1. The length of the final Lot shall be adjusted to ensure that the final Lot has between three and seven Sublots. In this example the final joint, Lot 5, shall be 13,000 linear feet as shown.

   21,000 LF x 3 joints = 63,000 LF total 63,000 LF – (4 x 12,500 LF) = 13,000 LF

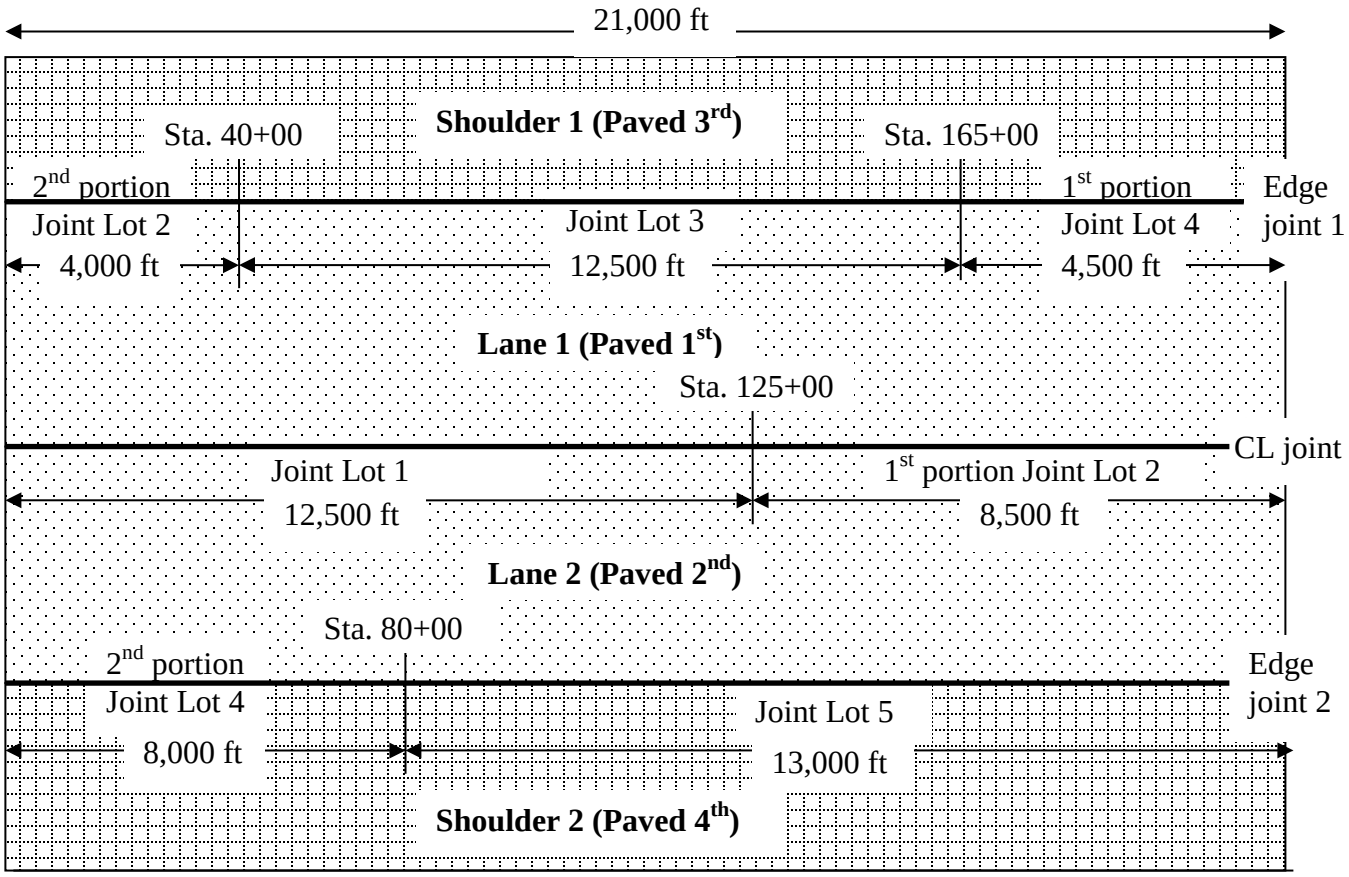
2. Sublots 1 - 5 will be 2,500 LF, leaving 500 LF at the end. 13,000 LF - (5 x 2,500 LF) = 500 LF. Calculate the sample location for the final Sublot based on 2,500 LF.

3. The random number will determine if a sample will be taken in this 500 LF. Two scenarios are shown illustrating the two possibilities.

   3.1 Random No. ("X") = 0.12 2,500 LF x 0.12 = 300 LF, so a sample shall be obtained 300 LF into Sublot 6. The final Lot would have six (6) Sublots.

   3.2 Random No. ("X") = 0.67 2,500 LF x 0.67 = 1,675 LF, so since this is beyond the 500 LF available. No sample shall be obtained and the final Lot would have five (5) Sublots.

Entire Project Lots:



Illustrative Example No. 4: Longitudinal Joint Lot Submittal Calculations for Theoretical Maximum Specific Gravity (Gmm)

Joint Core 1-1 = comprised of JMF#1 (2.451 daily Gmm) and JMF#1 (2.447 daily Gmm), joint paved on day 1

Joint Core 1-2 = comprised of JMF#1 (2.451 daily Gmm) and JMF#1 (2.447 daily Gmm), joint paved on day 1

Joint Core 1-3 = comprised of JMF#1 (2.451 daily Gmm) and JMF#1 (2.447 daily Gmm), joint paved on day 2

Joint Core 1-4 = comprised of JMF#1 (2.447 daily Gmm) and JMF#1 (2.443 daily Gmm), joint paved on day 3

Joint Core 1-5 = comprised of JMF#1 (2.447 daily Gmm) and JMF#2 (2.483 daily Gmm), joint paved on day 5

Step 1 – Verify JMF combinations for each sublot and any time impacts

- No work stoppages exceeded five (5) days, so no required break in TR-447's due to time
- Sublots 1 through 4 are comprised of the same JMF combination (JMF#1 and JMF#1). Include sublots 1 through 4 on one Form TR-447 (in the remarks, list the other TR-447's that will comprise the remainder of the lot)
- Sublot 5 is comprised of a different JMF combination (JMF#1 and JMF#2). Sublot 5 must be placed on a separate Form TR-447 (in the remarks, list the other TR-447's that comprise the remainder of the lot)

Step 2 – Calculate theoretical maximum specific gravity values for each TR-447

- FIRST FORM TR-447
  Joint core 1-1: (2.451 + 2.447) / 2 = 2.449
  Joint core 1-2: (2.451 + 2.447) / 2 = 2.449
  Joint core 1-3: (2.451 + 2.447) / 2 = 2.449
  Joint core 1-4: (2.447 + 2.443) / 2 = 2.445
  Overall average of the 4 cores = (2.449 + 2.449 + 2.449 + 2.445) / 4 = 2.448
  Use 2.448 as the value for AASHTO T-209 on the first TR-447 form and to calculate the density for each sublots 1 through 4 when calculating Percent within Tolerance.

- SECOND FORM TR-447
  Joint core 1-5: (2.447 + 2.483) / 2 = 2.465

Use 2.465 as the value for AASHTO T-209 on the second TR-447 form and to calculate the density for sublot 5 when calculating Percent within Tolerance.

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Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 737
October 2013
3 Pages

LABORATORY TESTING SECTION

Method of Test for

MEASURING THE THICKNESS OF BITUMINOUS CONCRETE COURSES

1. SCOPE

1.1 This method covers the procedure for determining the thickness of bituminous concrete courses from the cores taken from bituminous concrete roadways.

2. APPARATUS

2.1 Ruler - Standard ruler with 1 mm (1/16") graduations

3. TEST SPECIMENS

3.1 Cores used as specimens for thickness measurement shall be representative of the pavement from which they are removed. The specimen shall be drilled with the axis normal to the surface of the pavement. The upper and lower surfaces shall be free from all conditions not typical of the surfaces of the pavement. Cores that show abnormal defects or that have been damaged appreciably in the drilling operation shall not be used.

4. PROCEDURE

4.1 Place the core horizontally on a smooth flat surface with the end that represents the upper surface facing left.

4.2 Four measurements ninety degrees apart shall be made for each course (layer). Measurements shall be made from the top to bottom of each layer and recorded to the nearest 1 mm (1/16 inch) (Note 1).

NOTE 1-When the bottom of a layer is uneven at least two additional diametrical measurements shall be made.

5. CALCULATION

5.1 The thickness of each course shall be determined from the average of all readings.

6. REPORT

6.1 The thickness of the desired course shall be reported to the nearest 3 mm (1/8 inch).

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LABORATORY TESTING SECTION

Method of Test for

SAMPLING BITUMINOUS PAVING MIXTURES

1. SCOPE

1.1 Loose Mixture Samples (Box Samples) - These methods cover the procedures for sampling mixtures of bituminous materials with mineral aggregate as prepared for use in paving. The samples shall be used for either of two purposes:

1.1.1 To represent an average bituminous mixture for acceptance purposes.

1.1.2 To ascertain the periodic variations in characteristics of the mixture for the purpose of quality control.

2. EQUIPMENT

2.1 A flat-bottom, high sided scoop.

2.2 Sample Containers-

2.2.1 For 3/4" (19 mm) and smaller Nominal Maximum Aggregate Size (NMAS) mixtures, use cardboard boxes dimensioned approximately 3 3/4 inches x 4 3/4 inches x 9 1/2 inches.

2.2.2 For 1” (25 mm) and larger NMAS mixtures, use cardboard boxes dimensioned approximately 5 inches x 5 1/2 inches x 9 inches.

2.3 Putty knife for scraping the **INSIDE** of the scoop.

2.4 Incidental materials and equipment.

2.5 Permanent marker

2.6 Masking tape

3. SELECTION OF SAMPLES

3.1 Sampling on the Roadway

3.1.1 Acceptance of the bituminous mixture from the roadway shall be on the basis of test results from consecutive probability samples for each Lot. One probability sample shall be taken from each Sublot. Samples are to be selected by means of a stratified random sampling plan. Refer to Illustrative Examples No. 1 & No. 2 in the Appendix of this PTM for examples of how to select samples using a stratified random sampling plan. If density acceptance is by pavement cores, mixture acceptance samples must be cross referenced to the corresponding density acceptance samples on Form TR-447.

3.1.2 Bituminous mixture samples shall be taken directly from the un-compacted mixture placed by the paving equipment using a procedure described in Section 5 of this PTM.

3.1.3 Areas within the handwork required at the edge of obstructions to normal paving such as manhole covers, inlets and utility valve covers are considered non-testable areas for obtaining bituminous mixture samples. When a sample location falls within a non-testable area, adjust the location of the sample longitudinally in the direction of paving to a location at the edge of the non-testable area.

3.2 Sampling at a Bituminous Producer

3.2.1 Sampling shall be on a random basis in accordance with an approved quality control program.

3.2.2 Plant samples of the mixture shall be taken after the mixture has been discharged in hauling units using the procedure described in Section 6 of this PTM.

3.2.3 An integral part of each quality control program shall require that samples be selected using a random number selection procedure such that all hauling units have an equal chance of being sampled by means of a stratified random sampling plan. Random numbers from PTM No. 1, Table 1, Column “X” shall be used to select the random tons to be sampled. These tons shall be obtained by multiplying the random numbers by the number of tons. The hauling units containing these random tons shall be sampled. Refer to Illustrative Example No. 1 in the Appendix of this PTM for an example of a typical stratified random sampling plan based on tonnage.

3.3 Quality Assurance (QA) Sampling

3.3.1 QA Sampling at a Bituminous Producer- Three (3) samples of bituminous mixture shall normally be obtained from each day's production from hauling units using the procedure stated in Section 6 of this PTM. The producer may obtain a companion sample with each of the three (3) QA samples for quality control purposes. Samples are to be selected by means of a stratified random sampling plan to distribute the sampling over a given period of time using the following procedure:

3.3.1(a) Divide the anticipated time of the plant operation review into three (3) approximately equal time intervals.

3.3.1(b) Select, at random, a series of three (3) consecutive numbers from PTM No. 1, Table 1.

3.3.1(c) Determine the first sampling time by multiplying the first two place decimal value "X" by the number of minutes in the first time interval and add the product to the clock time at the beginning of the review. The load of mixture to be sampled is the first load (hauling unit) that leaves the plant following the computed sampling time.

3.3.1(d) Repeat the operation, using the other two random numbers in the same order they appear in PTM No. 1, Table 1 to determine the sampling times for the two remaining time intervals. In each case, the product of the random number and the number of minutes in the particular interval is added to the clock time at the beginning of the interval to determine the sampling time. Refer to Illustrative Example No. 3 in the Appendix of this PTM for an example of a typical stratified random sampling plan based on time.

3.3.2 QA Sampling on the Roadway- Quality Assurance samples of the bituminous mixture are to be obtained directly from the un-compacted mixture placed by the paving equipment using a procedure described in Section 5 of this PTM.

3.3.2(a) Divide the anticipated period of the paving operation review into three (3) approximately equal time intervals.

3.3.2(b) Select, at random, a series of three (3) consecutive numbers from PTM No. 1, Table 1.

3.3.2(c) Determine the first sampling time by multiplying the first two place decimal value "X" by the number of minutes in the first time interval and add the product to the clock time at the beginning of the review. The load of mixture to be sampled is the first load (hauling unit) placed by the paving equipment following the computed sampling time. Multiply the pavement width by the two place decimal value "Y" to obtain the offset location for the sample.

3.3.2(d) Repeat the operation, using the other two random numbers in the same order they appear in PTM No. 1, Table 1 to determine the sampling times for the two remaining time intervals. In each case, the product of the random number and the number of minutes in the particular interval is added to the clock time at the beginning of the interval to determine the sampling time. Refer to Illustrative Example No.3 in the Appendix of this PTM for an example of a typical stratified random sampling plan based on time.

4. SIZE OF SAMPLES

4.1 The size of the bituminous mixture samples shall be enough material to fill the appropriate sample container selected for the NMAS of the mixture as outlined in Section 2.2.

5. PROCEDURE FOR SAMPLING BEHIND PAVING EQUIPMENT ON THE ROADWAY

5.1 In the presence of the Department Representative, bituminous mixture samples shall be lifted at pre-determined random locations, directly from the un-compacted mixture placed by the paving equipment, with a flat bottom, high-sided scoop. The scoop shall pass completely through the entire depth of the lift of material being sampled. When transferring the mixture into a clean cardboard sample box, any fines sticking to the INSIDE of the scoop shall be scraped and included with the sample.

5.1.1 For 3/4" (19 mm) and larger NMAS mixtures, a sample larger than is required in Section 4.1 may be obtained and placed on a mixing board, thoroughly mixed, formed into a flat pile and carefully quartered to provide a representative sample of the required size. Scrape the INSIDE of the scoop at each transfer point to incorporate any fines sticking to the inside of the scoop.

6. PROCEDURE FOR SAMPLING FROM A HAULING UNIT

6.1 In the presence of the Department Representative, use a flat-bottom, high-sided scoop to obtain a bituminous mixture sample. Starting low on the pile and extending upward, sample the mixture by creating an approximately two (2) foot long and three (3) inches to four (4) inches deep vertical furrow. If the mixture is sampled from at least two places in the truck, place the material removed in this manner on a mixing board, thoroughly mix, form into a flat pile and carefully quarter to provide a representative sample of the required size. Scrape the INSIDE of the scoop at each transfer point to incorporate any fines sticking to the inside of the scoop.

7. IDENTIFICATION AND DELIVERY OF SAMPLES

7.1 Identify, using a permanent marker, package and immediately deliver bituminous mixture acceptance samples to the Department Representative as specified in Pub. 408, Section 409.

7.2 Bituminous mixture acceptance samples shall be stored in a proper environment until the Lot is completed or has been terminated.

7.3 After the Lot is completed or has been terminated, the Department Representative shall do the following:

7.3.1 Complete a Form TR-447 for proper Lot identification.

7.3.2 Using a permanent marker, write the TR-447 Sample Reference Number (A######) on the outside of each sample box and place the appropriate Bar Code Sticker from Form TR-447 on the outside of each sample box (Bar Code Sticker A######-1 on the sample box for Sublot # 1, etc.).

7.3.3 Secure all the samples for the Lot together.

7.3.4 Deliver the mixture acceptance samples to a Department pick-up point within three days for shipment to LTS.

8. REFERENCES

AASHTO T-168
PTM No. 1

APPENDIX

Illustrative Example No. 1: Sampling Based on Tonnage

Total tonnage of Wearing Course

Normal Lot size	2500 tons
Number of Sublots in each Lot	5
Number of tons per Sublot	500 tons
Number of samples per Sublot	1

Select at random a series of five (5) consecutive numbers from PTM No. 1, Table 1 for the first Lot. Multiply the number of tons in a Sublot by the two place decimal value "X" to obtain the sample location within that Sublot. Multiply the pavement width by the two place decimal value "Y" to obtain the offset location for the sample. A typical stratified random sampling plan shall be similar to the following:

RANDOM NUMBER			NUMBER OF TONS/SUBLOT	WIDTH OF PAVEMENT
	X	Y		
#41	.27	.52L	.27(500 tons) = 135 tons	.52(12 ft) = 6.24 ft. L
#42	.39	.91R	.39(500 tons) = 195 tons	.91(12 ft) = 10.92 ft. R
#43	.57	.10L	.57(500 tons) = 285 tons	.10(12 ft) = 1.20 ft. L
#44	.82	.12L	.82(500 tons) = 410 tons	.12(12 ft) = 1.44 ft. L
#45	.14	.94L	.14(500 tons) = 70 tons	.94(12 ft) = 11.28 ft. L

The sampling sequence for a Lot of 2500 tons shall be as follows:

Sublot 1 = 135 tons; Sublot 2 = 500 + 195 = 695 tons; Sublot 3 = 1000 + 285 = 1285 tons; Sublot 4 = 1500 + 410 = 1910 tons; Sublot 5 = 2000 + 70 = 2070 tons

Looking at the information above this would mean the following: Hauling units containing the 135^{th} ton would be sampled 6.24 ft. from the left edge of the paved lane; the 695^{th} ton would be sampled 10.92 ft. from the right edge of the paved lane; the 1285^{th} ton would be sampled 1.20 ft. from the left edge of the paved lane; the 1910^{th} ton would be sampled 1.44 ft. from the left edge of the paved lane; the 2070^{th} ton would be sampled 11.28 ft. from the left edge of the paved lane.

Note: When collecting samples from the roadway a Material Transfer Vehicle (MTV) is used in the paving train. Determine the amount of material carried in the paver hopper and the MTV. When the hauling unit carrying the sample tonnage empties into the MTV, allow the amount of material carried by the MTV and hopper to be placed prior to obtaining the sample from the roadway.

Illustrative Example No. 2: Sampling Based on Square Yards

Computing Theoretical Yield of Bituminous Pavement (from POM C/4/6)

Lift Depth (inch)	×	Compacted Conversion Factor ($0.75\ ft^3/yd^2 \cdot in$)	=	Cubic Feet Per Square Yard (ft^3/yd^2)
½		0.75		0.3750
¾		0.75		0.5625
1		0.75		0.7500
1¼		0.75		0.9375
1½		0.75		1.1250
1¾		0.75		1.3125
2		0.75		1.5000
2¼		0.75		1.6875
2½		0.75		1.8750
2¾		0.75		2.0625
3		0.75		2.2500

Example:

Starting Station of Paving = 0 +00
Pavement Design depth = 1½ inches
Paving Width = 12ft.
Mix Design Laboratory (MDL) Specific Gravity (N_{des} Density G_{mb} from Mix Design) = 2.352

Normal Lot size	2500 tons
Number of Sublots in each Lot	5
Number of tons per Sublot	500 tons
Number of samples per Sublot	1

1. Calculate the theoretical yield to determine the weight of a square yard of pavement at the given depth:

   (*Cubic Feet Per Square Yard ft^3/yd^2) x (MDL Specific Gravity) x ($62.4\ lbs/ft^3$) = lbs/yd^2

   ($1.1250\ ft^3/yd^2$) x (2.352) x ($62.4\ lbs./ft^3$) = $165\ lbs./yd^2$

*From the chart above for the compacted lift depth being placed (1½ inches for this example)

Illustrative Example No. 2: Sampling Based on Square Yards (continued)

2. Find the length of the Lot in feet:

(2,500 tons) x (2,000 lbs./ton) ÷ (165 lbs./yd^2) = 30,303 yd^2

(30,303 yd^2) x (9 ft^2 /yd^2) ÷ (12 ft. lane width) = 22,727 ft./Lot

22,727 ft./Lot ÷ 5 Sublots/Lot = 4545.4 ft./Sublot

3. Determine sample locations:

Select at random a series of five (5) consecutive numbers from PTM No.1, Table 1 for the first Lot. Multiply the length of each Sublot by the two place decimal value "X" to obtain the sample locations within each Sublot. Multiply the pavement width by the two place decimal value "Y" to obtain the offset location for the sample. A typical stratified random sampling plan shall be similar to the following:

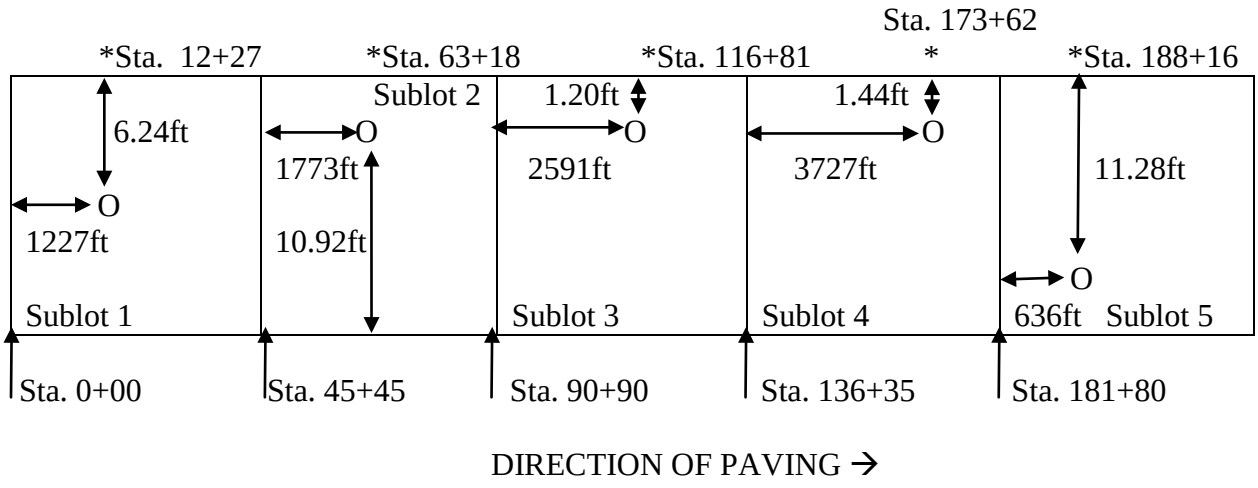
RANDOM NUMBER			LENGTH	WIDTH OF PAVEMENT
	X	Y	X	Y
#41	.27	.52L	.27 x 4,545.4 ft. = 1227 ft.	.52 x (12 ft.) = 6.24 ft. L
#42	.39	.91R	.39 x 4,545.4 ft. = 1773 ft.	.91 x (12 ft.) = 10.92 ft. R
#43	.57	.10L	.57 x 4,545.4 ft. = 2591 ft.	.10 x (12 ft.) = 1.20 ft. L
#44	.82	.12L	.82 x 4,545.4 ft. = 3727 ft.	.12 x (12 ft.) = 1.44 ft. L
#45	.14	.94L	.14 x 4,545.4 ft. = 636 ft.	.94 x (12 ft) = 11.28 ft. L

Note: The "X" value equals station along the pavement centerline.
The "Y" value equals the distance from the left or right edge of the paving lane.

Illustrative Example No. 2: Sampling Based on Square Yards (continued)

In summary the sampling for the Lot (22,727 ft.) shall be:

	Stations	X	Sample Location	Offset
Sublot 1	0+00 to 45+45	1227 ft.	12+27	6.24 ft. from L edge
Sublot 2	45+45 to 90+90	1773 ft.	63+18	10.92 ft. from R edge
Sublot 3	90+90 to 136+35	2591 ft.	116+81	1.20 ft. from L edge
Sublot 4	136+35 to 181+80	3727 ft.	173+62	1.44 ft. from L edge
Sublot 5	181+80 to 227+27	636 ft.	188+16	11.28 ft. from L edge



DIRECTION OF PAVING →

Illustrative Example No. 3: Quality Assurance Samples Based on Time

Assume the plant or project will be paving continuously throughout the day. Estimate the time needed for the plant/operation review. Divide this time into three (3) equal time intervals. For this example assume three (3) hours.

Each time interval will be one hour duration.

Select at random a series of three (3) consecutive numbers from PTM No. 1, Table 1. A typical stratified random sampling plan shall be similar to the following:

RANDOM NUMBER			TIME	WIDTH OF PAVEMENT
	X	Y	X	Y
#41	.27	.52L	.27 x 60 min. = 16 min.	.52 x (12 ft.) = 6.24 ft. L
#42	.39	.91R	.39 x 60 min. = 23 min.	.91 x (12 ft.) = 10.92 ft. R
#43	.57	.10L	.57 x 60 min. = 34 min.	.10 x (12 ft.) = 1.20 ft. L

The sampling times are indicated below:

8:00 am	9:00 am	10:00 am	11:00 am
x	x	x	
8:16 am	9:23 am	10:34 am	

For plant samples ignore the “Y” value. For roadway samples, determine the sample location on the mat using the “Y” value as indicated in the previous examples.

When it is not possible to obtain scheduled samples because of breakdown, weather, schedule, or other causes, it is still necessary to obtain a total of three samples wherever possible. Adjust the remaining intervals according to the situation and apply the originally selected random numbers as discussed above.

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Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 747
October 2013
4 Pages

LABORATORY TESTING SECTION

Method of Test for

DETERMINATION OF DISTRIBUTOR APPLICATION RATE IN THE FIELD

1. SCOPE

1.l This test method covers the procedure for determining the application rate in liters per square meter (gallons per square yard) of an approved pressure distributor (Note 1).

NOTE 1- Prior to the test, the pressure distributor shall be calibrated and any necessary adjustments made to give the desired rate of application. The height of the spray bar above the pavement surface shall be adjusted to assure uniformity of spread of the bituminous material without causing any streaking.

2. EQUIPMENT

2.1 Carpenter's level- 1.2 m (48 inches) long

2.2 Manufacturer's certificate of calibration for the tank (Note 2)

2.3 A dipstick for the tank

NOTE 2- Most dipsticks furnished by manufacturers are calibrated in 95 to 189 liters (25 to 50 gallon) increments, depending upon tank size, however, it is necessary to check the contents of the tank more closely. Therefore, a calibration curve shall be prepared from the measurements on the dipstick so that the tank contents can be measured to the nearest 20 or 40 liters (five or ten gallons).

3. SIGNIFICANCE

3.1 It is essential that the tank be level at the time of gauging.

3.2 The field application rate of the bituminous material at higher temperatures shall be determined by correcting for temperature using a Bulletin 25 conversion chart (Design Application Rate).

4. PROCEDURE

4.1 Place a level on top of the tank. Raise or lower the front wheels of the truck until the tank is level (Note 3). The tank shall be level both lengthwise and width wise.

NOTE 3- The truck may be leveled by driving the front wheels into a gutter or up a slight incline.

4.2 Using a dipstick, measure the level of bituminous material in the tank. Calculate the contents of the tank in liters (gallons) (Q_1) from the calibration table (Section 2.2). Interpolate the quantities, if necessary (Note 4).

NOTE 4- For maximum accuracy in gauging, the tank should either be nearly full or nearly empty.

4.3 Select a test strip of a suitable length according to Table l and apply the bituminous material at the temperature corrected application rate.

TABLE l. LENGTH OF THE TEST STRIP

Application Rate L/m^2(gal/sq yd)	Length of the Test Strip, m(ft.)
Less than or equal to 0.45 (0.1)	300 (1000)
More than 0.45 (0.1)	150 (500)

4.4 Level the tank again and determine the level of bituminous material in the tank using the dipstick. Calculate the remaining contents of the tank in liters (gallons) (Q_2) from the calibration table. Interpolate the quantities, if necessary.

5. CALCULATIONS

5.1 Calculate the application rate (G) in L/m^2 (gal/yd^2) as follows:

$$G = \frac{Q_1 - Q_2}{LW}$$

METRIC EQUATION

Where:

G = application rate in liters/m^2

Q_1 = quantity of bituminous material in liters in the tank before application

Q_2 = quantity of bituminous material in liters in the tank after application

L = length of the test strip in meters

W = width of the test strip in meters

$$G = \frac{9\,(Q_1 - Q_2)}{LW}$$

ENGLISH EQUATION

Where:

G = application rate in gallons/sq yd.

Q_1 = quantity of bituminous material in gallons in the tank before application

Q_2 = quantity of bituminous material in gallons in the tank after application

L = length of the test strip in feet

W = width of the test strip in feet

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Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. 751
October 2013
10 Pages

LABORATORY TESTING SECTION

Method of Test for

MEASURING SURFACE MACROTEXTURE DEPTH USING A VOLUMETRIC TECHNIQUE AND DETERMINING PATTERN SEGREGATION

1. SCOPE

1.1 This method of test, which is a modification of ASTM E965, outlines the procedure for determining the average depth of a pavement surface macrotexture by careful application of a known volume of material on the pavement surface and subsequent measurement of the total area covered. This technique is designed to provide an average depth value of only the pavement macrotexture and is considered insensitive to pavement microtexture characteristics. This method of test is also used to determine pattern segregation in bituminous concrete pavements.

NOTE 1- Pavement macrotexture is defined as the deviations of a pavement surface from a true planar surface. Average texture depth is the average depth between the bottom of the pavement surface voids and the tops of the surface aggregate particles. This test method is considered insensitive to distinguishing between (+) and (-) deviations of a pavement surface from a true planar surface.

NOTE 2- The pavement surface to be measured using this test method must be dry and free of any construction residue, surface debris, and loose aggregate particles that would be displaced or removed during normal environmental and traffic conditions.

2. APPARATUS AND MATERIAL

2.1 Scale- A standard 300-millimeter (12-inch) scale having 2.0 millimeter (0.1 inch) divisions.

2.2 Sample Container- A cylindrical plastic or metal container with an internal volume of approximately 20,000 cubic millimeters (1.2 cubic inches) used to determine the volume of material to be spread on the pavement surface. An 18 mL polyethylene vial with a friction fit snap closure (Fisher Cat. #03-388-E) is suitable and is the standard container used to develop Table 1 in Section 4.

2.3 Spreader Tool- A #14 solid rubber stopper (Fisher Cat. #14-130V) or an ice hockey puck is suitable.

2.4 Brushes- Any size of paint brush with a soft bristle is suitable for cleaning loose debris and aggregate particles away from the test locations.

NOTE 3- If it is necessary to test locations that are contaminated with dried mud or other tightly adhering foreign material, a stiff wire brush shall be used to thoroughly clean the area prior to testing.

2.5 Material Storage Container- A one (1) liter (1-quart) plastic sample bottle with a lid is suitable for storing, transporting, and maintaining dry testing material. The container shall be kept sealed except for filling sample containers and recharging.

2.6 Material- Either of the following dry, clean materials is suitable.

NOTE 4- Use the same material for testing each area when conducting pattern segregation tests.

2.6.1 Solid glass beads- Tested by ASTM Test Method D1155 (70% roundness). The beads shall be graded such that 100% of the sample passes a 1.18 mm (No. 16) sieve, and no more than 5% of the sample passes the 150 µm (No. 100) sieve.

2.6.2 Standard graded sand- Meeting the requirements of ASTM Specification C778, Table 1.

2.7 Wind Screen- Any suitable method may be used to prevent turbulence from disturbing the material during the test. A 330 millimeter (13-inch) tubeless tire is the minimum sized tire that is suitable to be used as a shield. This tire is to be placed on the pavement surface around the test site when sufficiently windy conditions prevail or turbulence is created by traffic such that the test procedure is disturbed without the shield.

3. PROCEDURE

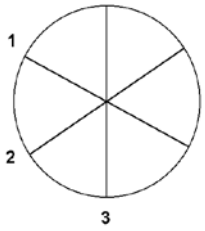
3.1 Test Surface- Inspect the pavement surface to be measured and select a dry, homogeneous area that contains no unique, localized features such as cracks or joints. Thoroughly clean the pavement surface using a soft bristle brush to remove any residue, debris, or loosely bonded aggregate particles that are on the surface (See NOTES 2 and 3). Position the portable windscreen around the surface test area, if necessary.

3.2 Material Sample Preparation- Fill the sample container with dry material and gently tap the base of the cylinder three times on a rigid surface. Add more material to fill the cylinder to the top, and level the cylinder with a straight-edge.

3.3 Test Measurement- Pour the measured volume of material onto a clean test surface within the area protected by the windscreen. Carefully spread the material in a circular

patch with the spreader tool, filling the surface voids flush with the aggregate particle tips. Measure and record the diameter of the circular area covered by the material using the scale. Perform a minimum of three readings on the circular patch. Determine the radius by dividing the average diameter reading by 2. Record the measurements to the nearest 2.5 millimeters (0.1 inch).

Example of circular patch measurements:



NOTE 5- For very smooth pavement surfaces where test patch diameters exceed 203 millimeters (8-inches), it is recommended that the pavement be re-tested using a smaller sample container. (A 12 mL polyethylene vial, Fisher Cat. #03-388C, with an actual volume of 14 000 mm^3 is suitable for such cases).

NOTE 6- For coarse open pavements, it may be necessary to use two or more 18 mL polyethylene vials.

3.4 Number of Test Measurements for Determining Surface Macrotexture when Used to Evaluate Surface Frictional Characteristics- The same operator shall perform at least 5 randomly selected measurements, utilizing PTM No. 1, per lane kilometer (mile) of a given test pavement surface type. Measurements shall be determined in either the right or left wheel path for each longitudinal offset calculated.

3.5 Number of Test Measurements for Determining Pattern Segregation- Perform a minimum of three tests in the suspected segregated area. Perform an equal number of tests in an acceptable area using PTM No. 1. Calculate the average radius for each area, suspected and acceptable. Determine the average texture depth for each area in accordance with Section 4. Calculate the difference between the average texture depths of suspected and acceptable areas to determine pattern segregation.

Example:

4. CALCULATION

4.1 When using a standard sample container (18 mL Fisher vial), refer to the Table 1 Conversion Table, and convert each radius measurement to an average Texture Depth (T.D). Calculate and record an Average Surface Macrotexture Depth (ASMD) to 0.0254 mm (0.001 in.), and a Standard Deviation (S) for the measurements for each pavement surface type. Use Table 2 for the two 18 mL polyethylene vials. When more than two 18 mL polyethylene vials are used, follow the calculation procedure listed in Section 4.2.

4.1.1 Calculate the ASMD by:

$$\text{ASMD} = \frac{\text{Sum of T.D. Measurements}}{\text{Number of Measurements}}$$

4.1.2 Calculate the S by:

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

Where:

S= Standard deviation

n = Number of measurements

$\overline{X}$ = ASMD

X_i= Individual T.D. measurement

$\sum_{i=1}^{n}$ = Sum of the squares of the deviation from ASMD

4.2 When using a container other than the standard sample container, use the following procedure:

4.2.1 Cylinder Volume- Calculate the internal volume of the sample cylinder as follows:

$$V = \frac{\pi d^2 h}{4}$$

Where:

V = Internal cylinder volume, mm^3 (in^3)

d = Internal cylinder diameter, mm(in.)

h = Cylinder height, mm (in.)

4.2.2 Average Texture Depth - Calculate the average Texture Depth (T.D.) using the following equation:

$$T.D. = \frac{V}{\pi R^2}$$

Where:

T.D. = average texture depth, mm (in.)

V = sample volume, mm^3 (in^3)(calculated in Section 4.2.1)

R = average radius of the area covered by the material, mm (in.)

Calculate and record an Average Surface Macrotexture Depth (ASMD) to 0.025 mm (0.001 in.) and a Standard Deviation (S) as shown in Sections 4.1.1 and 4.1.2 for each pavement surface type.

5. REPORT

5.1 The report for each pavement test surface type shall contain the following items:

5.1.1 Date of Testing

5.1.2 Identify the roadway (Co., SR, Seg.) and pavement surface type (seal coat, etc.)

5.1.3 Record each test location (Seg. offset, L or R wheel path) with an average texture depth (T.D.) determined for each location.

5.1.4 For each pavement surface type report the following: Average Surface Macrotexture Depth (ASMD), Range (R) of measurements, and the Standard Deviation (S).

6. REFERENCES

ASTM E965
British Standards - Sand Patch Method

TABLE 1- STANDARD MIXES
AVERAGE TEXTURE DEPTH*
CONVERSION FROM RADIUS

Radius		Texture Depth		Radius		Texture Depth	
mm	(in)	mm	(in)	mm	(in)	mm	(in)
50.8	2.0	2.47	0.097	129.5	5.1	0.380	0.015
53.3	2.1	2.24	0.088	132.1	5.2	0.365	0.014
55.9	2.2	2.04	0.080	134.6	5.3	0.352	0.014
58.4	2.3	1.87	0.073	137.2	5.4	0.338	0.013
61.0	2.4	1.71	0.067	139.7	5.5	0.326	0.013
63.5	2.5	1.58	0.062	142.2	5.6	0.315	0.012
66.0	2.6	1.46	0.057	144.8	5.7	0.304	0.012
68.6	2.7	1.35	0.053	147.3	5.8	0.294	0.012
71.1	2.8	1.26	0.050	149.9	5.9	0.283	0.011
73.7	2.9	1.17	0.046	152.4	6.0	0.274	0.011
76.2	3.0	1.10	0.043	154.9	6.1	0.265	0.010
78.7	3.1	1.03	0.040	157.5	6.2	0.257	0.010
81.3	3.2	0.964	0.038	160.0	6.3	0.249	0.010
83.8	3.3	0.907	0.036	162.6	6.4	0.241	0.009
86.4	3.4	0.853	0.034	165.1	6.5	0.234	0.009
88.9	3.5	0.806	0.032	167.6	6.6	0.227	0.009
91.4	3.6	0.762	0.030	170.2	6.7	0.220	0.009
94.0	3.7	0.721	0.028	172.7	6.8	0.214	0.008
96.5	3.8	0.684	0.027	175.3	6.9	0.207	0.008
99.1	3.9	0.649	0.026	177.8	7.0	0.201	0.008
101.6	4.0	0.617	0.024	180.3	7.1	0.196	0.008
104.1	4.1	0.588	0.023	182.9	7.2	0.190	0.007
106.7	4.2	0.559	0.022	185.4	7.3	0.185	0.007
109.2	4.3	0.534	0.021	188.0	7.4	0.180	0.007
111.8	4.4	0.510	0.020	190.5	7.5	0.176	0.007
114.3	4.5	0.488	0.019	193.0	7.6	0.171	0.007
116.8	4.6	0.467	0.018	195.6	7.7	0.166	0.007
119.4	4.7	0.447	0.018	198.1	7.8	0.162	0.006
121.9	4.8	0.429	0.017	200.7	7.9	0.158	0.006
124.5	4.9	0.411	0.016	203.2	8.0	0.154	0.006
127.0	5.0	0.395	0.016				

* Valid only when using ONE standard container as specified in Section 2.2 (18 ml vial, Fisher Cat. # 03-388-E, with an actual volume of 20,000 mm^3) or an equivalent container with a measured volume of 20,000 mm^3 (1.2204 in^3).

TABLE 2 - COARSE MIXES
AVERAGE TEXTURE DEPTH*
CONVERSION FROM RADIUS

Radius		Texture Depth		Radius		Texture Depth	
mm	(in)	mm	(in)	mm	(in)	mm	(in)
50.8	2.0	4.94	0.194	129.5	5.1	0.760	0.030
53.3	2.1	4.48	0.176	132.1	5.2	0.730	0.029
55.9	2.2	4.08	0.161	134.6	5.3	0.703	0.028
58.4	2.3	3.74	0.147	137.2	5.4	0.677	0.027
61.0	2.4	3.42	0.135	139.7	5.5	0.653	0.026
63.5	2.5	3.16	0.124	142.2	5.6	0.630	0.025
66.0	2.6	2.92	0.115	144.8	5.7	0.608	0.024
68.6	2.7	2.71	0.107	147.3	5.8	0.587	0.023
71.1	2.8	2.52	0.099	149.9	5.9	0.567	0.022
73.7	2.9	2.35	0.092	152.4	6.0	0.548	0.022
76.2	3.0	2.19	0.086	154.9	6.1	0.531	0.021
78.7	3.1	2.06	0.081	157.5	6.2	0.514	0.020
81.3	3.2	1.927	0.076	160.0	6.3	0.498	0.020
83.8	3.3	1.814	0.071	162.6	6.4	0.482	0.019
86.4	3.4	1.706	0.067	165.1	6.5	0.467	0.018
88.9	3.5	1.612	0.063	167.6	6.6	0.454	0.018
91.4	3.6	1.525	0.060	170.2	6.7	0.440	0.017
94.0	3.7	1.442	0.057	172.7	6.8	0.427	0.017
96.5	3.8	1.368	0.054	175.3	6.9	0.415	0.016
99.1	3.9	1.297	0.051	177.8	7.0	0.403	0.016
101.6	4.0	1.234	0.049	180.3	7.1	0.392	0.015
104.1	4.1	1.176	0.046	182.9	7.2	0.381	0.015
106.7	4.2	1.119	0.044	185.4	7.3	0.371	0.015
109.2	4.3	1.068	0.042	188.0	7.4	0.360	0.014
111.8	4.4	1.019	0.040	190.5	7.5	0.351	0.014
114.3	4.5	0.975	0.038	193.0	7.6	0.342	0.013
116.8	4.6	0.934	0.037	195.6	7.7	0.333	0.013
119.4	4.7	0.894	0.035	198.1	7.8	0.325	0.013
121.9	4.8	0.857	0.034	200.7	7.9	0.316	0.012
124.5	4.9	0.822	0.032	203.2	8.0	0.309	0.012
127.0	5.0	0.790	0.031				

* Valid only when using TWO standard containers as specified in Section 2.2 (Two 18 mL vials Fisher Cat. #03-388-E with an actual total volume of 40 000 mm^3) or an equivalent container with a measured volume of 40 000 mm^3 (2.4408 in^3).

TABLE 3 - VERY SMOOTH MIXES
AVERAGE TEXTURE DEPTH*
CONVERSION FROM RADIUS

Radius		Texture Depth		Radius		Texture Depth	
mm	(in)	mm	(in)	mm	(in)	mm	(in)
50.8	2.0	1.73	0.068	129.5	5.1	0.266	0.010
53.3	2.1	1.57	0.062	132.1	5.2	0.256	0.010
55.9	2.2	1.43	0.056	134.6	5.3	0.246	0.010
58.4	2.3	1.31	0.051	137.2	5.4	0.237	0.009
61.0	2.4	1.20	0.047	139.7	5.5	0.228	0.009
63.5	2.5	1.11	0.044	142.2	5.6	0.220	0.009
66.0	2.6	1.02	0.040	144.8	5.7	0.213	0.008
68.6	2.7	0.95	0.037	147.3	5.8	0.205	0.008
71.1	2.8	0.88	0.035	149.9	5.9	0.198	0.008
73.7	2.9	0.82	0.032	152.4	6.0	0.192	0.008
76.2	3.0	0.77	0.030	154.9	6.1	0.186	0.007
78.7	3.1	0.72	0.028	157.5	6.2	0.180	0.007
81.3	3.2	0.675	0.027	160.0	6.3	0.174	0.007
83.8	3.3	0.635	0.025	162.6	6.4	0.169	0.007
86.4	3.4	0.597	0.024	165.1	6.5	0.164	0.006
88.9	3.5	0.564	0.022	167.6	6.6	0.159	0.006
91.4	3.6	0.534	0.021	170.2	6.7	0.154	0.006
94.0	3.7	0.505	0.020	172.7	6.8	0.149	0.006
96.5	3.8	0.479	0.019	175.3	6.9	0.145	0.006
99.1	3.9	0.454	0.018	177.8	7.0	0.141	0.006
101.6	4.0	0.432	0.017	180.3	7.1	0.137	0.005
104.1	4.1	0.411	0.016	182.9	7.2	0.133	0.005
106.7	4.2	0.392	0.015	185.4	7.3	0.130	0.005
109.2	4.3	0.374	0.015	188.0	7.4	0.126	0.005
111.8	4.4	0.357	0.014	190.5	7.5	0.123	0.005
114.3	4.5	0.341	0.013	193.0	7.6	0.120	0.005
116.8	4.6	0.327	0.013	195.6	7.7	0.117	0.005
119.4	4.7	0.313	0.012	198.1	7.8	0.114	0.004
121.9	4.8	0.300	0.012	200.7	7.9	0.111	0.004
124.5	4.9	0.288	0.011	203.2	8.0	0.108	0.004
127.0	5.0	0.276	0.011				

* Valid only when using ONE standard container as specified in Section 3.3 (12 mL vial Fisher Cat. #03-388-C with an actual volume 0f 14 000 mm^3) or an equivalent container with a measured volume of 14 000 mm^3 (0.8543 in^3).

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