Hot-Mix Asphalt Construction

JOINT
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TRAINING
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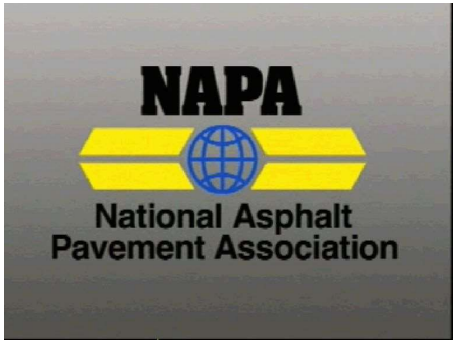
ON ASPHALT



“Partners in Performance”

Hot-Mix Asphalt Construction

NATIONAL HIGHWAY INSTITUTE

Federal Highway Administration

JOINT AASHTO FHWA INDUSTRY TRAINING COMMITTEE ON ASPHALT

"Partners in Performance"

Asphalt Pavement Association OF WEST VIRGINIA

STATE OF WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

NAPA National Asphalt Pavement Association

West Virginia University Asphalt Technology Program

Module 1

1. Introduction
2. Communication
3. Project Documents

1. Introduction: *Class Format*

- Lecture/discussion
- Informal
- Questions are encouraged
- Class participation is essential
- Respect others
- Observe class schedule

1. Introduction: *Course Options*

Gauge User

- Radiation Safety
- Exam Friday
- Certified to perform Nuclear Density Testing

Non-Gauge User

- Exam Thursday

1. Introduction: *Revisions*

MP 106.03.50: General Information Guide Technician And Inspector Certification

Section 10: Asphalt Field and Compaction Technician

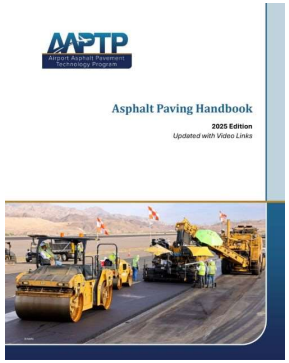
"Participant shall complete a minimum 40 hours of hands-on training"

"Practical exam may be attempted prior to the completion of the apprenticeship cycle"

"All Practical Examinations must be completed within 90 days from the date of the original written test date"

1. Introduction: *Reference Materials*

- **Participant's Workbook**
- **Asphalt Paving Handbook**
- **WVDOH Materials**
  - **Compaction Worksheets 401 & 407**
  - **Daily Work Report**
  - **Tack Coat Form (SM)**
- **DOH Website**



1. Introduction: *Objectives*

1. **Describe the purpose of project documents and cooperative communication on the job**
2. **List the steps involved in preparing bases and existing surfaces for asphalt overlays**
3. **Define a proper asphalt delivery process to the job site**
4. **Explain the effect of the various components of an asphalt paving machine on the finished mat**
5. **Describe what effect the compaction process has on the finished pavement**

1. Introduction: *Objectives*

6. **Identify the roles and responsibilities of the WVDOH Inspector**
7. **Describe how density measurements are taken**
8. **Explain the different processes of QC/QA for testing**
9. **Define the key components of PWL paving**
10. **Describe the process for troubleshooting if things go wrong**

1. Introduction: *Objectives*

- **Typical design**
  - **Superpave? Marshall? SMA? OGFC?**
- **Contractors/material suppliers**
  - **Aggregate source? Skid??**
- **Specs…401, 410?**
- **Hauling**
- **Laydown**
- **Compaction**
- **Other?**

1. Introduction:

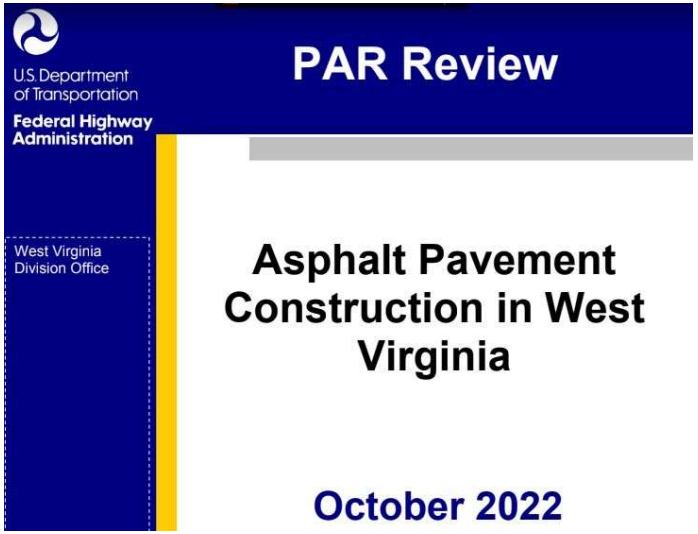
"at least one certified Asphalt Field and Compaction Technician at each project during paving operations."

- **FHWA Requirement**
- **Training for asphalt paving projects**
- **Confidence in work**

1. Introduction

"certified Asphalt Field and Compaction Technician with certification to perform nuclear density testing of asphalt pavements shall perform all testing necessary to assure compaction of the asphalt meets specification requirements."

- **FHWA Requirement**
- **Training for asphalt paving projects**
- **Confidence in work**



1. Introduction: *Certification*

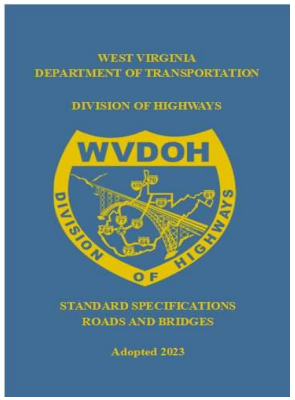
- **Value to you**
- **Value to company**
- **Downsizing…who goes first?**

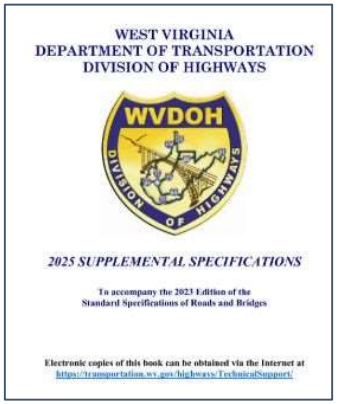
2. Communication

2. Communication

- **Schedule**
- **Weather forecast**
- **Closed Lanes**
- **Traffic Control**
- **Plant issues**
- **Other requirements/ restrictions**
- **CHANGES**

3. Project Documents





3. Project Documents

- Reports
- Pay Estimates
- Traffic Control Plan
- **Compaction Forms**
  - **401/407**
  - **Spec year?**
- **Tack Coat Forms**
  - **Residual**
- Daily Work Report
- Change Orders
- As-Built Plans
- **Job Mix Formula**
  - **Max Density**
- Environmental Documents
- **QC Plan**

3. Project Documents: *Hierarchy*

1. **Special Provisions**
2. **Plans**
3. **Supplemental Specifications**
4. **Standard Specifications**

3. Project Documents:

1. **<u>Special Provisions</u>**
   - **Project specific additions or revisions to the standard or supplemental specifications**
2. **<u>Plans</u>**
   - **Drawings of location, character, dimensions, and details of work**
   - **Plan notes**

3. Project Documents:

3. <u>Supplemental Specifications</u>
   - Approved additions and/or revisions to standard specifications
   - Typos are issued as errata

4. <u>Standard Specifications</u>
   - Directions, provisions, and requirements for performing the work illustrated and described in the plans
   - Methods of performing the work, desired outcome, or qualities and quantities of materials and labor to be furnished

The "Team"

- Owners
  - Long-term performance
  - Ensure quality
- HMA Industry
  - Provide quality
  - Increase performance
  - Lower costs

Teamwork and Cooperation

Module 2

1. QC/QA
2. Specifications
3. Variability

1. # QC / QA

1. # QC/QA: *Learning Objectives*

1. **Describe and differentiate between quality control (QC) and quality assurance (QA)**
2. **Relate different types of specifications to pavement performance and to risk**
3. **Identify sources of variability within HMA construction process**
4. **Explain the use of statistical analysis of test results for QC and QA**

1. # QC: *Quality Control*

- QC refers to the ***control*** component of the production or construction process
- Also referred to as *process control*
- QC *ensures* the production of uniform materials that meet specification
- QC is achieved through *periodic inspection and testing*
- QC is the responsibility of the producer or contractor!

1. # QA: *Quality Assurance*

- QA refers to the ***assurance*** portion of the overall inspection process
- QA *assures* the buyer/owner that the producer's test results are accurate
- Sampling and testing for acceptance are typically conducted at less *frequency* and with greater *randomization* than the producer's process
- QA is the responsibility of the buyer!

1. **QA:** *Elements of QA*

1. **QA:** *Elements of QA*

Producer / Contractor provides documentation that the material / end product met specification.

1. **QA:** *Elements of QA*

Buyer / Owner determines if the quality of the product as specified in the contract requirements

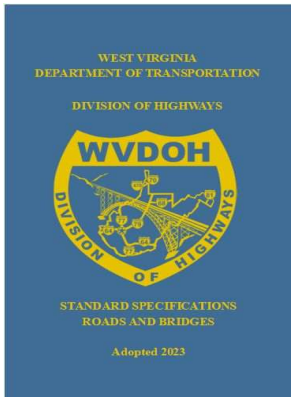
1. **QA:** *Elements of QA*

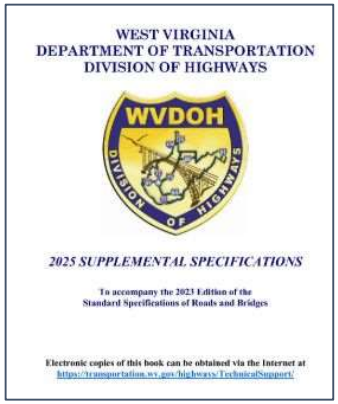
Activities that combine to produce an unbiased and independent evaluation of all the sampling and testing procedures used in the acceptance program

1. QC/QA: *Examples*

Buyer/ Owner	Product	QC Process	Accept-ance	Independent Assurance
Individual	New Car	?	?	?
Individual	Fast Food	?	?	?
Public Agency	Road-way	?	?	?

2. Specifications:





2. Specifications: *Objectives*

1. **Types**
2. **Relationship to performance**
3. **Risk considerations**

2. Specifications: *Types*

- Method (Recipe)
- QC/QA
- End-Result
- Performance

2. Specifications: *Method*

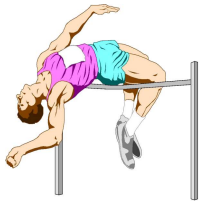
- Old school
- Owner prepares designs and sets requirements for structure, materials and construction processes
- Contractor supplies manpower, materials and equipment
- Owner is responsible for inspection
- Payment based on labor, materials, and equipment use
- Problems:
  - Little or no testing
  - Question of quality
  - Uncertainty of performance

2. Specifications: *QC/QA*

- Lies between method and end-result specifications
- Separates QC from QA
- Applies statistical approach to both QC and QA
- Requires inspection and testing
- Introduced pay adjustment as a function of QA testing
- Most Common

2. Specifications: *End-Result*

- Owner specifies the expected end-result of the finished pavement such as:
  - Layer thickness
  - Mix properties
  - Smoothness



- Establishes criteria for acceptance (including rejection and pay adjustment)

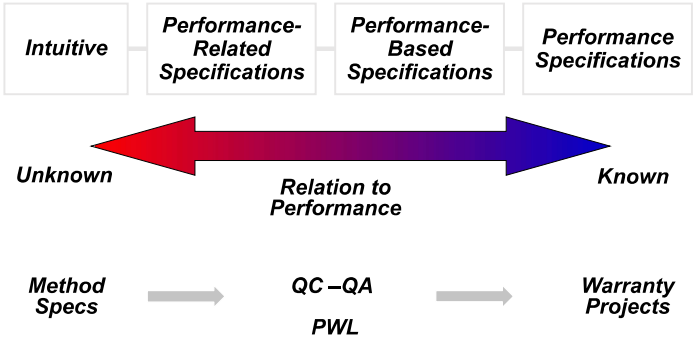
2. Specifications: *End-Result*

- Owner does NOT specify equipment nor methods of construction
- Increased testing, statistically rigorous, and considers owner and contractor risk
- Requires both QC and QA
- Third party (for independent assurance) often required
- Commonly used

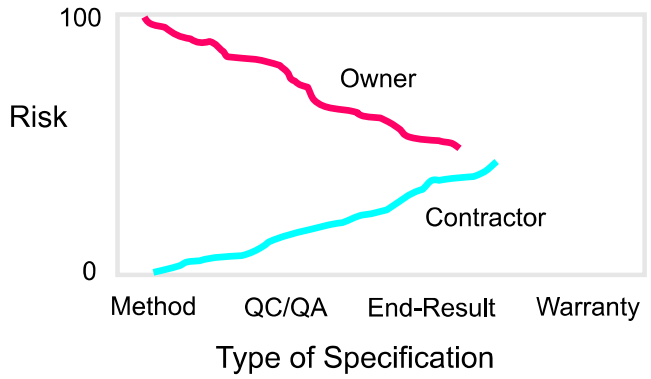
2. Specifications: *Performance*

- Performance-related
- Performance-based
- Guarantee and Warranty

2. Specifications: *Relationship*



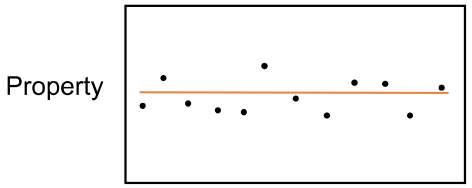
2. Specifications: *Risk Considerations*



3. Variability

3. Variability

- What is it?



- Importance
- Properties affected
- Standard measures
- Sources

3. Variability: *Importance*

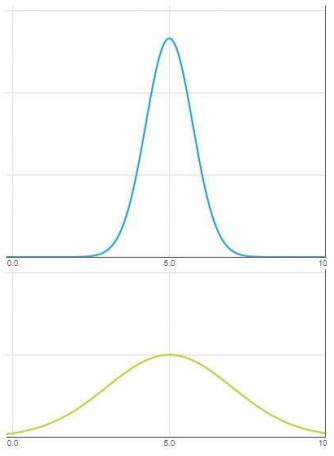
- Major effect on:
  - Quality control
  - Quality assurance
  - Pay adjustment
  - Pavement performance

3. Variability: *Properties Affected*

- Thickness
- Aggregate gradation
- Asphalt content
- Air void content (or density)
- Smoothness

3. Variability: *Standard Measures*

- Range
- Standard deviation



3. **Variability:** *Sources*

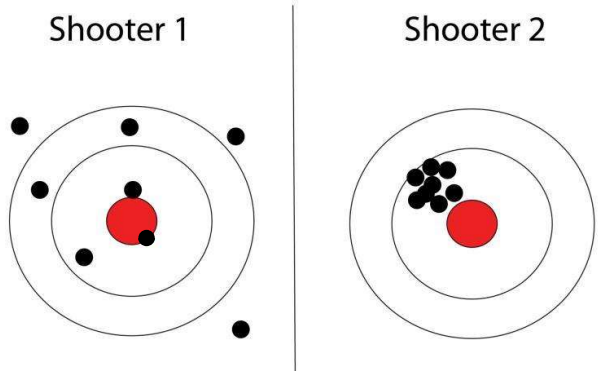
- Materials and construction:
  - Plant (stockpiles, cold feeds, binder addition, additives, mixing, transfer and storage)
  - Hauling (loading, transport, unloading)
  - Paver (operation)
  - Compaction (roller equipment and patterns)
- Sampling and testing….

3. **Variability:** *Reduce Variability*

- Technician Training
- Certification (Qualified Workforce)
- Laboratory Accreditation (AASHTO Re:Source)
- Regionalize/Standardize Test Methods
- Regionalize/Standardize Test Method Options
- Proficiency Sample Programs (Round Robins)

3.. **Variability:** *Statistical Analysis for QC*

Who is the better shooter?

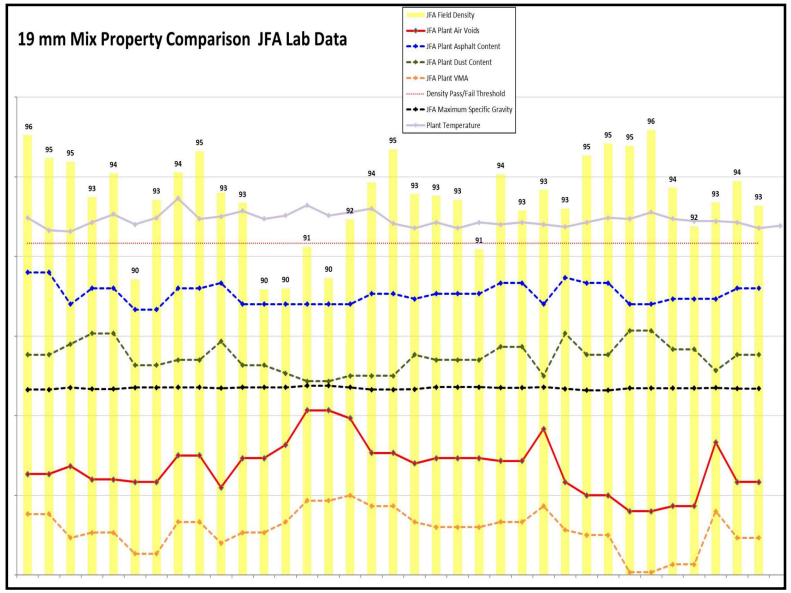


3. **Variability:** *Control Charts*

- What is plotted?
  - Control sieves
  - Asphalt content
  - Specific gravities
  - Voids and VMA
  - In-place density
  - Layer thickness

3. **Variability:** *Control Charts*

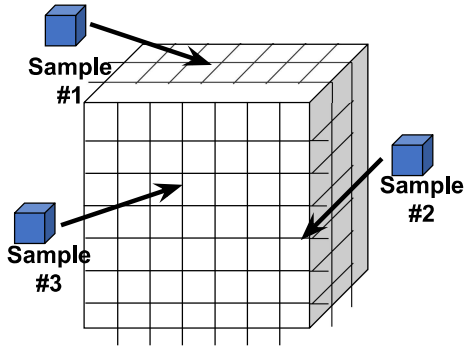
- Early detection of trends
- Establish process capability
- Decrease inspection frequency
- Permanent record of quality
- Provide a basis for acceptance
- Instill quality awareness
- Taking corrective measures
- Evaluating data for cost savings
- Recording and reporting



3. **Variability:** *Statistical Analysis for QA*

- Sampling
- Testing
- Apply acceptance criteria
- Determine pay adjustment

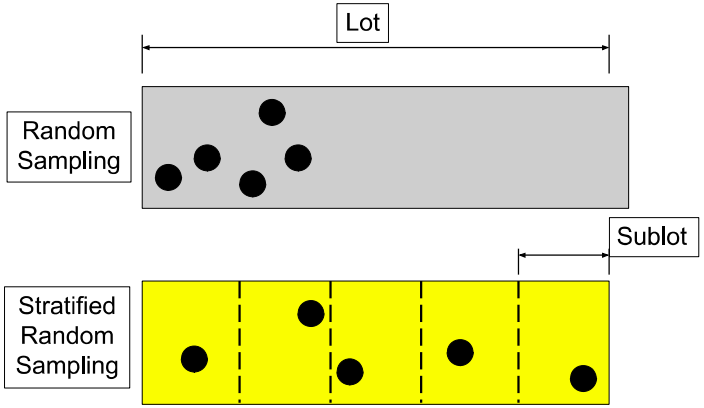
Sampling



3. Variability: *Random Sampling*

- Any portion of the population has equal chance of being selected
- Bias is introduced when judgment is used
- Use random number tables

3. Variability: *Lots and Sublots*



Pay Adjustments

- Most QA processes apply pay factor to adjust payment on a lot-by-lot basis
  - PWL and/or PD are commonly used to calculate Pay Factors (both penalty and bonus)
  - Pay Factors are typically determined for different factors and then combined
  - Max and limits on Pay Factors are established
- Not common to consider the Contractor's QC process

Payment Based on PWL

- Small number of tests results outside the specification limits is normal and not necessarily detrimental to performance
- Can also define Acceptable Quality Level (AQL) for key M&C factors (within which no pay adjustment is made)

Summary

1. Differentiate between quality control (QC) and quality assurance (QA)
2. Different types of specifications (relate to performance and risk)
3. Sources of variability within HMA construction process (emphasis on M&C variability)
4. Statistical analysis for QC (control charts) and QA (sampling to payment)

Questions

West Virginia University
Asphalt Technology Program

Module 3 – Surface Preparation

Chapter 5 – Asphalt Paving Handbook

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1

Learning Objectives

- Why surface preparation matters
- Explore the different existing conditions prior to HMA overlay
- Explore various repair techniques
- Describe proper Milling techniques
- Describe proper Tack coat applications

2

Why surface preparation matters?

- The performance of an HMA pavement under traffic is directly related to the condition of the surface on which it was placed.
- "Why bother - it gets covered up anyway"
  - Surface prep often doesn't get the attention it needs. It is easy to cover up problems with HMA, but rarely do the problems go away.
- Properly prepared surface conditions will maximize the performance of the new HMA surface (or overlay).

3

Preparation of the Subsurface Layers for a New Pavement

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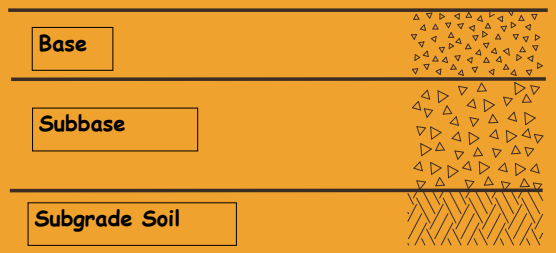

What materials and construction factors do we strive to control?

5

Is this subgrade ready?

6

Proof Rolling

7

Re-Work Weak Areas

8

Aggregate Base Preparation

- For best results use an asphalt paver
  - Improvements to overall pavement smoothness

9

Preparing for an Overlay on an Existing Asphalt Surface

- All depends on the its condition

Good Condition vs Poor Condition

10

Treatment options

- Overlay
- Patching
- Level or Scratch courses
- Base repairs
- Crack Sealing
- Milling

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Pavement Surface Repairs Must

- Address the distress mechanism (as well as symptom)
- Employ proper materials and construction procedures
- The plans and specification should define the contractor's responsibility for surface repairs.

12

Is this old patch okay?

13

Patch Construction

- Mark patch boundaries
- Cut boundaries
- Remove HMA and weak materials
- Repair foundation
- Apply tack coat
- Place HMA patch material (max lift of 4")
- Compact the patch

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Mark Patch Boundaries

- Identify limits that exceed the distressed area (recalling that the condition of the HMA is usually worse at the bottom than at the top).
- Mark straight boundary lines with areas as rectangular as possible.
- Extend boundaries into existing surface by at least 1-foot
- Consider width of your compaction equipment.

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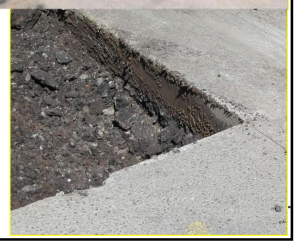
Cut Boundaries

- Ensure Clean, vertical faces
- Keep repairs with square corners and rectangular in shape
- Use diamond saw to cut edges
  - Consider partial-depth saw cut for thick HMA surfaces to retain some interlock.



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What's wrong with these?

17

Remove HMA & Weak Materials

18

Address Drainage Problems

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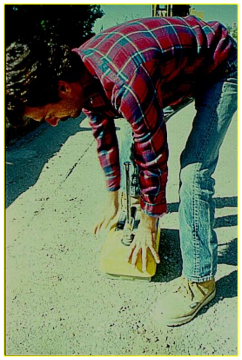
Repair Foundation (Replace Base Material)

20

Repair Foundation (Base Compaction)



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Apply Tack Coat

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Place HMA Patch Material

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Patch Compaction

Small Patches

Medium to Large Patches

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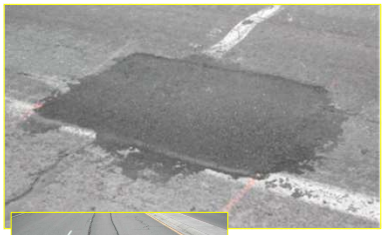
HMA Patch Examples



Good

Poor

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Smoothness Measurement Equipment

- WV 401.7.2
  - Machine evaluation
    - Inertial Profilometer
  - Other cases
  - 10 ft straight edge
  - Max Deviations
    - Base ¼ in
    - Surface 3/16 in

Straight Edge

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Surface Preparation of Existing PCC Pavements

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Two Primary Categories

PCC Slab Repairs (CPR)

- Joint Resealing
- Partial-Depth
- Full-Depth
- Slab Replacement

Fractured Slab Techniques

- Crack and Seat
- Break and Seat
- Rubblization

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PCC Slab Repairs

Partial-Depth Repair

Full-Depth Repair

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Rubblization

Resonant Frequency Pavement Breaker

Multiple Drop Hammer

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What is Rubblization?

- The Rubblized material has the structural capacity of a high-quality tightly keyed and interlocked stone layer
  - Eliminates slab action
  - Destroys bond between concrete and steel
  - Layer cannot crack; already fractured
  - High-density
- Proper compaction (and perhaps even a layer of crushed aggregate to provide a better working surface) is required prior to overlay placement

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Potential Problem with Crack Sealing

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Improving the Template

- Patch and Level
- Scratch Course
- Milling

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Patch and Level

- WVDOH
  - General: Patching and Leveling is to be placed at various locations throughout the project to remove irregularities in the existing pavement
    - Dips
    - Raise outside edge
    - Uniform template
  - Not specified as a continuous layer

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Scratch Course

- WVDOH
  - General: Scratch course shall be specified when deviations in the existing pavement are less than 1 inch in depth.
    - Full lane width
    - Not a constant thickness
    - Equipment "drags" on high spots and fills low spots
  - Can be placed over entire pavement or limits specified by engineer.

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Surface Leveling Course

36

Manually Placed Leveling Course

37

What caused these problems?

38

Surface Milling and Micromilling

39

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Uses for Surface Milling

- Surface distress removal
  - Rutting, raveling, surface cracking
- Achieve desired profile/grade correction
  - Allows smoother placement of the overlay
  - Utilized often in lieu of a leveling course
- Maintain curb reveal
- Improve bond between layer

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Delamination potential

- Ensure milling depth removes distress
- Do not leave scabs or unadhered materials on surface

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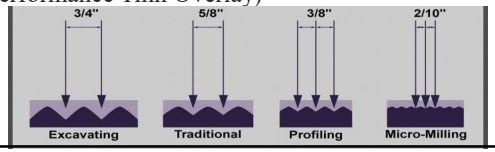
Micromilling

- Finer texture than standard milling
- Special provision
  - Remove less material
  - Template correction
  - Existing surfaces with minimal distress
  - Used with thin preservation treatments (High Performance Thin Overlay)



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Surface Milling and Ride Quality

- Milling is the first opportunity for a contractor to achieve smoothness requirements
- Mills can be outfitted with grade control devices
  - Ski, laser, GPS, etc.

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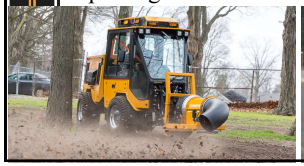
Surface Preparation

- After patching and sealing, and prior to applying the tack coat, the surface must be properly clean and dry.
- Typically, a power broom or street sweeper is used.
- Any foreign material (dried mud, spilled asphalt, etc.) must be removed.
- Cleaning is typically done immediately prior to placing the tack.



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Surface Preparation

- What is "CLEAN AND DRY"?
- Clean…
  - Remove anything that would interfere with adhesion or with placement operations, e.g. dust, loose aggregate, soil, leaves, pieces or lumps of foreign material, etc.
- Dry…
  - Emulsions may be placed on "damp" surfaces
  - Pavement should not be wet

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Apply Tack Coat

- While the surface is still clean, apply the tack coat (as shown in top photo).
- Slow-set asphalt emulsions are typically used
- Distributor must be working properly for even application

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Why do we tack??

- To bond paving layers in order to create a monolithic pavement structure
- Failure to achieve a Monolithic Layer??
  - Flexural strength is reduced
  - Structural design is invalid
  - **Premature failure**

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Structural Importance

Up to 5 sheets (layers) 48" x 4" x 11/32"

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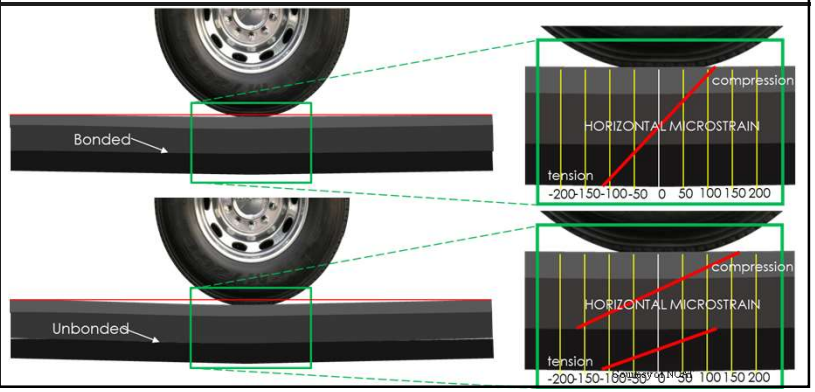
Structural Importance



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Telltale signs of a bond failure?

- Layers slipping under traffic load

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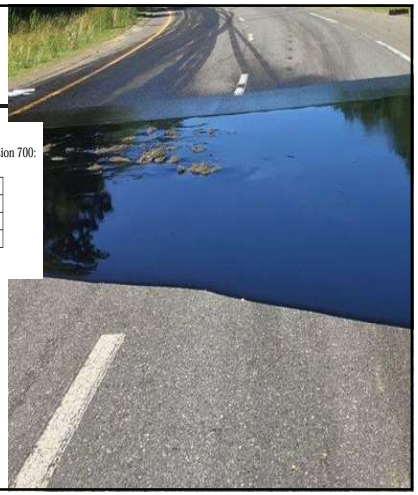
The Right Material

408.2-MATERIALS:
Materials shall conform to the requirements of the following Subsection of Division 700:

MATERIALS	SUBSECTION	TYPE
Asphalt Emulsion	705.4	SS or RS Grades
Cationic Emulsified Asphalt	705.11	CSS or CRS Grades
Non-Tracking Asphalt Material	705.13	NTSS-1HM or similar*

* Refer to MP 401.02.25 for a list of Certified Asphalt Materials.



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Non-Tracking Tack Coat

- Shorter break and set time vs standard tack
  - 10-15 minutes vs 20-30 minutes
- Typically harder base binder
  - Does harder mean Stronger??
- Quick curing keeps tack on roadway where it is needed
  - accelerates paving operations
  - Improves aesthetics by avoiding tracking onto local roadways
- Night paving
- Any project where conditions do not allow for adequate cure time for standard tack coat
  - Urban & suburban areas with numerous driveways, intersections and high traffic volume
  - Any project where tracking onto local roads is unacceptable

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APPLICATION OF ASPHALT MATERIAL

- Determining your Application Rate Table 407.06-1
  - Existing surface (asphalt vs concrete)
  - Aged of the existing surface? (oxidized, fresh,…)
  - Pavement texture (milled, fine-milled, rough, smooth,…)
  - On concrete (or brick)

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	0.07 – 0.10	0.13 – 0.20
Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

Note 2: Application rates are for slow setting emulsions grades (SS and CSS) that contain approximately 60% asphalt material. Rapid setting emulsion grades may contain slightly higher or lower asphalt contents, but can usually be applied within the same application range.
Note 3: Dilution rate only applies to SS and CSS grades.
Note 4: Tack coat is normally not needed over a layer of new HMA that has been placed within the last few days, as long as the underlying new layer has not become dirty under traffic or from windblown dust.

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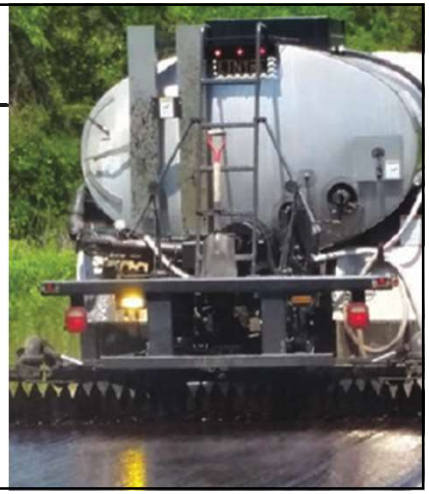
The Tack Coat Distributor

- End goal…Apply Tack Coat material to obtain a **uniform, complete coverage****
- Spray bar set-up level with the paving surface
- ~12” off the surface
- Double or Triple Coverage
- Correct nozzles



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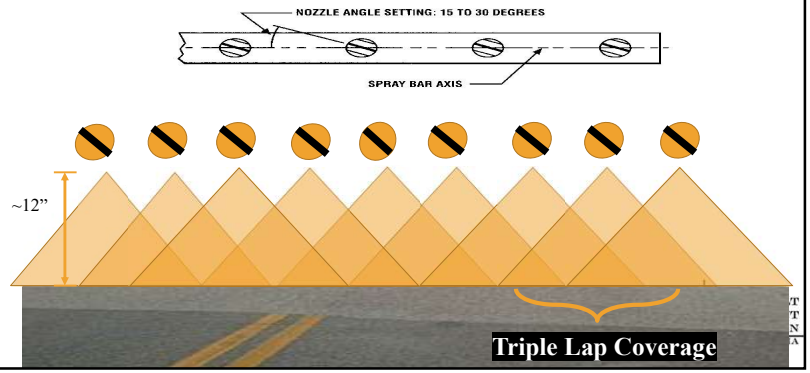
Effect of Nozzle Orientation



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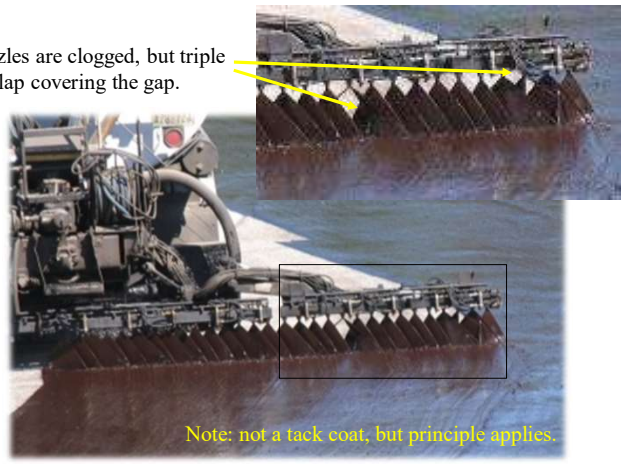
Nozzle Application Charts

57

58

Nozzles are clogged, but triple overlap covering the gap.



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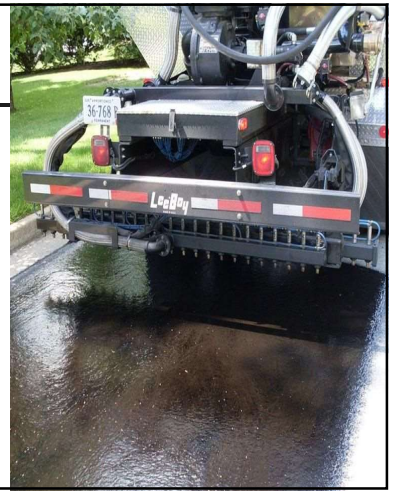
Emulsion Breaking vs Setting

- Emulsions are asphalt droplets suspended in water
- Breaking
  - Contact with surface changes pH; reducing charge
  - Color change… brown to black
- Setting
  - Evaporation leads to coalescence
  - Original asphalt characteristics return



60

Tracking and Pickup

61

Non-Tracking Tacks fix the problem, Right?

- If you don't let it break material choice doesn't matter

62

63

64

65

Is this application acceptable?

Is it uniform?

Is this complete coverage?

No, No and No.

66

Acceptable?

Uniform?

Complete Coverage?

No

67

Acceptable?

Uniform?

Complete Coverage?

Yes

68

Tack Application Rate

- Verifying the final tack coat application rate is important to ensure it meets the specified requirements
  - Too little or too much – both are bad.
- The applied rate should be compared to the specified rates from Section 408
- Application rates are commonly expressed as a volume per area, e.g., gallons per square yard

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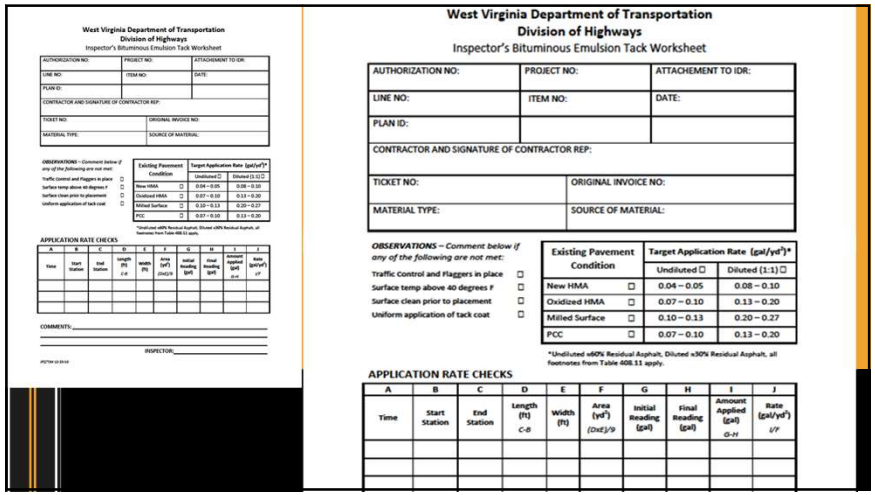
Tack Application Rate Calculation

- **Step 1:** Determine the distance traveled.
- **Step 2:** Calculate the area covered = distance traveled X width sprayed. (convert from square feet to square yard if needed).
- **Step 3:** Calculate the gallons of material applied = beginning volume—ending volume.
  - The volumes may be determined by using a dipstick calibrated to the truck's tank (much preferred), or onboard meters.
- **Step 4:** Correct for temperature back to 60 °F by applying correction factor.
  - Page 130-131 from Handbook
- **Step 5:** Account for any dilution.
- **Step 6:** Calculate application rate which is the gallons of material applied divided by the area of application

70



West Virginia Department of Transportation
Division of Highways
Inspector's Bituminous Emulsion Tack Worksheet

AUTHORIZATION NO:	PROJECT NO:	ATTACHEMENT TO IDR:
LINE NO:	ITEM NO:	DATE:
PLAN ID:		
CONTRACTOR AND SIGNATURE OF CONTRACTOR REP:		
TICKET NO:	ORIGINAL INVOICE NO:	
MATERIAL TYPE:	SOURCE OF MATERIAL:	

OBSERVATIONS – Comment below if any of the following are not met:

Traffic Control and Flaggers in place	☐
Surface temp above 40 degrees F	☐
Surface clean prior to placement	☐
Uniform application of tack coat	☐

Existing Pavement Condition		Target Application Rate (gal/yd²)* Undiluted ☐	Diluted (1:1) ☐
New HMA	☐	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	☐	0.07 – 0.10	0.13 – 0.20
Milled Surface	☐	0.10 – 0.13	0.20 – 0.27
PCC	☐	0.07 – 0.10	0.13 – 0.20

*Undiluted ≥60% Residual Asphalt, Diluted ≥30% Residual Asphalt, all footnotes from Table 408.11 apply.

APPLICATION RATE CHECKS

A	B	C	D	E	F	G	H	I	J
Time	Start Station	End Station	Length (ft) C-B	Width (ft)	Area (yd²) (DxE)/9	Initial Reading (gal)	Final Reading (gal)	Amount Applied (gal) G-H	Rate (gal/yd²) I/F

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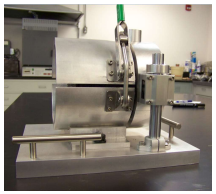
Insurance VS Performance

- Insurance
  - Calibration of the Distributor
  - Application Rate verification
- Performance
  - Destructive testing (Shear/Torsion/Tension/etc)



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Why surface preparation matters?

- The performance of an HMA pavement under traffic is directly related to the condition of the surface on which it was placed.
- By addressing issues and creating a smooth template to pave upon, greater ride quality and greater density can be achieved extending the life of the pavement

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West Virginia University
Asphalt Technology Program

Module 4 – Material Delivery

ASPHALT PAVEMENT ASSOCIATION OF WEST VIRGINIA

1

Learning Objectives

- State the objective of HMA delivery
- Discuss key issues related to haul trucks
- Describe proper truck operation (loading and unloading) techniques
- Describe the two types of segregation
- Identify the 4 production rates needing coordination

2

HMA Delivery

- What is the objective?
  - Do we care how long it takes to deliver the material?
  - Do we care what condition the material is in when we deliver it?

- Ultimately, the objective is one that involves picking up and delivering the HMA material in a timely fashion without seriously affecting its desirable properties (i.e., temperature uniformity and aggregate gradation).
- Truck drivers are a key component,… Make them a part of the team!

3

Key Issues Related to Haul Trucks

- Types and characteristics of haul trucks
- Methods of heat insulation
- Cleaning
- Truck maintenance

4

West Virginia
Best Management Practices

- WVDOT/ Public Service Requirements
  - Oil drip
  - Dirt
  - Tires
  - Back-up alarm
  - Release agent (no diesel)

5

Three Basic Types of Haul Trucks

- End dump
- Belly dump
- Horizontal discharge




6

Truck Comparison

- Standard End Dump Truck
  - Capacity: 12-20 tons
  - Advantage: Short wheelbase - Maneuverability (good for tight spaces)
  - Disadvantage: Limited capacity, Overhead obstructions
- Semi-trailer, high dump
  - Capacity: 20-22 tons
  - Advantage: Larger capacity
  - Disadvantage: Higher chance of material segregation, Overhead Obstructions
- Belly Dump
  - Capacity: 22-24 tons
  - Advantage: Larger capacity, No raised be so no overhead obstruction issues
  - Disadvantage: Need for additional equipment(windrow elevator), Long wheelbase
- Live Bottom
  - Capacity: 12-20+ tons
  - Advantage: No raised be so no overhead obstruction issues
  - Disadvantage: Extra attention towards cleaning to ensure drag slat is functioning

7

Specification 401.9.7
Trucks for Transporting Mixture

- Truck
  - Good repair –
    - No delays in transporting
    - No "large" oil leaks
  - Insulated
  - Covered
    - Limit air infiltration
    - Water tight
    - Above mix
    - Over sides
  - Hole for measuring temperature
- Release agent
  - Any commercial produce, subject to DOH approval
  - Thin coat
    - Soapy water
    - Mixture <10% lubricating oil
    - Polymer modified binder
      - Agent recommended by supplier
  - Remove excess prior to loading
  - NO DIESEL, KEORSENE OR SIMILAR SOLVENT

8

Tarp for (Some) Protection Against Heat Loss and Inclement Weather

Are there any potential problems with this tarp configuration?

9

Side Insulation

10

Keep Truck Bed Clean

11

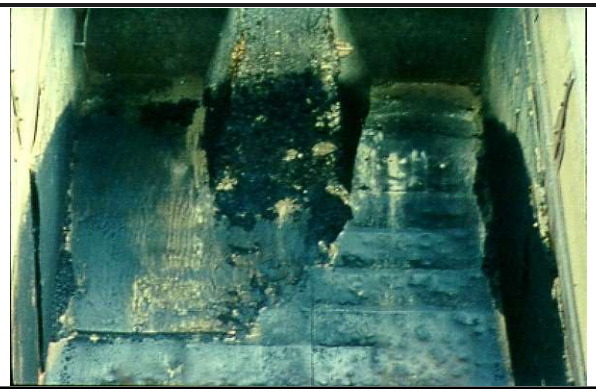
Use Only Approved Release Agents

12

Keep Outside of Bed Clean Too

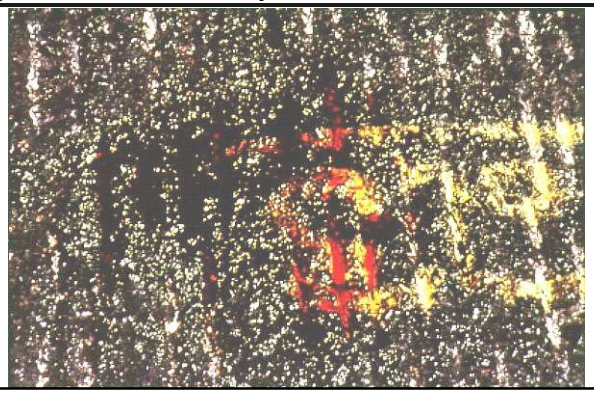
13

Acceptable Truck Bed?



14

What problem does this hydraulic fluid leak create?

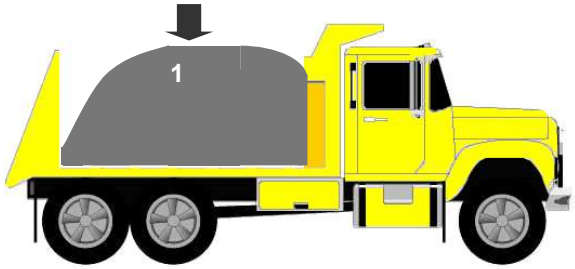


15

Truck Loading Practices Must Avoid Segregation

16

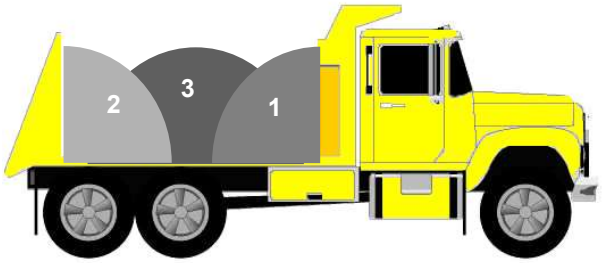
Bad Loading Practice



Not recommended for segregation-prone mixes!

17

Correct Sequence for Typical End Dump Trucks in WV



18

Other Loading Practices to Avoid

- Topping off to reach legal limit
  - Plant operators may want to top-off the truck to legal limits to reduce haul costs, especially if truck is sitting on the scale under the silo.
    - While good economics, it should not occur by dribbling mix into a nearly full truck.
    - Discharging small amounts of mix into the truck greatly increases the chance for mix segregation.
- Overloading
  - Overloading is not recommended as it is illegal and dangerous. Modern electronic scales and printed tickets have helped eliminate this practice.

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General Recommendations

- Trucks should wait in designated areas and avoid tracking of tack coat
- Coordinate truck schedule to assure timely arrivals with minimum wait time
- Maintain good communications with plant operators and truck drivers
- Collect weigh tickets upon arrival to site

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End Dump Truck Operation

Positioning in front of paver

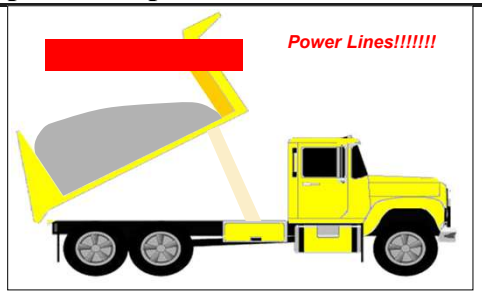
21

End Dump Truck Operation

- Allow the paver to "pick up" the truck
  - Truck should stop short of the paver
- First contact with paver,… avoid bump!
  - Bumping the paver can leave a screed mark and roughen the mat
- Truck should apply light braking force to remain in contact with the paver

22

End Dump Truck Operation



Raise bed, but keep tailgate closed until mix slides against it

23

End Dump Truck Operation

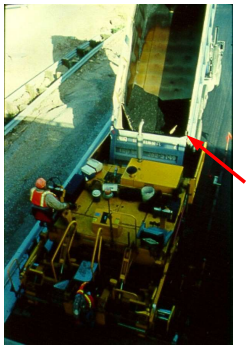
Open gate and continue to raise bed

24

End Dump Truck Operation

Empty mix in one smooth, continuous discharge

WV Practice??



What are baffles for?

25

End Dump Truck Operation

Lower bed before pulling away

26

End Dump Truck Operation

Move out and make room

27

End Dump Truck Operation

Proceed to the designated clean-up area

28

End Dump Truck Operation

29

What happened here?

End Dump Truck Operation

30

End Dump Truck Operation

Problem with pulling away with bed up

31

End Dump Truck Operation

What probably caused this?

32

End Dump Truck Operation

Why can't this be paved over?

33

Types of Segregation

- Coarse/Fine Aggregate
- Thermal

34

Aggregate Segregation

- Problem – Mix segregation results in non-uniform gradation and density, interconnected air voids, and poor mix performance
- Typical sources:
  - Mix loading
  - Mix unloading
  - Paver operation

35

Minimize Aggregate Segregation by:

- Better mix gradations
- Improved loading, unloading and paving practices
- Material Transfer Vehicle (MTV)

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Material Transfer Vehicle

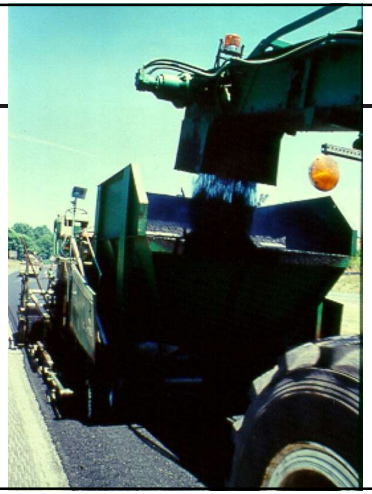
WV Contractor option unless required in the plan notes

Truck dumps into MTV (rather than paver)

37

Material Transfer Vehicle

MTV conveys mix into surge bin inserted into paver hopper



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Thermal Segregation

- Problem – Non-uniform temperature distribution makes it difficult to achieve uniform compaction and maximum HMA performance
- Typical sources:
  - Time duration between loading and paving
  - Processes that increase mix exposure to non-uniform cooling

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Thermal Segregation Can Be Reduced by:

- Minimizing time between truck loading and placement
- Use of truck insulation
- Proper paving techniques
- Special equipment – Material Transfer Vehicle (MTV)

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Thermal Segregation As Depicted by Infrared Photos

- End dump truck directly into paver
- Blaw-Knox MC-30 MTV
  - a) With mixing
  - b) Without mixing
- Cedarapids MS-3 MTV
- Roadtec Shuttle Buggy
- Belly dump truck with windrow elevator

Photos Courtesy of Washington State DOT

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1. End Dump Directly Into Paver

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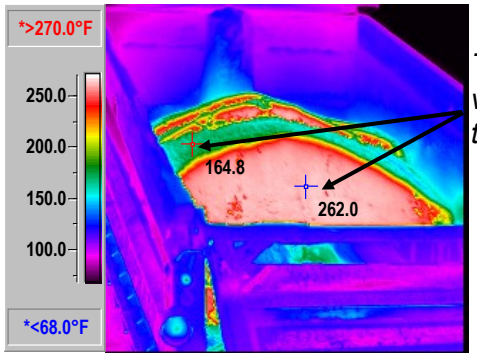
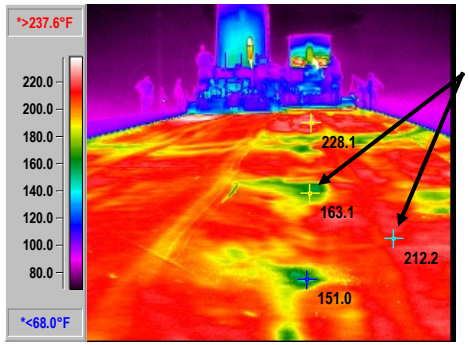
Infrared Photo of End Dump



Temperature variation in truck bed

43

Infrared Photo (End Dump Mix Behind Paver)



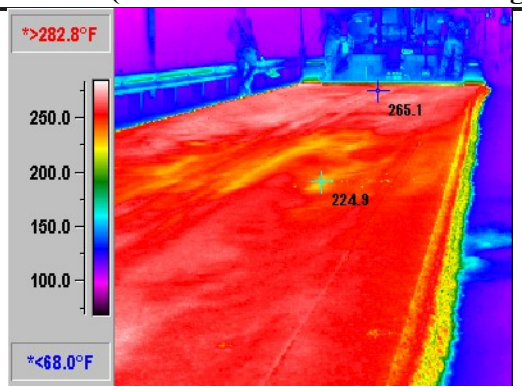
Temperature variation in mat

44

2. Blaw-Knox MC-30 MTV

45

Infrared Photo (Blaw Knox MTV with Mixing)



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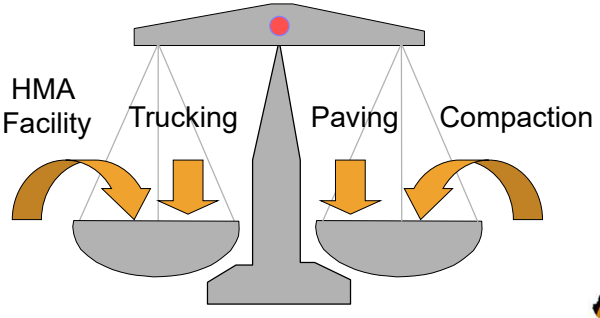
Balancing Production



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West Virginia University
Asphalt Technology Program

Module 5 – HMA Placement

Chapter 7 – Asphalt Paving Handbook

ASPHALT PAVEMENT ASSOCIATION OF WEST VIRGINIA

1

Learning Objectives

- State the Objectives of HMA Placement
- Identify Components and Function – Tractor and Screed Unit
- Describe Operational Principles of Screed
- Describe Grade and Slope Control Systems
  - Types
  - Functions
  - Capabilities

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2

Learning Objectives

- Recognize Yield-Thickness-Smoothness Relationship
- Describe Proper Operating Techniques
- WVDOH Documents
  - MP 401.03.50 – requirement for QC Plan
  - Specification 401.10 – Paving Operations

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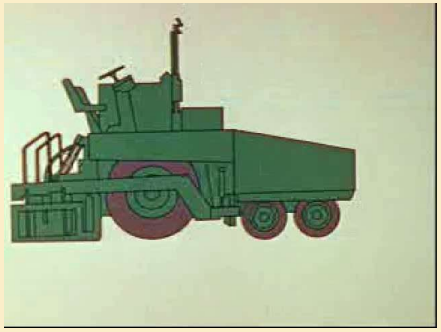
5-3

3

Proper Auger Loading



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5-4

4

Tractor Unit

- Drive Systems
- Push Rollers and Truck Hitches
- Hopper
- Slat Conveyer
- Conveyer Flow Gates
- Augers
- Materials Feed System
- Tow Points

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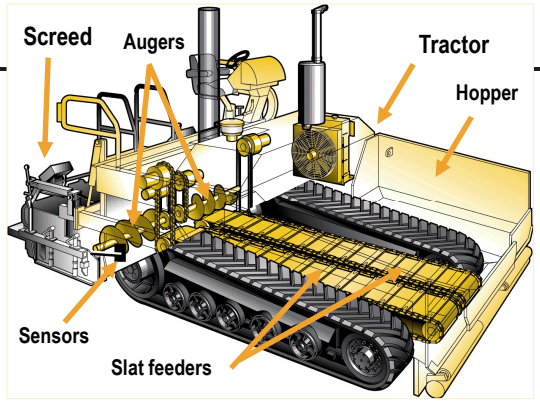
5-5

5



CAT *Courtesy of Caterpillar Paving Products*

6

Tractor Unit

CAT *Courtesy of Caterpillar Paving Products*

7

Track Drive

CAT *Courtesy of Caterpillar Paving Products*

8

Truck Hitch

Not used in WV. Truck can take control of paver

9

Push Rollers With Truck Hitch

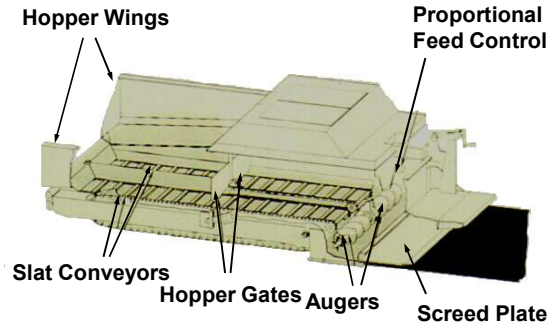
Keep Clean
Careful with Tack!!

10

Truck Should Not Bear On Paver

11

Material Flow



12

Paver Hopper

13

Repair Worn Flashing

14

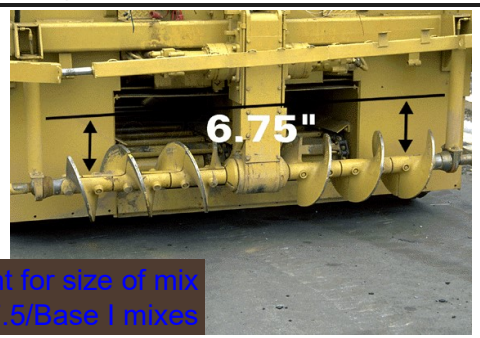
Slat Conveyors

15

Flow Gates

16

Adjustable Screw Augers



Adjust height for size of mix
Raise for 37.5/Base I mixes

CAT

Courtesy of Caterpillar Paving Products

17

Adjustable Screw Augers

- Auger height affects mat texture
- Auger height 2" above mat is right for most mixes
- Fine tune according to mix

CAT

Courtesy of Caterpillar Paving Products

18

Proper Head of Material

Mix at middle of auger shaft
Too much mix causes segregation

CAT

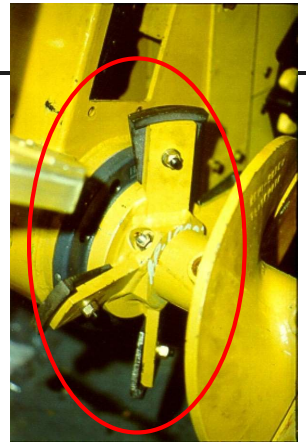
Courtesy of Caterpillar Paving Products

19

Kick Back Paddles

"Tuck" mix under gear box

Prevents segregation at center of paver



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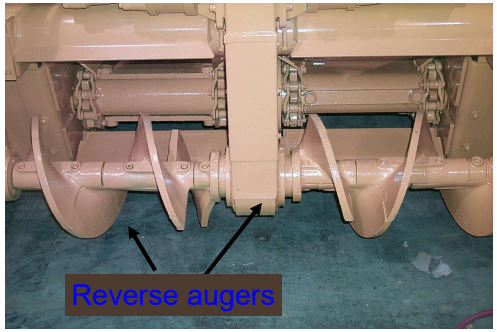
Kick Back Flights



CAT

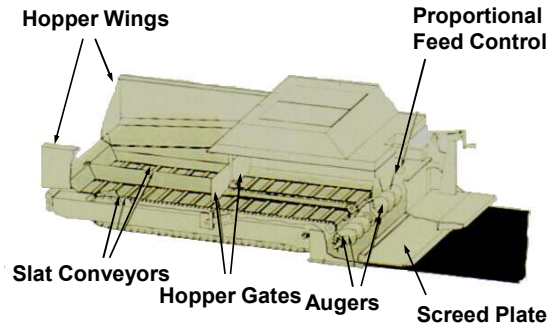
Courtesy of Caterpillar Paving Products

21

Extendable Augers

22

Material Flow



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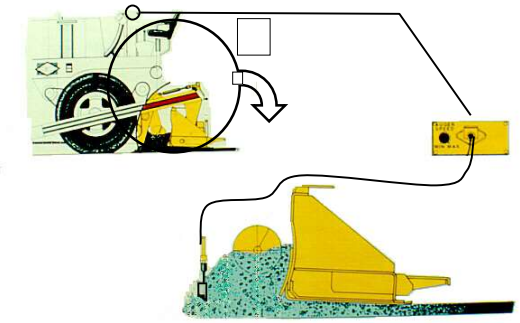
Feed Control Sensors



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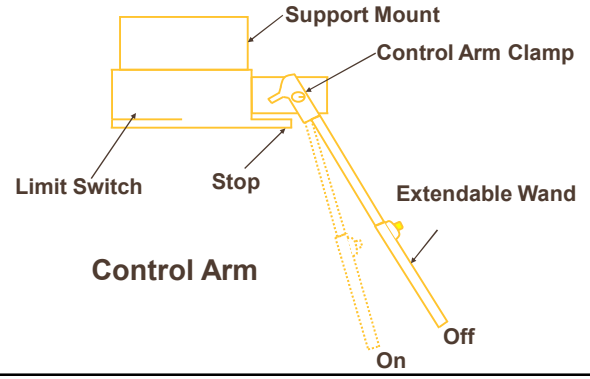
Mechanical Feed Control Sensors



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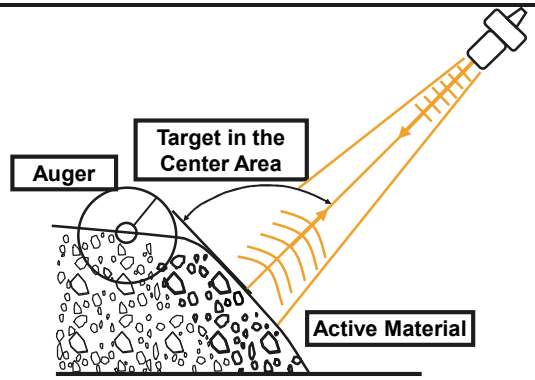
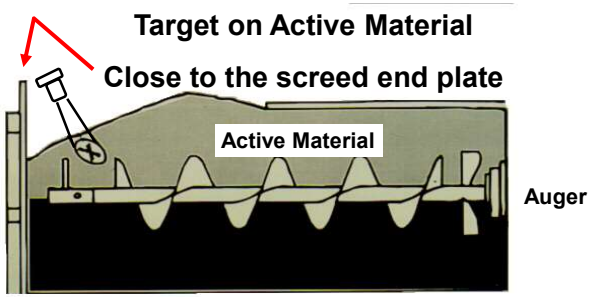
Remote Feed Control



26

Feed Control Sensor

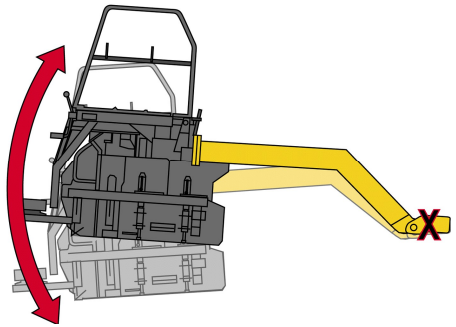


27

Screed End Plate

28

Tow Point



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Tow Point

Used with
automatic controls

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Screed Unit

- Screed plate
- Strike-off
- Crown control
- Extensions and end plates
- Thickness Control Screws
- Screed Arm
- Pre-Compaction System
- Heating Systems
- Maintenance

Blaw-Knox

Courtesy of Blaw-Knox Ingersoll Rand Paving Products

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Screed Plate

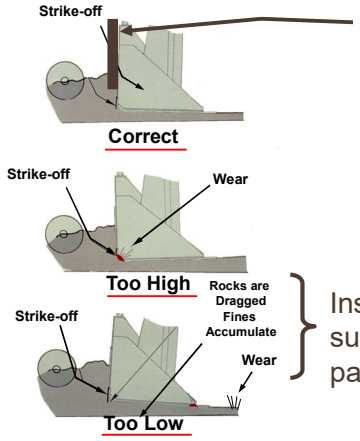
The screed plate is a high wear item.

Maintenance!!!

32

Screed Plate

33



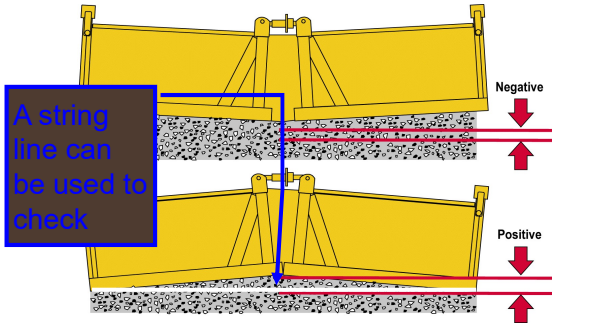
Prestrike off plate used on some pavers

Strike-off Plate Adjustment

Inspection of surface during paving

34

Screed Plate Crown Adjustment



CAT *Courtesy of Caterpillar Paving Products*

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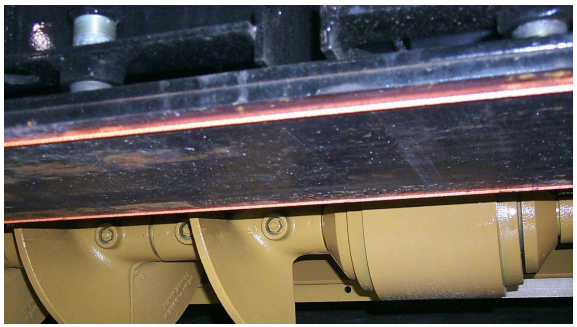
Checking Screed Crown with Stringline



CAT *Courtesy of Caterpillar Paving Products*

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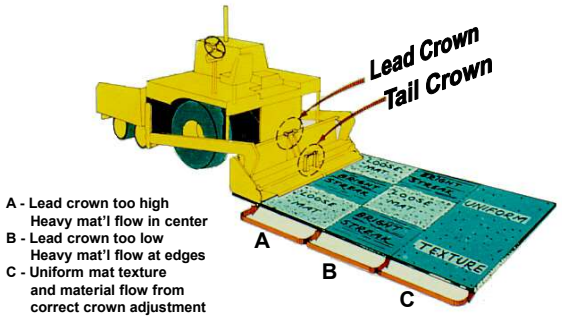
Crown Adjustment



A - Lead crown too high
Heavy mat'l flow in center
B - Lead crown too low
Heavy mat'l flow at edges
C - Uniform mat texture
and material flow from
correct crown adjustment

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Lead crown too high, heavy material flow in center	Lead crown too low, heavy material flow at edges	Uniform mat texture and material flow from correct crown adjustment

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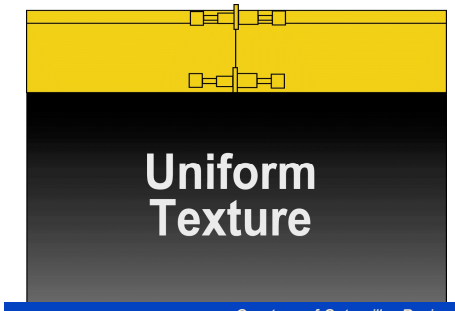
Lead Crown - ~1/8 in Greater Than Tail Crown



CAT

Courtesy of Caterpillar Paving Products

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Hydraulic Screed Extension

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Courtesy of Caterpillar Paving Products

40

Mechanical Screed Extension

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Screed End Plate

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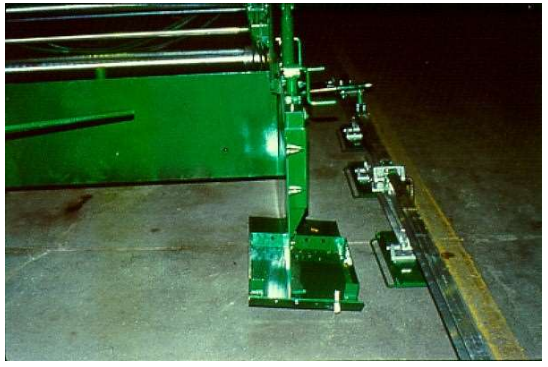
Longitudinal Joint Forming

43

Cut-off Shoes



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Thickness Adjustments

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Courtesy of Caterpillar Paving Products

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Thickness Control Screws

Changes the angle of the screed

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Courtesy of Blaw-Knox Ingersoll Rand Paving Products

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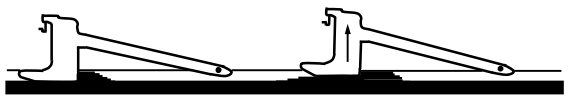
Hand Crank Effects

Hand cranks turned to thicken

Tow point unchanged

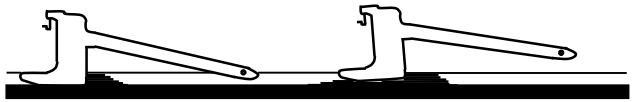


47

Tow Point Effects

Hand cranks unchanged

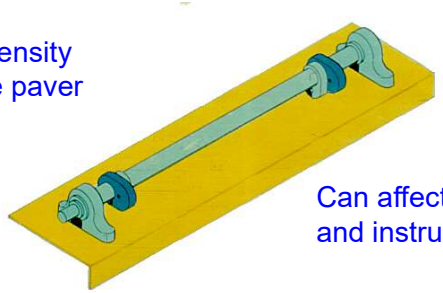
Tow point raised



48

Screed Vibrators

Improve density behind the paver

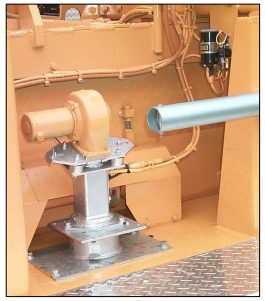


Can affect controls and instruments

Vibratory Shaft With Weights

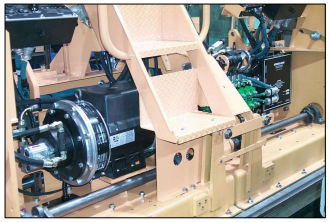
49

Screed Heaters



Diesel System

Screed heaters cannot be used to raise the heat of the mix.
Heat a cold screed to about 300°F prior to the start of paving.



Electric System

Blaw-Knox. Courtesy of Blaw-Knox Ingersoll Rand Paving Products

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Warming Up

- Screed heater. Heaters used to preheat the screed to HMA temperature. HMA may stick to a cold screed and cause mat tearing. After the screed has been in contact with the HMA for a short while (usually about 10 minutes) its temperature can be maintained by the HMA passing beneath it and the heater can be turned off. If the screed is removed from contact with HMA for an extended period of time, it may need to be pre-heated again before resuming paving.

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Warming Up

- The screed heaters cannot be used to increase the temperature of the mix being placed because the amount of time that the mix is actually under the screed is much too short to accomplish any temperature rise in the mix.
- Screed heaters can over heat the mix if the paver is stopped with the screed in contact with the mix, e.g. wait for the next truck.

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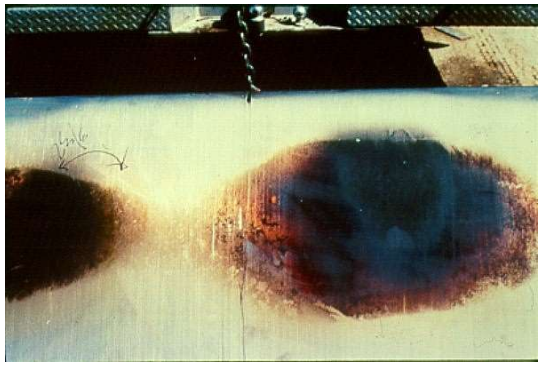
Damaged Screed Plate



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Operational Principles of the Screed

- Self-leveling Concepts
- Screed Response versus Distance
- Forces Acting on a Screed

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Screed Adjustment

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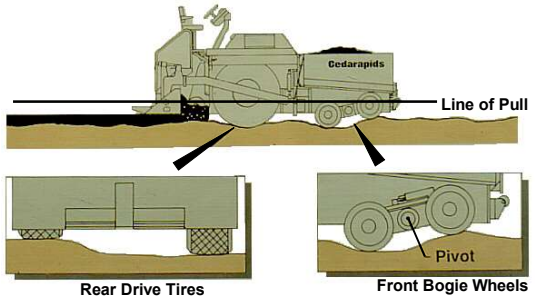
55

Self Leveling - Rubber Tired Paver



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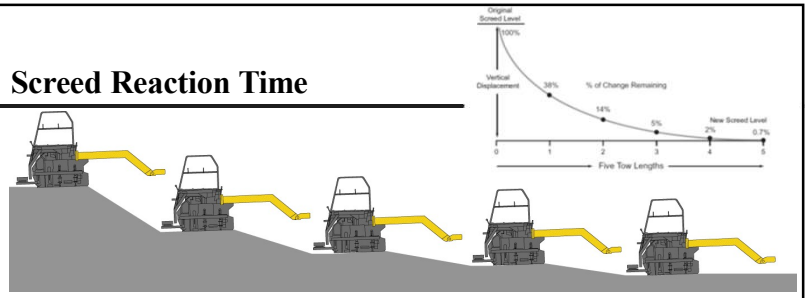
Screed Reaction Time



- Screed reacts to change in angle of attack over 5 tow arm lengths
- 65% of change occurs in the first tow arm length
- 35% of change occurs in the last 4 tow arm lengths

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Courtesy of Caterpillar Paving Products

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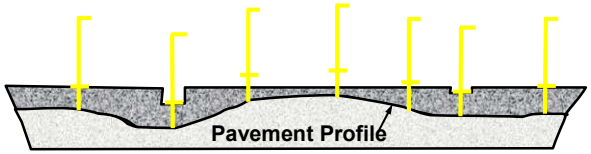
Sticking the Mat?



Direction of Paving

What is the correct thickness?

58

Main Forces Acting on Screed

- Speed of Paver
- Head of Material
- Angle of Attack
- Other Forces
  - Pre-compaction
  - Screed Weight

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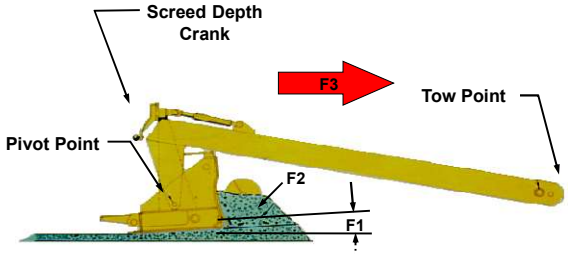
Screed Forces



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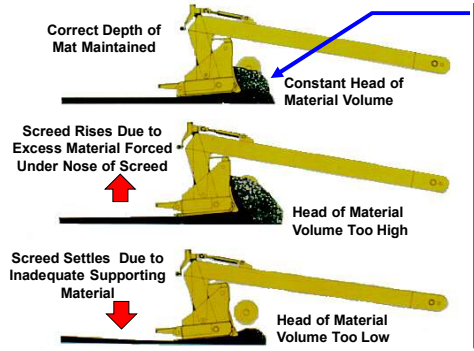
Mix Effect on Paving

- Coarser mixtures
- Modified asphalts

61

Head of Material



Key issue for Smoothness. The "system" must work together
Trucks
Hoppers
Slats
Constant head of material!!!

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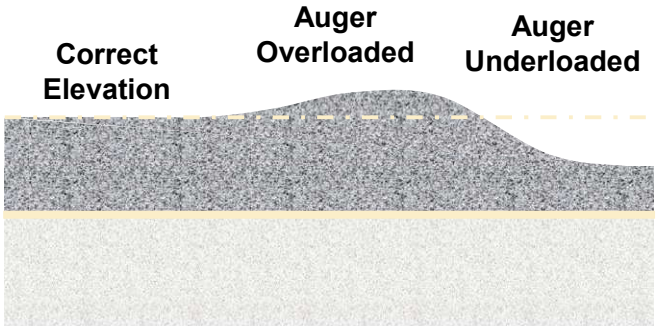
Head of Material Effects



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Stopping the Paver?

64

Screed Control Systems

- Who's Responsible for Changes?
- Sticking the Mat
- Manual Controls
- Automatic Controls

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Manual vs. Automatic Adjustments

- The more the operator tries to assist the self-leveling action of the screed, the rougher the new surface will be.

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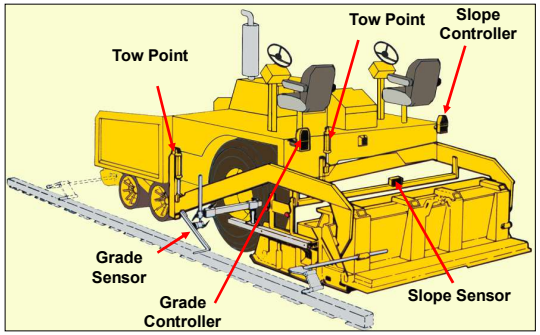
Grade and Slope Control



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Types of Grade Reference

- Stringline
- Mobile reference
- Joint matching shoe
- Sonic sensor
- Laser

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Stringline

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Bridge Ski

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Floating Beam

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Contact-less Beam with Ultra Sonic Sensors

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Joint Matching Shoe

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Joint Matching with a Non-contact Grade Sensor

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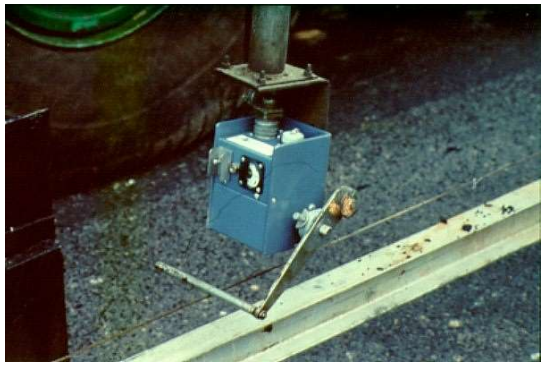
Automatic Grade Sensor

Operation of the sensor should be checked regularly.



75

Yield-Thickness-Smoothness

- Base Condition
- Minimum Thickness
- Yield
- Smoothness
- Controlling Yield versus Thickness or Smoothness

You can't control yield and thickness or smoothness. Establish beforehand which will be the controlling factor!!!!!

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Types of Paving

- Planning Pulls
- Mainline Paving
- Shoulder Paving
- Variable Width Paving
- Transitions
- Temporary Paving
- Echelon Paving
- Night Paving

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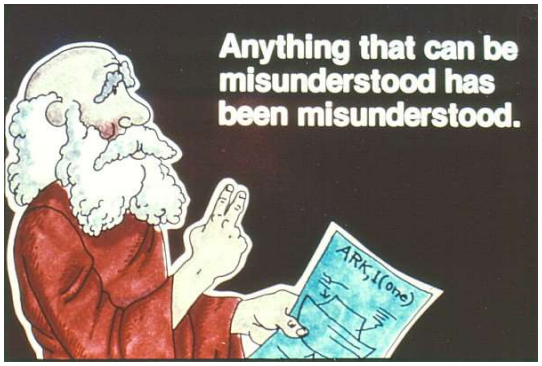
Paving Widths



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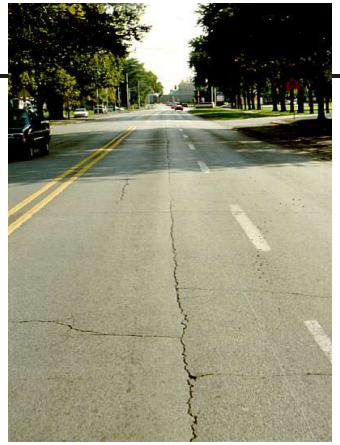

Good Joint Location?

79

Mainline Paving

80

Shoulder Slope Paving

81

Variable Width Paving

82

Echelon Paving

83

Night Paving

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Night Paving

- Becoming more common
- Requires more attention
- Issues:
  - Visibility
  - Cooler Temperatures
  - New Crews
  - Lighting
  - Safety!!!

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Night Paving-Safety Issues

- Changes in Driving Habits
- Drunk drivers

86

Night Paving-Construction Issues

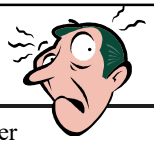
- Operator Awareness
- Equipment Maintenance
- Additional care during testing
- Impacts of limited lighting

87

Night Paving-Other Issues?

88

Operating Techniques



- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
- Checking Yield
- Truck Exchanges
- Folding Hopper Wings
- HMA Level in Hopper
- Auger Operation
- Flow Gate Position
- Raking and Luting
- Concluding Paving

Traffic Control

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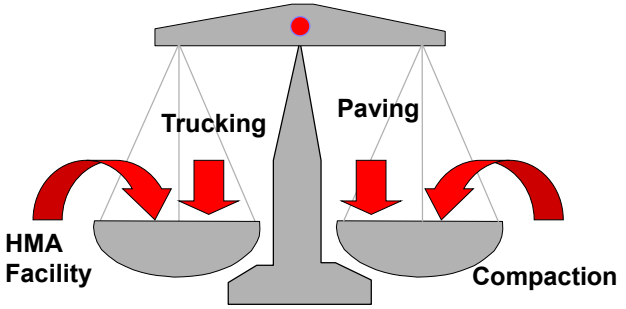
Balancing Production



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PAVING PRODUCTION CALCULATION FORM:

Date:_____ Project #: _____

Project:_____

Tonnes scheduled to be placed today (T-MIX): _____ tonnes

Hours of Paving Scheduled (P-TIME): _____hours

Mix Delivery Rate (H-RATE):
= T-MIX ÷ P-TIME
= _____ ÷ _____ = _____ tph

Paving Width (WIDTH): _____ m

Paving Thickness (THICK): _____ millimeters

Compacted Mix Density (DENSITY):

Specification limits for density: Minimum = _____; Maximum = _____
The in-place target density should be above the Minimum: Target = _____

DENSITY = Reference Density x % Target Density
= _____ kg/cu m x _____
= _____ kg/cu m

Actual Paver Production Rate (P-RATE):

= MIX RATE (tph) x 1,000 kg / 1 tonne x 1 hr / 60 min ÷ WIDTH (m) ÷ THICK(m) ÷ DENSITY(kg/r

= _____ x 1,000 ÷ 60 ÷ _____ ÷ _____ ÷ _____

P-RATE = _____ meters/min

Paving Efficiency Factor (EFF1): _____ (recommended: 0.75 - 0.85)

Actual Paver Speed (PAVER):

PAVER = P-RATE ÷ EFF1 = _____ ÷ _____ = _____ meters/min

Methods are available for computing the balance between:
- paver production
- roller production
- plant production
- number of trucks required

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Operating Techniques

- **Warming up machine and screed**
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- Flow Gate Position
- Raking and Luting
- Concluding Paving

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Warming Up

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Operating Techniques

- Warming up machine and screed
- **Positioning on Joint**
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
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- Raking and Luting
- Concluding Paving

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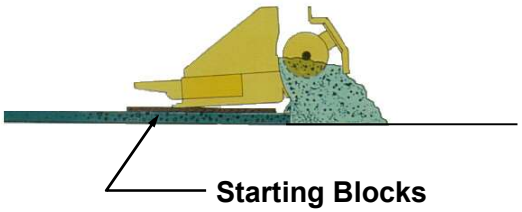
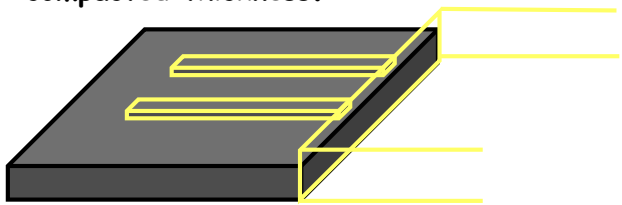
Screed in Position



95

A good rule of thumb is to raise the screed 20% to 25% more than the compacted thickness.



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Steering Guide

Varies by operator SKILL!!!!

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Operating Techniques

- Warming up machine and screed
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- **Nulling the Screed**
- **Initial Settings**
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- Concluding Paving

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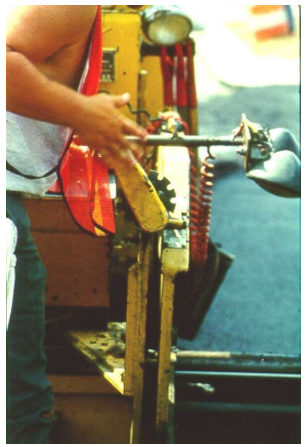

Null Screed

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Setting Angle of Attack

100

Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- **Charging Hopper, Tunnels, Screed**
- Pulling off Joint
- Re-checking Settings
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- HMA Level in Hopper
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- Raking and Luting
- Concluding Paving

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Misaligned Screed Extension

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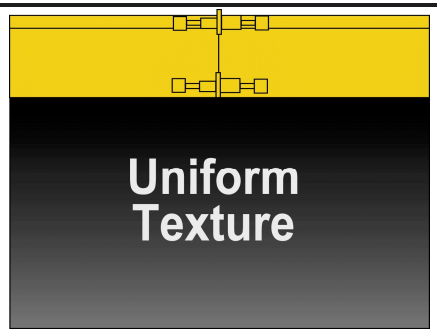
Lead Crown - ~1/8 in Greater Than Tail Crown



CAT Courtesy of Caterpillar Paving Products

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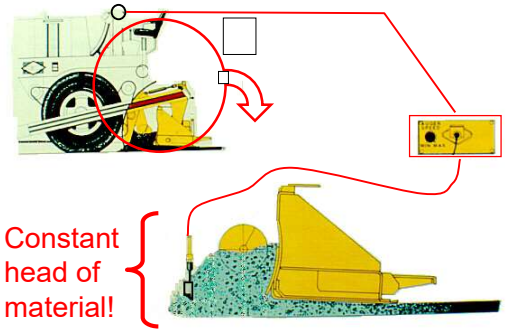
Check and Adjust Sensors



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Smoothness

Stop 1 foot short of paver!!

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Operating Techniques

- Warming up machine and screed
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- Concluding Paving

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Loading Augers

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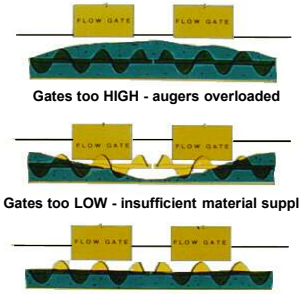
Adjust Flow Gates



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Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- **Pulling off Joint**
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- **Speed of Paver**
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- Truck Exchanges
- Folding Hopper Wings
- HMA Level in Hopper
- Auger Operation
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- Concluding Paving

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Start Up

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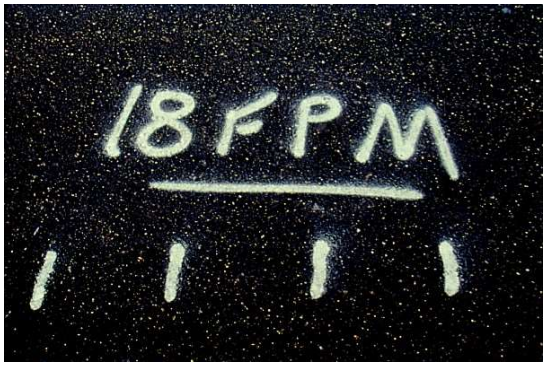
Check Paver Speed



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Operating Techniques

- Warming up machine and screed
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- Re-checking Settings
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- Raking and Luting
- Concluding Paving

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Re-Check Settings

- Is thickness okay?
- Is cross slope okay?
- Is mat texture okay?

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Check Settings

114

Check Head of Material

115

Check Yield Periodically

You can't control yield and thickness or smoothness.

Adjusting for yield or thickness will reduce smoothness!!!!

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Truck Exchanges

117

Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
- Checking Yield
- Truck Exchanges
- **Folding Hopper Wings**
- **HMA Level in Hopper**
- Auger Operation
- Flow Gate Position
- Raking and Luting
- Concluding Paving

118

Fold the Wings?

119

Don't Let This Happen to Your Slat Conveyors!

120

Next Truck Not Ready?

121

Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
- Checking Yield
- Truck Exchanges
- Folding Hopper Wings
- HMA Level in Hopper
- **Auger Operation**
- **Flow Gate Position**
- Raking and Luting
- Concluding Paving

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Constant Head of Material

123

Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
- Checking Yield
- Truck Exchanges
- Folding Hopper Wings
- HMA Level in Hopper
- Auger Operation
- Flow Gate Position
- **Raking and Luting**
- Concluding Paving

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Minimal Luting

125

Minimal Luting

126

Lute when necessary…

127

Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
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- Folding Hopper Wings
- HMA Level in Hopper
- Auger Operation
- Flow Gate Position
- Raking and Luting
- **Concluding Paving**

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Cleanup

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Paver Maintenance

- Washing down
- Wear check
- Storage of electrical equipment
- Checklists

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Maintenance Checklist

FORM 5-1 **PAVER MAINTENANCE CHECKLIST** Page 1 of 2

Paver ID#:_____
Date:_____

CHECK DAILY

☐ (1) COOLING SYSTEM - (a) Check coolant level; (b) Check radiator core for plugging with dirt or oil; (c) Check hoses for cracking and leaking; (d) Check belts for proper tension; (e) Check fan for loose bearings. Fill, adjust and/or replace as needed.

☐ (2) ENGINE LUBE SYSTEM - (a) Check engine oil level; (b) Check for any leakage on or around engine; (c) Report any discolorations (milky) or overfilled conditions right away.

☐ (3) FUEL SYSTEM - (a) Check sediment bowl for dirt or water and clean as needed; (b) Check for any leaks around lines and fittings. DO NOT OVERTIGHTEN.

☐ (4) HYDRAULIC SYSTEM - (a) Check oil level; (b) Check and look for any leaks around pumps, lines, fittings, and filters. DO NOT OVERTIGHTEN.

☐ (5) ELECTRICAL SYSTEM - (a) Look at the wiring and connections for being loose or oily. If oily, spray with contact cleaner. (b) Look at battery cable connections and clean if starting to corrode.

☐ (6) TIRES - (a) Check tires and maintain _____ lb. air pressure. Note: Tires are also 75% to 100% filled with calcium chloride solution.

☐ (7) INSPECTION - (a) Look for loose bolts and tighten right away when found; (b) clean out hoppers, augers and screed after each days run and spray with cleaner; (c) Keep top deck and screed clean; (d) Check wheel drive chains, conveyor drive chains and conveyor flight chains for being too loose. Adjust as needed. Don't run machine with loose chains; (e) Check for other oil or grease leaks from gear boxes, transmission, differential, axle hubs and report to shop immediately.

CHECK WEEKLY

☐ (1) BRAKE SYSTEM - (a) Check both LH and RH master cylinders for hydraulic brake fluid level. Keep filled to proper level.

DAILY LUBRICATION

☐ (1) Vibrator shaft bearings and U-Joints on vibrator shafts. DO NOT FLUSH GREASE.
☐ (2) Auger shafts flange bearings. (twice daily)
☐ (3) Rear conveyor flight shaft bearings.
☐ (4) Front conveyor flight shaft bearings. SEE OPERATORS MANUAL
☐ (5) Jack shafts and idler sprockets.
☐ (6) Screed arm lower pivot pin

WEEKLY LUBRICATION

☐ (1) Screed Crank
☐ (2) Clutch Throwout Bearing
☐ (3) Clutch Lever Shaft
☐ (4) Brake Pedal
☐ (5) Bogie Pivots and King Pin Bearings. SEE OPERATORS MANUAL
☐ (6) Bogie Wheel Bearings
☐ (7) Drive Wheel Bearings
☐ (8) Main Drive Shaft

OILS & GREASES & FILTER CHANGES

☐ (1) ENGINE - Change oil and filter every 150 hrs. For oil, see engine manual.
☐ (2) HYDRAULIC SYSTEM - Change oil yearly, and change filter 3 times a season.
☐ (3) AIR CLEANER - Oil bath every 150 hrs. Dry the cleaners 3 times a year.
☐ (4) FUEL SYSTEM - Filter change 3 times a year.
☐ (5) PUMP DRIVE BOX, TRANSMISSION, DIFFERENTIAL, LH & RH CONVEYOR DRIVE BOXES - Change gear lube yearly; use 85W140 gear oil.

☐ (1) Drive chain. Adjust 19 mm slack one side.
☐ (2) Conveyor Drive Chains. Larger units: 125-175mm from ground. Smaller units: 75-125mm from frame.

OTHER THINGS THAT NEED SPECIAL ATTENTION AND HANDLING

☐ (1) Grade and Slope Boxes and Cables
☐ (2) Screed Extensions
☐ (3) Skis
☐ (4) Don't tamper with the governors or speed adjusting screws.

(Courtesy of Blaw-Knox)

REMARKS:_____

_____

_____

Completed by:_____

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Operating Techniques

- Warming up machine and screed
- Positioning on Joint
- Nulling the Screed
- Initial Settings
- Charging Hopper, Tunnels, Screed
- Pulling off Joint
- Re-checking Settings
- Speed of Paver
- Checking Yield
- Truck Exchanges
- Folding Hopper Wings
- HMA Level in Hopper
- Auger Operation
- Flow Gate Position
- Raking and Luting
- Concluding Paving

Traffic Control

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Traffic Control

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MUTCD?

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Review:

- What is the objective of HMA placement?
- List 3 tractor components and their function
- List 3 screed components and their function

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Review :

- Describe the operational principles of the screed
- List and describe 2 types of grade and slope control systems
- How are yield-thickness-smoothness related?

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Review:

- Name 2 important paver maintenance items
- List 2 good paver operating techniques

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Module 6 – Joint Construction

Chapter 9 – Asphalt Paving Handbook

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1

Learning Objectives

- State the objective of joint construction
- Describe the two types of joints
  - Describe transverse joint construction methods
  - Describe longitudinal joint construction methods
- Identify proper joint raking/luting techniques

2

Goal

- Construct well compacted, sealed joints which will resists infiltration of air, water, and other contaminants, which would lead to early deterioration.

3

Types of Joints

- A **transverse joint** is a joint in a pavement that runs **perpendicular to the direction of traffic**. Typically occurs:
  - Where paving operations stop and restart (extended material delay, end of day)
  - Project limits
  - Bridge tie-in
- A **longitudinal joint** is a joint in a pavement that runs **parallel to the direction of traffic**,
  - Typically, along the centerline or between paving lanes

4

Transverse Joint

- There will almost always be some handwork necessary to complete the joint. Do not get carried away with overworking the mix.
- When handworking mix, "leave the mix high" to allow compaction. Handworked mix is looser than paver-laid mix. Leave about 10 mm (0.4 in) per 25 mm (1 in) of mix laid.
- Compact this immediately. Handworking (and the time to do it) results in a cooler mix.

Blaw-Knox. Courtesy of Blaw-Knox Ingersoll Rand Paving Products

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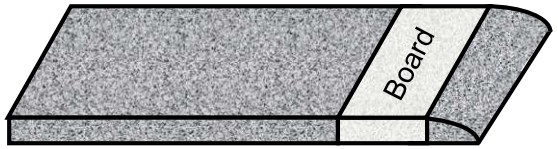
Transverse Construction Joints – Butt Joint

- A butt joint can be used when traffic will not be passing over the joint.
- Selected joint location. Do not touch upstream material. Rake the downstream side away, and place boards lengthwise to allow the roller to compact the edge without rolling the material over.
- A small ramp of material is added on the downstream side of the board to aid in getting equipment off the mat.



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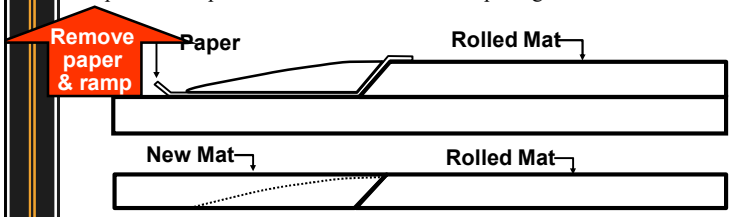
Transverse Construction Joint – Papered Butt Joint

- Mix is shoveled away from the joint location, and treated paper is placed downstream of the joint.
- Mix is shoveled back onto the paper, formed into a ramp, and then the mat and the transition are compacted.
- Paper and ramp are then removed to continue paving



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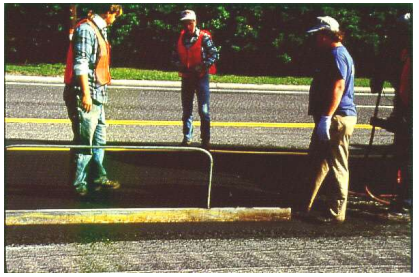
Transverse Construction Joints – Feathered Joint Without Paper

- Another option is to run out the paver and feather the joint into the existing mat.
- Note the location when the paver begins to taper
  - Use a straightedge to determine where the pavement thickness began decreasing…



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8

Transverse Construction Joints Feathered Joint Without Paper

- Mark the location and remove material downstream of the transition
  - Unlike a papered joint, material will have bonded to the existing mat and a larger amount of effort will be needed for removal

9

Remove Downstream Material

10

Small Milling Machine

11

Transverse Construction Joints

- Ensure all transition materials are moved and the joint location thoroughly cleaned.
  - Is a push broom a good method to remove debris and dust?

12

Transverse Construction Joints - Tack Matters!

13

Transverse Construction Joints - Tack Matters!

- Use hand wand to apply material
- If pour pot must be used, use a broom or mop to place material on vertical face
- Ensure uniform coverage of vertical face
- Minimize "puddles"

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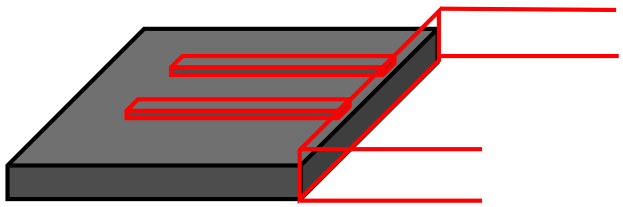
Transverse Construction Joints

- Remember to raise the screed 20 to 25% more than the compacted thickness.
  - Roughly ¼" per 1" of material



Boards can be used to account for reduction in thickness during compaction

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Transverse Construction Joints - Starting Off

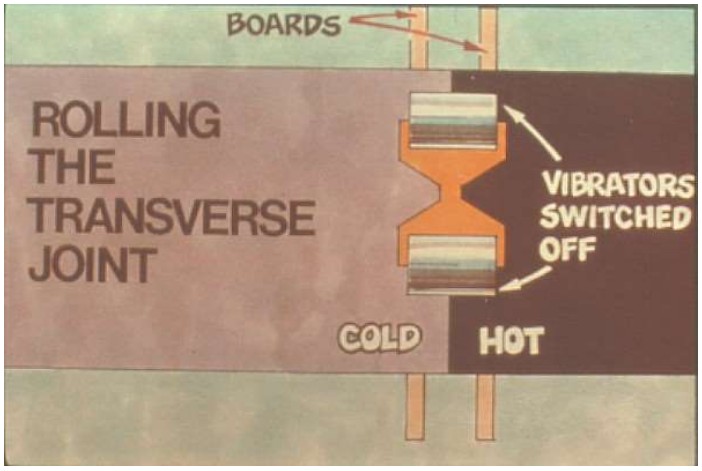
16

Transverse Construction Joints - Minimize Luting

17

Transverse Construction Joints - Smoothness Check

18



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Transverse Joint Rolling

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20

Transverse Joint Rolling - Space Restrictions

21

Check for Smoothness

22

Sealing Transverse Joint

23

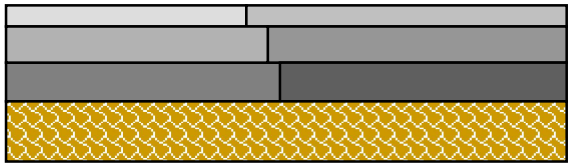
Longitudinal Joint Construction

- Pave the first lane straight and set the screed end gate properly on the second lane to produce a clean joint.

24

Longitudinal Joint Construction - Start with a plan

- Staggered Paving Joints from multiple lifts a minimum of 6”
  - Surface joints should not be located in the wheel paths
  - Avoid joints located under painted lines



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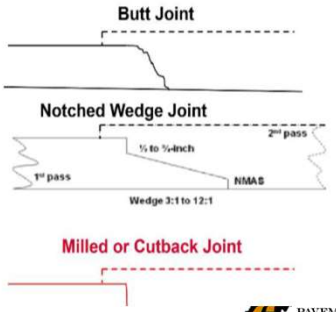
Longitudinal Joint Construction - Start with a plan

- Pave shoulders with travel lanes to avoid joint construction
- With the extendable screed there is no cold joint at the lane/shoulder line.

26

Longitudinal Joint Construction - Types

- Butt Joint
  - Most Common
  - Inherently Low density materials in unsupported edge
- Notched Wedge Joint
  - More complex, need for compaction on wedge
  - Higher joint density
- Milled/Cutback Joint
  - Removed unsupported edge material
  - Wasteful



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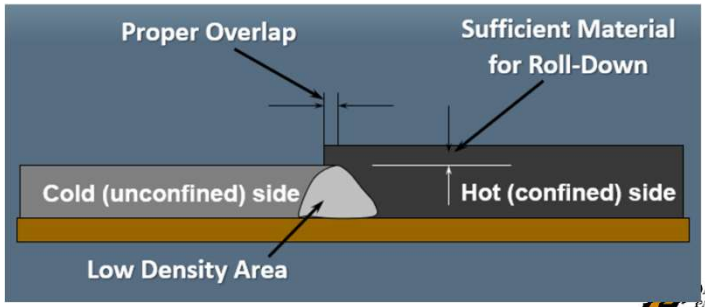
Longitudinal Joint Construction



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Longitudinal Joint Construction
Start with a good edge to pave against

29

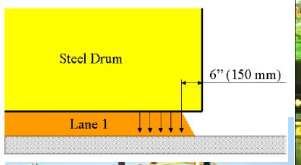
Longitudinal Joint Construction

- Keep the end gate DOWN seated flat on the Existing Surface

30

Longitudinal Joint Construction – Compacting the Unsupported "Cold" Side

- The drum should be extended over the unsupported edge of the lane by approximately 6"



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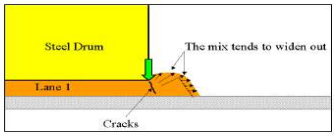
Longitudinal Joint Construction – Compacting the Unsupported "Cold" Side

- Do not run a steel drum roller inside the unsupported edge
  - High chance of stress cracks



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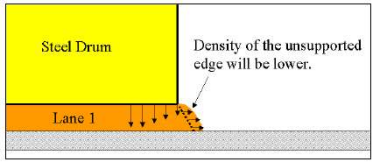
Longitudinal Joint Construction – Compacting the Unsupported "Cold" Side

- Do not run a steel drum roller directly over the unsupported edge
  - High chance of stress cracks



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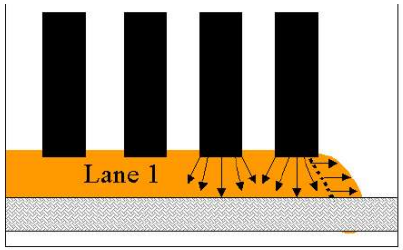
Longitudinal Joint Construction – Compacting the Unsupported "Cold" Side

- Pneumatic Tired Rollers should not be used directly on the unsupported edge
  - Will shove material laterally degrading the joint



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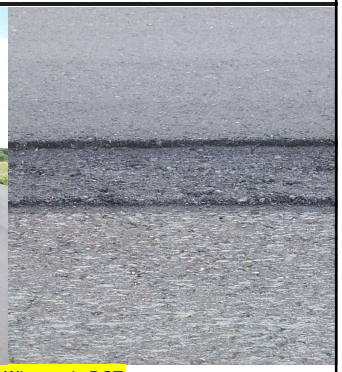
Longitudinal Joint Construction - Butt Joint Alternative Notched Wedge Joint



Courtesy of Wisconsin DOT

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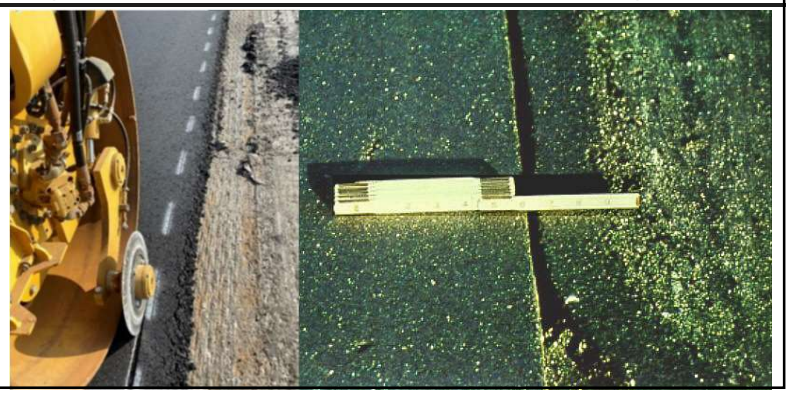
Longitudinal Joint Construction – Cut back edge



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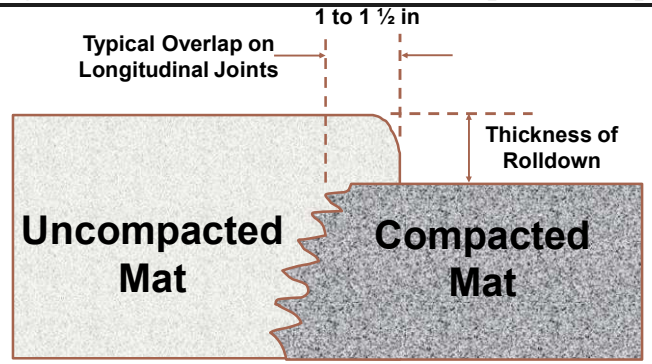
Longitudinal Joint Construction – Proper Overlap



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Longitudinal Joint Construction – Proper Overlap

39

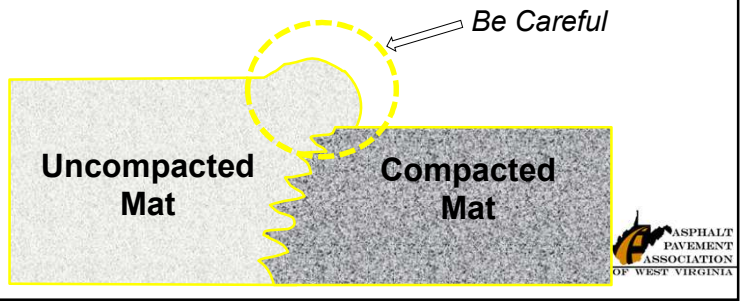
Longitudinal Joint Construction – Compacting the "Hot" Side

- Minimize luting, unless necessary
- Do not push material back past joint
- The proper overlap provides just enough material on top of the joint to allow proper compaction without having extra mix.
  - This mean the lute remains in the truck

40

Longitudinal Joint Construction – "Bumped Back" to Joint

- If Bumping Back is necessary, do not "cast" mix across the mat
- Do no bump all the way to the joint, stop just short



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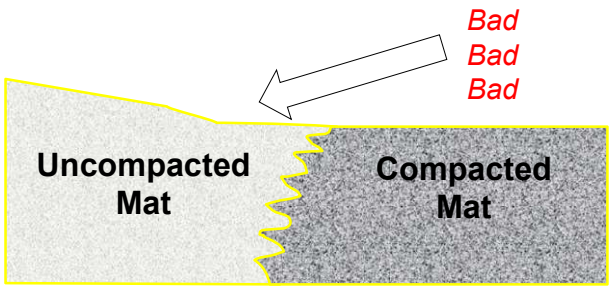
Incorrect Luting

42

Mix "Bumped Back" Past Joint



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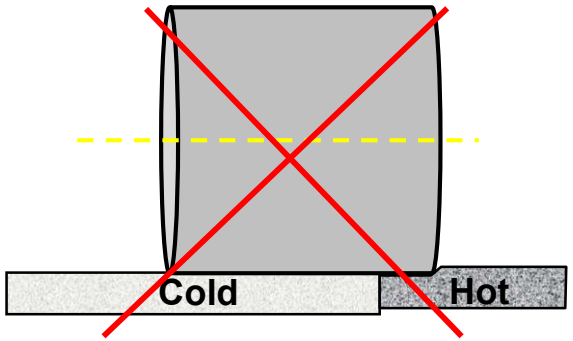
Joint Without Luting

44

Improper Joint Rolling



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Poor Longitidunal Joint Performance is not Uncommon

46

What Is Wrong Here?

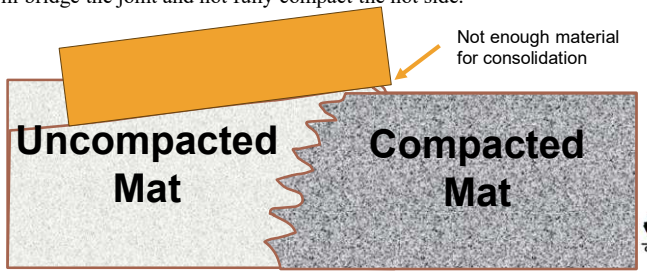
47

Rolling from the Hot Side

48

Longitudinal Joint Construction – Starving the Joint

- If the level of the second lane is at or below the first lane, proper compaction along the joint cannot be achieved.
- When the roller is properly placed with some of the roller on the cold mat, the roller will bridge the joint and not fully compact the hot side.



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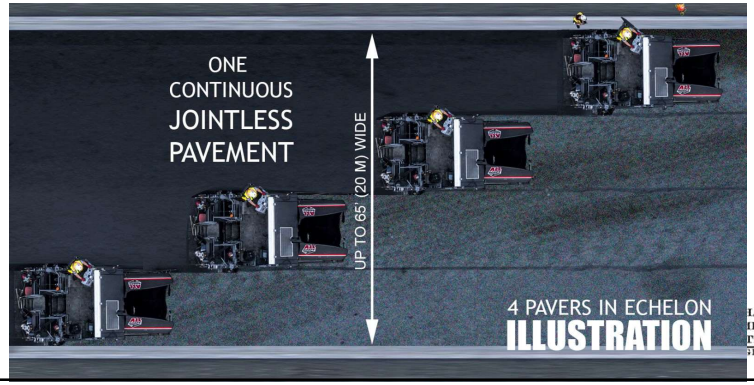
Best Joint is one you don't have to make – Echelon paving



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Summary of Best Practices

First lane

- Use string line or skip lines to guide paver
- Keep side gates down
- Overhang roller 6" past mat

Second Lane

- Tack joint
- Hang paver 1" to 1.5" past joint
- Carefully lute and only if needed
- First pass hold roller 6-8" from joint, second pass "pinch" the joint by over hanging to cold mat 3-6"
  - **Watch for the formation of stress cracks**

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Questions?

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Module 7 – HMA Compaction

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1

Learning Objectives

- Objective of compaction
- Asphalt concrete properties related to compaction
- Material and mix properties that affect compaction
- Types of compaction equipment
- Selection of compaction equipment
- Identify compaction variables
- Main components of compaction equipment maintenance
- Calculate roller productivity
- Describe proper compaction operating procedures

2

Definitions

- Density
  - The weight of the material that occupies a certain volume
- Compaction
  - The process through which the asphalt mix is compressed and reduced in volume
    - Cannot compress the aggregate or the binder
    - Volume reduction of the mix is the result of squeezing out the air!

3

Definitions

- Pass
  - The entire roller traverses (moves) over one point in the mat one time
- Coverage
  - The roller moving over the entire width of the mat one time

4

Importance of Compaction

- Improve Mechanical Stability
- Improve Resistance to Permanent Deformation
- Reduce Moisture/Air Penetration
- Improve Fatigue Resistance
- Reduce Low-Temperature Cracking Potential

5

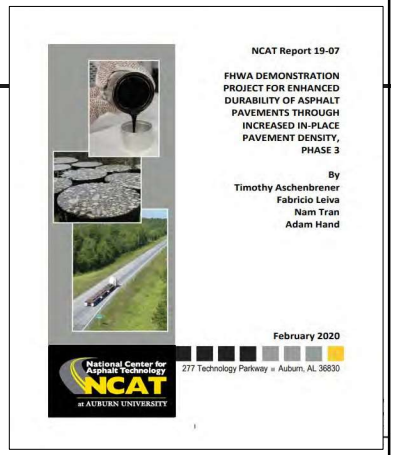
Importance Of Compaction

- During the construction of HMA, compaction is considered to be the most important factor that contributes to the performance of the pavement.
- "Density is not only a top quality indicator, in terms of how long the pavement will last, but it is also a top pay item in most state specifications,"
- Rollers are the last piece of equipment to touch the mat after it is placed and are the last opportunity to "undo" the smooth mat that the paver has placed

6

Importance of Density

- 1% decrease in air voids:
  - Estimated to improve the fatigue performance between 8 and 44%
  - Estimated to improve rutting resistance by 7 to 66%.
- 1% decrease in air voids would extend the service life by 10%, conservatively.



7

Topics

- Factors affecting compaction
- Time available for compaction
- Roller types
- Roller operations
- Roller pattern
- Production rate
- Roller maintenance

8

Factors Affecting Compaction

- Properties of the Materials
- Laydown Site Conditions
- Environmental Variables

9

Properties of the Materials

- Aggregate
- Asphalt Binder
- Mix Properties

Courtesy of Caterpillar Paving Products

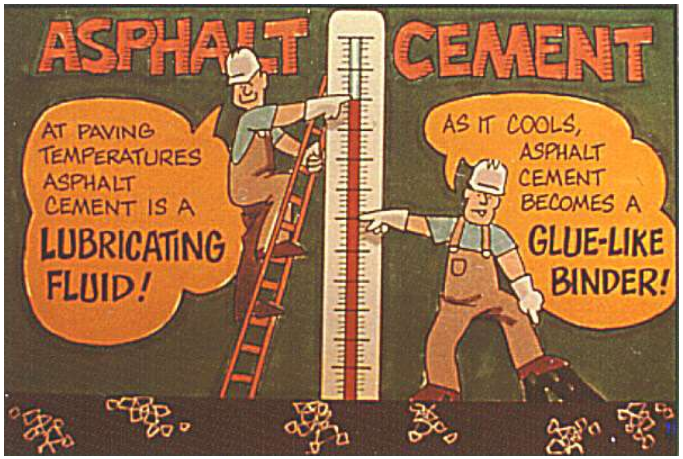
5-10

10

11

Aggregate Carries the Load

12



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Binder and Compaction

- Asphalt binder holds particles together
  - Provides lubrication at high temperatures
  - Provides cohesion at in-service temperatures
- Prevents air and water intrusion into mat

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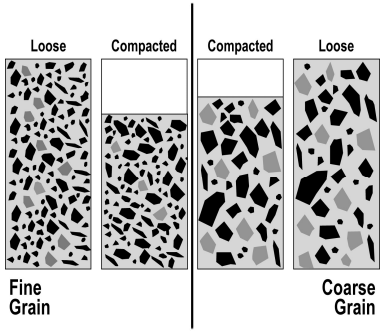
14

15

Mix Properties

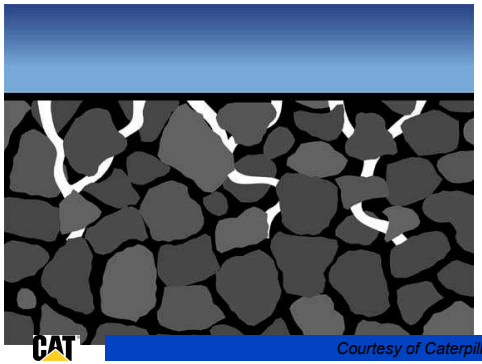


- Compaction rates vary by mix design
- Adjust placement thickness to match desired compacted mat thickness

5-16

16

Mat after Compaction



- 4%-8% theoretical air voids allow for binder expansion
- Aggregates moved closer together
- Provides cohesion, impermeability, and stability

Courtesy of Caterpillar Paving Products

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17

Laydown Site Conditions

- Base/Existing Surface Conditions
  - Oxidized pavement
  - Rutted pavement
  - Cracked pavement
  - Soft and yielding

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Topics

- Factors affecting compaction
  - ➢Time available for compaction
- Roller types
- Roller operations
- Roller pattern
- Production rate
- Roller maintenance

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Rate of Cooling Variables

- Research work and field experience show that once a pavement cools to 175 oF, the internal friction and cohesion of the mix increases to the point that little density gain is achievable.
  - Layer Thickness
  - Air Temperature
  - Base Temperature
  - Mix Laydown Temperature
  - Wind Velocity
  - Solar Flux

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DOH SPEC 401.10.4

- **The required density shall be obtained prior to the mat reaching a temperature of 175F.**
- The contractor shall be allowed to lower this temperature to 165F if they can demonstrate during the first day of placement of each lift on each project that additional densification can be achieved without causing any pavement distress.

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Thickness = Time

- Minimum temperature to achieve final density is 175 F (165 F sometimes)
- In general, an increase of mat thickness by 50% will result in almost twice as much time for compaction
- HMA delivered at 300 F, Air Temp = 40 F, and Surface Temp = 50 F, Clear and Dry, Wind = 5 mph
  - 1.0" cools to 175F in about 8 minutes
  - 1.5" cools to 175F in about 15 minutes

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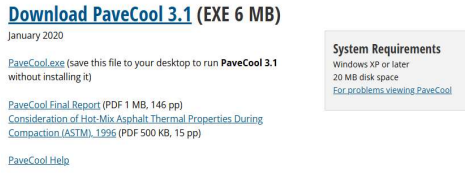
PaveCool

- Actual calculation of pavement cooling times based on job site conditions
- Available FREE (google Pavecool)
  - http://www.dot.state.mn.us/app/pavecool/



5-23

23

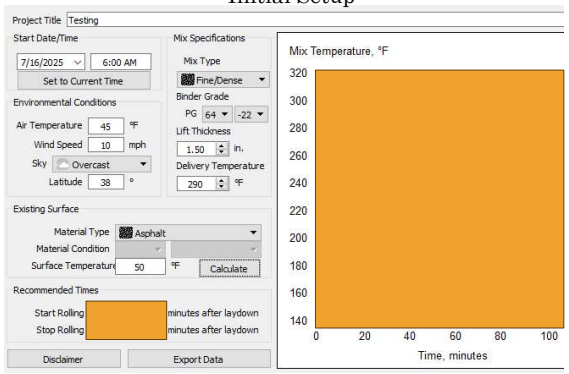
Major Factors Affecting Rolling Time

- Initial Conditions
  - 1.5" Dense Graded Asphalt Overlay Placed on a milled asphalt surface in Charleston, WV
  - Material Delivery Temp – 290F
  - Compaction Threshold – 175F
  - Air Temp – 45F
  - Surface Temp – 50F
  - Wind – 10mph
  - Conditions – Overcast/Sunrise

24

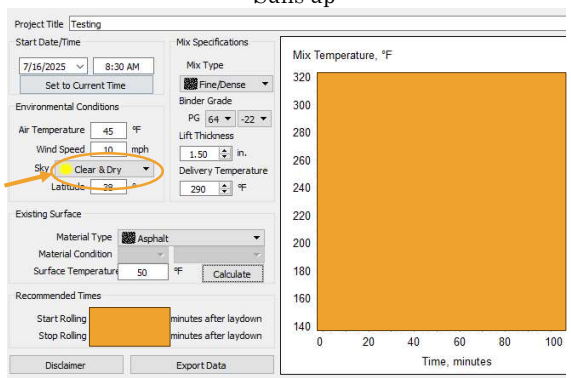
24

Initial Setup



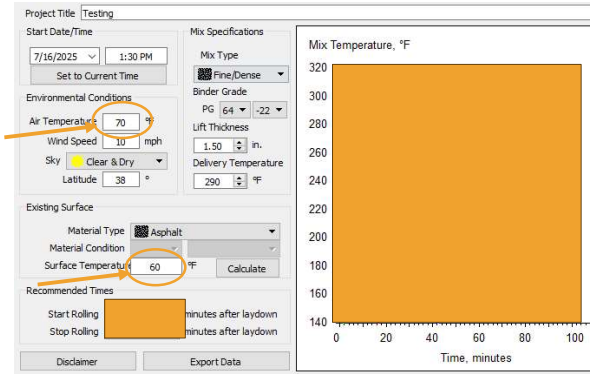
25

Suns up



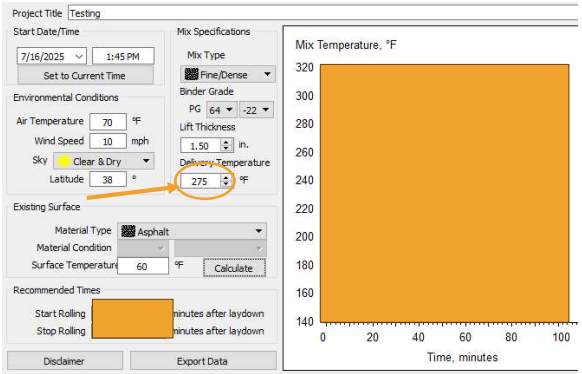
26

Conditions Improve Throughout



27

Delivery of Cold Load



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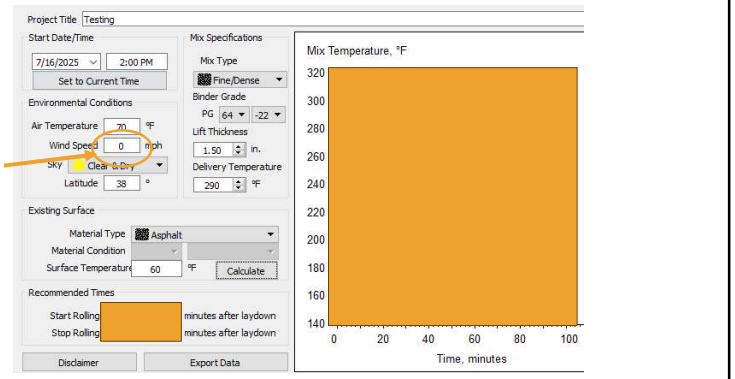
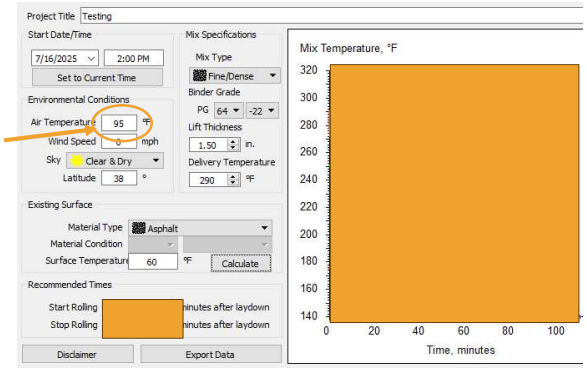
Wind Dies Off



29

70F in July???



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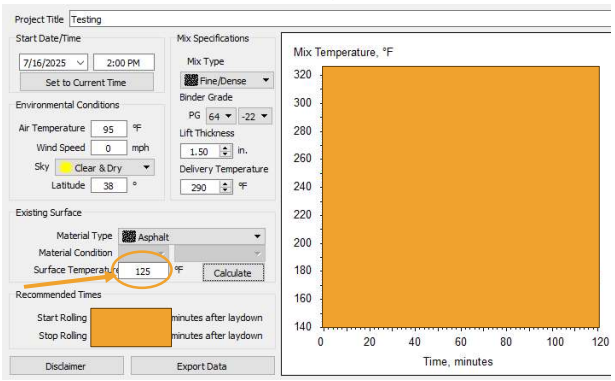
70F in July???



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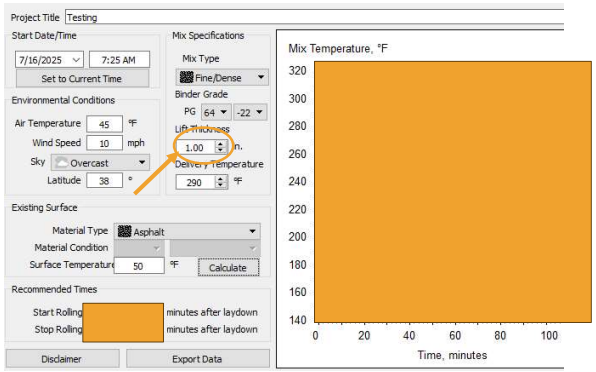
	Start Rolling Time (min)	Stop Rolling (min)
Initial Setup (6:00a)	2	12
Suns up (8:30a)	2	14
Enviro Temps Increase (1:30p)	2	17
Delivery of Cold Load(s) (1:45p)	1	14
Wind Dies Off (2p)	2	20
Air Temp (95F)	2	22
Surface Temp (125F)	4	118

32



33

Temperature

- Take Regular Mat Temperature Readings
- Temperature control is critical

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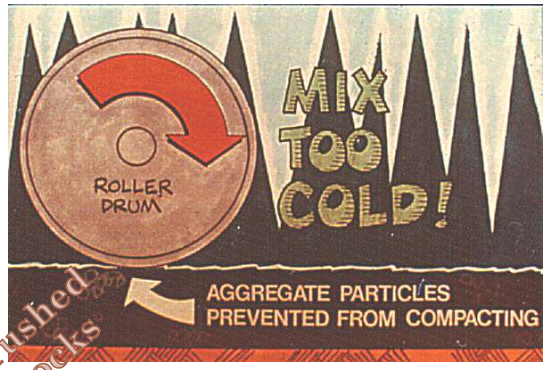

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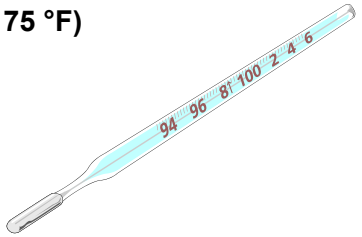
Temperature

Typical Compaction Temperature Range

80 °C (175 °F) - **150 °C (~300 °F)**



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Lift Thickness vs Aggregate Size

- Lift thickness is determined by aggregate size
  - *Marshall ~2-3x maximum aggregate size*
  - *Superpave ~3-4x nominal maximum agg. size**
  - Check with design directive 644 for specifics
- Lifts with variable thickness
  - Patch and Leveling
  - Scratch
  - Wedges and other unique conditions

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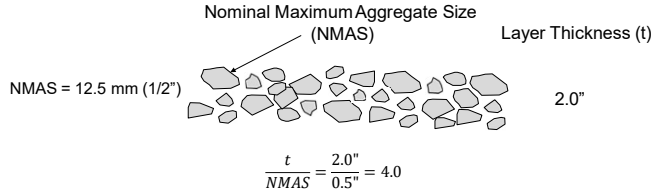
Lift Thickness vs Aggregate Size



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Relationship between lift thickness and aggregate size

Cores at 2" thickness
95.5% of G_{mm}

40

Relationship between lift thickness and aggregate size

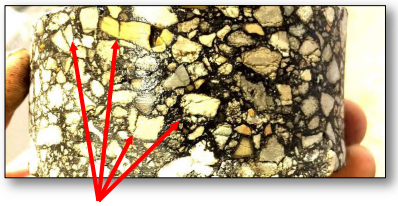
Cores at 1.75”
thickness 93.0% of G_{mm}

41

Relationship between lift thickness and aggregate size

Cores at 1.5”
thickness

92.2% of G_{mm}



Broken aggregate

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MARSHALL VS SUPERPAVE

Surface	• MARSHALL - Wearing I	• SUPERPAVE - 9.5 mm
	• NMAS 3/8”, MAS 1/2”	• NMAS 3/8”
	• 2X(1/2) = 1”	• 3*(3/8) = 1 1/8” 1/4”
	• DOH Recommended min = 1”	• DOH Recommended min = 1.5”
Base	MARSHALL - Wearing IV	SUPERPAVE -19 mm
	NMAS 3/4”, MAS 1”	NMAS 3/4”
	2X(1) = 2”	3*(3/4) = 2 1/4”
	DOH Recommended min = 2.0”	DOH Recommended min = 2.5”

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Topics

- Factors affecting compaction
- Time available for compaction
- Roller types and stages
- Roller operations
- Roller pattern
- Production rate
- Roller maintenance

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Types of Rollers

- Static Steel Wheel
- Pneumatic – Rubber Tired
- Vibratory Steel Wheel
- Oscillating Steel Wheel

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How Do Rollers Compact?

By applying their load over a given area!

(Contact Pressure)

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Static Steel Wheel Roller

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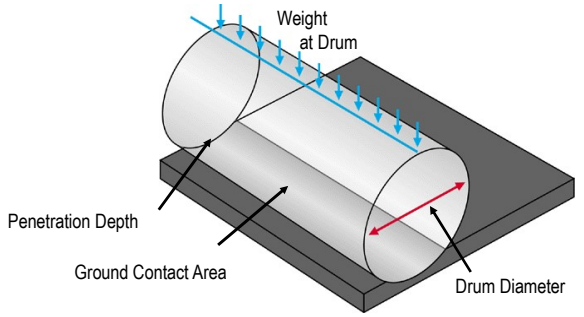
Contact Pressure



CAT Courtesy of Caterpillar Paving Products 5-48

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Roller Contact Pressure

Penetration Depth (in)	3/4”	1/2”	1/8”	1/16”
Contact Pressure (psi)	36	46	88	132

Roller Contact Pressure at Varying Penetration Depths for 12 ton Static Roller

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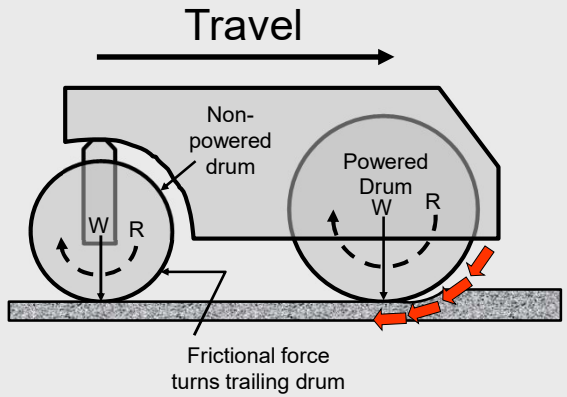

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Pneumatic Tired Rollers

- Wheel load
- Tire design
- Inflation pressure
- Contact area
-

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Pneumatic

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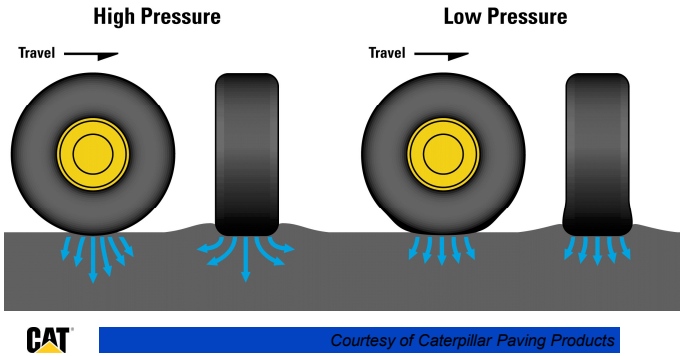
Tire Inflation Pressure Versus Ground Contact Pressure



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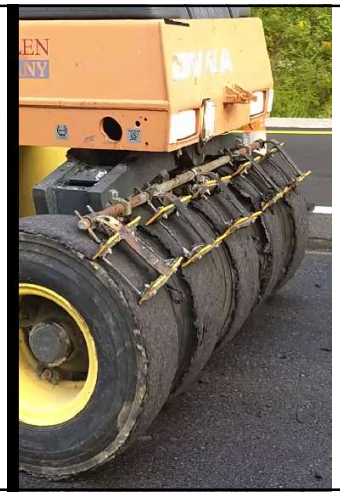

Pneumatic Roller I79 Flatwoods

INSUFFICIENT HEAT IN THE TIRES!!!

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Tire Pick Up

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Skirted Pneumatic Roller

- Skirts keep Tires Hot and Minimize Pick-up
- Required by the Specs

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Pneumatic Roller Operation

Ideal for uneven courses – and specifically called out in the specifaction for Scratch and PnL for this reason

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Vibratory Roller

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Single Articulated Frame

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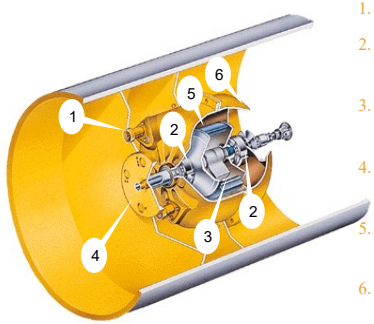
Eccentric Weight System



1. Oil level sight gauge
2. Eccentric weight shaft bearings
3. Three-position counterweight
4. Amplitude selection wheel
5. Fixed eccentric weight
6. Pod-style housing

CAT

Courtesy of Caterpillar Paving Products

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Oscillating Roller I 79 Flatwoods

What's wrong with this pictures??????

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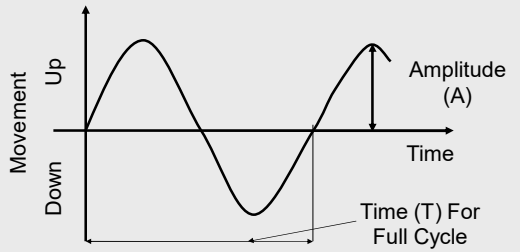
Vibratory Rollers

- Amplitude
- Frequency
- Impact Spacing (speed)
- Operation

62



Frequency, f = the number of hertz (cycles/s)--a single cycle is one full rotation of the eccentric weight. Frequency = 1/T

Amplitude, A = the maximum deviation from position at rest -- one-half the total movement.

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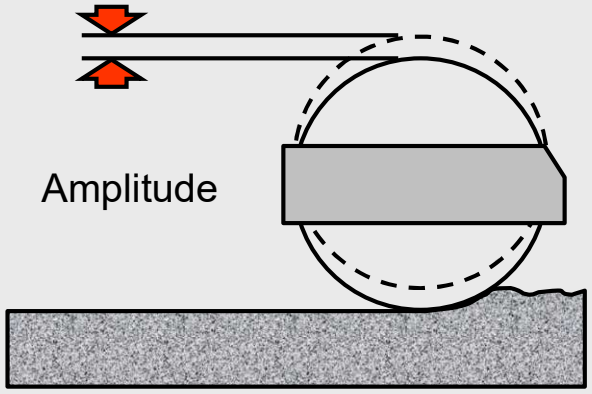

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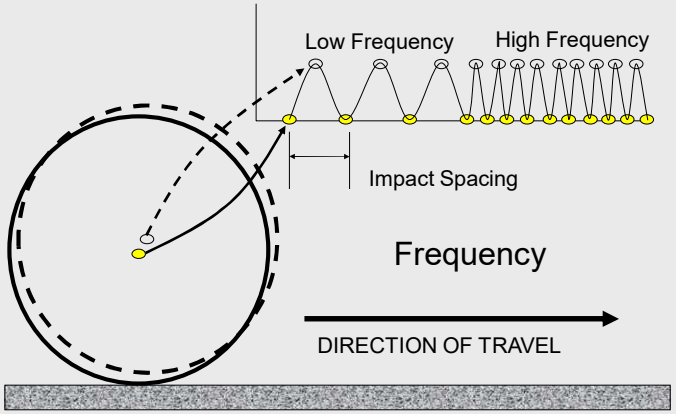
Ideal is 10-12 impacts per foot



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Typical Data for Vibratory Tandem Rollers

Vibratory Steel Tandem ton	Oper. Wt. lb	Drum Diam. ft	Drum Width ft	Static Drum lb/in	Dynamic Drum lb/in	VPM	Nom. Amp. in
6.0-8.0	14,700	3.6	4.6	130	260	2,900	0.025
9.5-11.0	20,500	3.9	5.6	158	384	2,600	0.03
> 13.0	30,000	4.9	6.9	186	423	2,400	0.03

Increase due to vibration

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Example

- Given:
  - Vibrations (impacts) per minute = 2900
  - Desired impacts/ft = 11
- Determine speed of roller can operate at.

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Reed Tachometer

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Improper Impact Spacing

Improper impact spacing can be obvious; but there can be differential compaction that is not initially seen at the surface that decreases long term pavement performance.

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Topics

- Factors affecting compaction
- Time available for compaction
- Roller types
- ➢Roller operations
- Roller pattern
- Production rate
- Roller maintenance

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Roller Operator Controls

- Speed
- Starts & Stops
- Pattern
- Amplitude
- Frequency
- Distance from paver

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Roller Controls

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Compaction Variables

- Roller Speed
- Number of Coverages
  - Pass - the entire roller moving over one point in the mat one time
  - Coverage - the roller moving over the entire width of the mat one time
- Rolling Zone
- Rolling Pattern

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Stages Of Rolling

- Breakdown Rolling - Where most of the actual densification is achieved
- Intermediate Rolling - Where a small amount of additional density is achieved (needed when breakdown rolling does not provide sufficient density)
- Finish Rolling - Used to remove roller marks and finish the surface (Very little additional densification is achieved)

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Breakdown Rolling

- Breakdown rolling is the first interaction between the roller and the mat and is where the majority of the compaction is obtained
- Should be completed before the surface temperature of the mix falls below 240o F.
- Operated at the highest possible frequency
- Amplitude setting will be dependent on the thickness of the asphalt concrete
- Due to the large initial consolidation, rollers should stop and start slowly on uncompacted mix.
- Always angle the drum when stopping to reverse.

https://www.forconstructionpros.com/asphalt/article/12188306/how-to-compact-asphalt-pavements

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Keep Breakdown Roller Close To Paver

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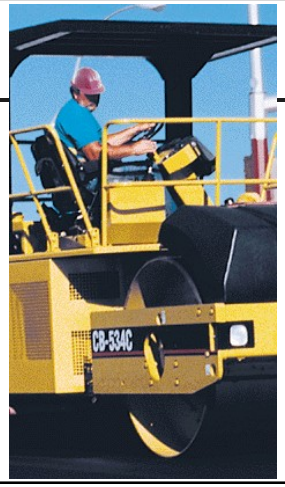
Intermediate Rolling

- Temperature between 240°F to 190°F
- Completion of density gain
  - Not always required
- Watch out for tender mixes
  - May need to let mix cool a bit in order to avoid shoving
- Vibratory or pneumatic rollers

77



Finish Rolling

- Finish rolling normally takes place within a temperature range of 185°F down to 175°F (165°F*).
- Static steel-wheel finish roller
  - (vib in Static)
- Marks from other rollers can be removed from the surface of the layer without adding new marks by the finish roller itself.
- Finish rolling for a stable mix is accomplished at higher temperatures than finish rolling for a tender mix.

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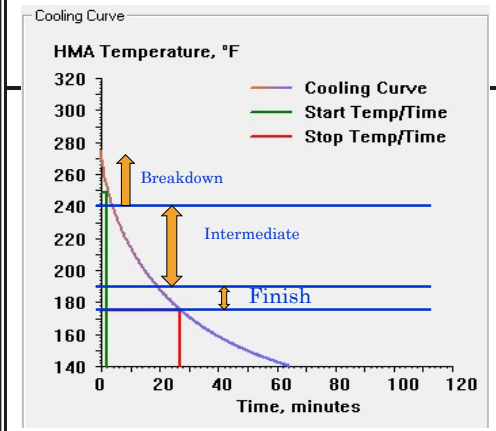

Approximate temperatures for stages of rolling

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Speed – Slow and Stead

- Ensure enough "Dwell" time
- Increasing speed - decreases density
- Speed is based on: productivity, layer thickness, and the position of the equipment in the roller "train."

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Stopping - Easy Does It!

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Typical Range of Roller Speeds (mi/hour)

Type of Roller	*Breakdown*	*Intermediate*	*Finish*
Static Steel Wheel	2.0 to 3.5	2.5 to 4	3.0 to 5.0
Pneumatic	2.0 to 3.5	2.5 to 6.4	4.0 to 7.0
Vibratory	2.0 to 3.0	2.5 to 3.5	-------

Remember slow and steady!

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Topics

- Factors affecting compaction
- Time available for compaction
- Roller types
- Roller operations
- ➢Roller pattern
- Production rate
- Roller maintenance

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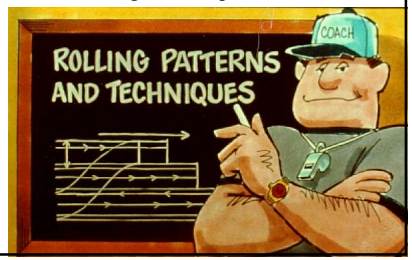
Roller Patterns

- Rollers are "busy" most of the time on a paving project.
- Are your rollers operating correctly and effectively? In the right places?
- Numerous compaction studies have shown that the middle of the width of the paver pass typically receives more compactive effort than the edges of the pavement.
  - Edges and wheel paths?



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Roller Widths

- What size do you need?
- Can you use multiple size?
- Your optimum combination may vary from project to project.

85

Paving Widths

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Passes and Coverage

- Each time the roller goes over a specific point is ONE PASS.
- Paving widths are greater than roller width so more than one pass is required to complete a COVERAGE across a pavement.
- How many passes of the roller are needed to cover the width of the mat one time?

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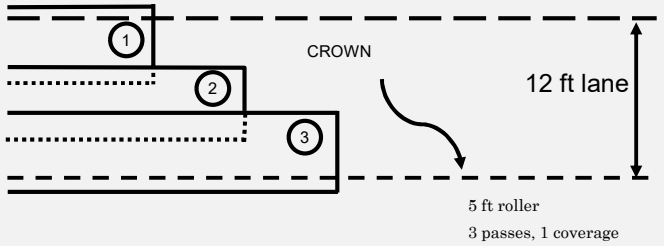
One Roller Coverage



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- Cover mat in no more than 3 overlapping passes
- Applies to highways, roads, streets where production is a concern

Required Number of Overlapping Passes per Drum Width

Paving Width (Meters / Feet)	Drum Widths				
	140 cm (55in)	150 cm (59in)	170 cm (67in)	200 cm (79in)	213 cm (84in)
2.5 / 8	2	2	2		
2.75 / 9	3	3	2		
3.00 / 10	3	3	3	2	2
3.35 / 11	3	3	3	2	2
3.70 / 12	(4)	3	3	2	2
4.00 / 13			3	3	2
4.25 / 14			3	3	3
4.50 / 15				3	3
4.80 / 16				3	3
5.20 / 17				3	3
5.50 / 18					3

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Operating Techniques

- Test Strip Construction
- Establishing Roller Patterns
- Breakdown Rolling
- Intermediate Rolling
- Finish Rolling
- Re-watering
- Concluding Operations

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Test Strip Construction

- Simulating Actual Conditions
- Establishing Roller Patterns
- Calculating Effective Roller Speed
- Adjust production/paving rates to not outrun Rollers

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Establishing Roller Pattern

- Selecting Compaction Equipment
- Width of Paving
- Width of Roller
- Number of Coverages Needed
- Nuclear Gauge

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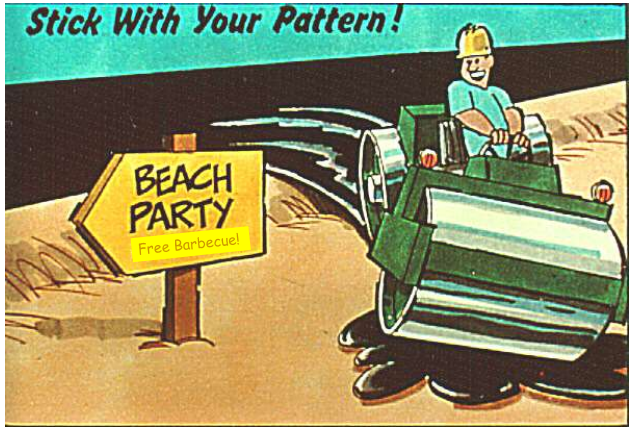

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How Many Repeat Passes to Assure Density?

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Checking Density

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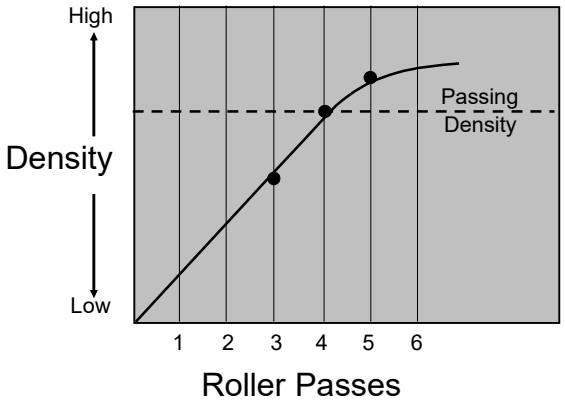

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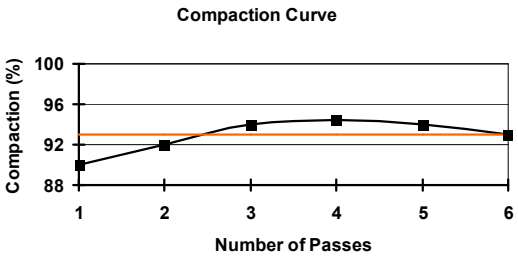
Roller Pattern Problem #1



Decreasing Temperature

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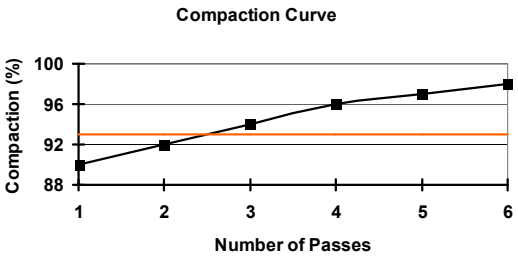
Roller Pattern Problem #2



Decreasing Temperature

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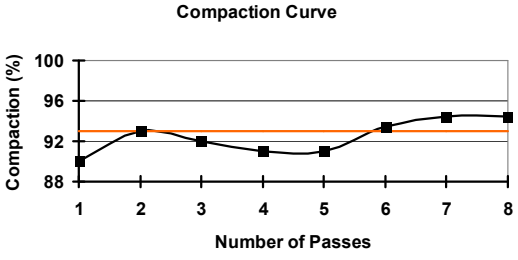
Roller Pattern Problem #3



Decreasing Temperature

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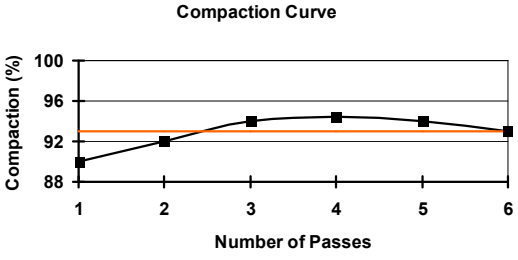
Roller Pattern Problem #1



Decreasing Temperature

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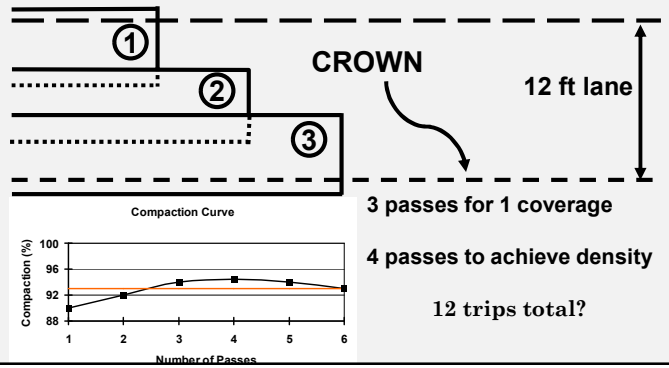
One Roller Coverage



3 passes for 1 coverage

4 passes to achieve density

12 trips total?

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Temperature Gauges

102

Interior Temperature

103

Improper Gauge Usage

104

Coring

What's wrong with this picture?

105

Topics

- Factors affecting compaction
- Time available for compaction
- Roller types
- Roller operations
- Roller pattern
  - Production rate
- Roller maintenance

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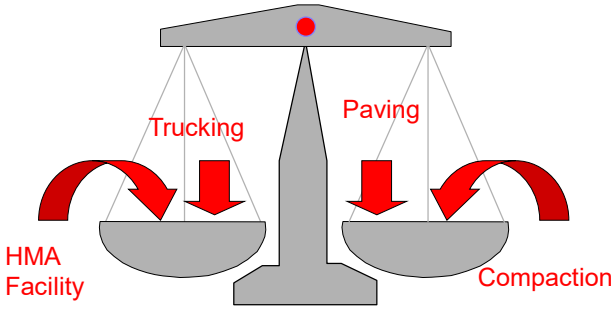
Balancing Production



107

Rolling Zone

108

Calculating Your Rolling Zone (Vibratory roller)

- Estimate roller speed using frequency and impacts per foot:
  - Frequency = 2800 vpm
  - 12 impacts per foot
  - Actual Roller speed = 2800/12 = 233.3 fpm (2.7 mph)
- Adjust for Roller Efficiency
  - Roller speed*(Efficiency Factor/100)
  - 80% Efficiency factor
    - This accounts for water refill stops and roller stops for reversing
    - Varys depending on roller type, brand, ext.
- Effective roller speed = 233.3*(80/100) = 186.7 fpm

109

Calculating Your Rolling Zone

- Effective roller speed = 186.7 fpm
- Effective Compaction Rate
  - =Effective roller speed/(number of passes per coverage)
  - Number of passes for coverage
    - 3 passes to cover
    - 3 coverages for density
    - 9 total passes
- Effective compaction rate = 186.7/9 = 20.7 fpm

110

Calculating Your Rolling Zone

- Roller rate = 20.7 fpm
- Time available for compaction (TAC)
  - From Environmental Variables chart
  - Or PaveCool
  - Example: 10 minutes
    - 2 in thick mat
    - mix temperature of 250 F
    - base temperature of 50 F.
- Rolling zone
- Roller rate x TAC = 20.7 fpm X 10 minutes = 207 ft

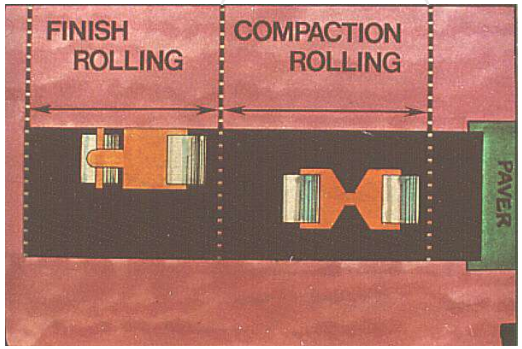
111

Balancing the paving example

- A roller rate of 20.7 fpm could control the productivity of the paving operation
- What can be done???
-
-

112

Rolling Zones



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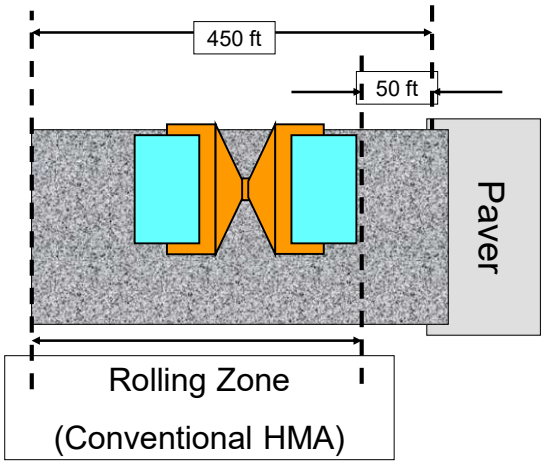

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Roller Production Rate Problem

MIX DELIVERY RATE		
Plant Rate Avail.	300	tph
Total Mix	3000	tons
Total Paving Time	10	hours
Mix Rate	300.0	tph
OK?	Truck>Plant = OK!	
# of Loads	8	loads/truck
# of Trucks	25	trucks
OK?	Exactly enough trucks	

PAVING RATE		
Paving Width	12	feet
Paving Thickness	3	inches
Reference Density	159.5	pcf
Target (% of Ref.)	92	%
Compacted Density	146.7	pcf

ROLLING RATE		
VPM (highest)	2800	vpm
Impacts/foot (10-12)	10	impacts/ft
Reverse factor (10%)	10	%
Roller Speed	280.0	fpm
Effective Speed	252.0	fpm
	84	inches
	6	inches
	6.50	feet
	2	
	3	
	7	
	63	%
	22.7	fpm
	200	
	8.8	

Spreadsheet for balancing production

	Paver	Roller	
Production Rate (fpm)	22.7	22.7	STOP!! - Whoa Pete!
Production Rate (sq.yd/hr.	1817	1814	Paver's outrunning Roller

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Topics

- Factors affecting compaction
- Time available for compaction
- Roller types
- Roller operations
- Roller pattern
- Production rate
- Roller maintenance

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Roller Maintenance

- Water Systems
- Hydraulic Systems
- Mechanical Systems
- Vibratory Systems
- Rolls, Tires, Pads, Scrapers

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Water Spray Bar

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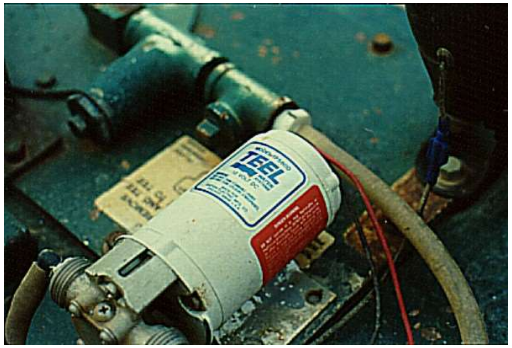
Pads

119

Poor Maintenance

120

Water Pump



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Maintenance Chart

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Roller maintenance checklist

- ☐ (1) COOLING SYSTEM - (a) Check coolant level; (b) Check radiator core for plugging with dirt or oil; (c) Check hoses for cracking and leaking; (d) Check belts for proper tension; (e) Check fan for loose bearings. Fill, adjust and/or replace as needed.
- ☐ (2) ENGINE LUBE SYSTEM - (a) Check engine oil level; (b) Check for any leakage on or around engine; (c) Report any discolorations (milky) or overfilled conditions right away.
- ☐ (3) FUEL SYSTEM - (a) Check sediment bowl for dirt or water and clean as needed; (b) Check for any leaks around lines and fittings. DO NOT OVERTIGHTEN.
- ☐ (4) HYDRAULIC SYSTEM - (a) Check oil level; (b) Check and look for any leaks around pumps, lines, fittings, and filters. DO NOT OVERTIGHTEN.
- ☐ (5) ELECTRICAL SYSTEM - (a) Look at the wiring and connections for being loose or oily. If oily, spray with contact cleaner. (b) Look at battery cable connections and clean if starting to corrode.
- ☐ (6) ROLLS & TIRES - (a) Check rolls for uneven wear; (b) Check tires for uneven wear and maintain at ___ kPa. air pressure (cold/hot); (c) Check scrapers and mats (replace as necessary).
- ☐ (7) WATER SYSTEM - (a) Check fill areas for debris; (b) Check filters for contamination and clean; (c) Test system to see if all nozzles are clear and operational.
- ☐ (8) INSPECTION - (a) Look for loose bolts and tighten right away when found; (b) clean out scraper and mat areas after each day's run; (c) Keep top deck and operator's station clear; (d) Check for other oil or grease leaks from gear boxes, transmission, differential, axle hubs, and report to shop immediately.

CHECK WEEKLY

- ☐ (1) BRAKE SYSTEM - (a) Check master cylinders for hydraulic brake fluid level. Keep filled to proper level.
- ☐ (2) ELECTRICAL SYSTEM - Batteries: (a) Check water level and maintain level above the plates. If one or more cells keeps going dry, it means the battery is near the end of its life.
- ☐ (3) TRANSMISSION - Gear boxes and pump drive housing: (a) Check grease levels and fill as needed to proper level.

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Summary notes

- Maintaining proper speed
  - Roller speed has one of the greatest influences on mat quality.
    - too slow can over compact the surface
    - too fast can leave gaps and compromise safety if the operator gets too close to the paver

ASPHALT PAVEMENT ASSOCIATION OF WEST VIRGINIA

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Summary notes cont'd

- Maintaining proper speed
  - Roller speed has one of the greatest influences on mat quality.
    - Using the correct speed will also help to maintain the appropriate impact spacing to prevent wash boarding. For most jobs, correct spacing is between **10 and 12 impacts per foot**.
    - Even if the wash boarding isn't readily seen at the time the road is paved, over time, it increases its affect because of the way the asphalt continues to compact

125

Summary notes cont'd

- Temperature
  - Cannot improve the density of cold mats!!!
  - Breakdown >240F
  - Intermediate 240 – 190
  - Finish 190 – **175** (165)

126

Summary notes cont'd

- Good vibrations
- Vibratory compaction creates shock waves that compact from the bottom up
- Static compaction works from the top down.
- Most jobs use a combination of compaction modes,
  - start with vibratory compaction
  - finishing with static
- Select the right amplitude
  - amplitude settings are determined by the depth of the lift
    - Lower amplitude settings are recommended for lifts of 2 in. or less;
    - higher amplitude settings should be used for deeper lifts.

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Do Not Park The Roller On A Hot Mat!!

128

Summary notes cont'd

- Follow the rolling pattern
  - Gradual turns
  - Gradual acceleration and breaking
- Always stop at an angle to the direction of paving

129

What are the 3 most important aspects of pavement construction?

Density

Density

130

130

Finally

"The single most important thing you can do to a pavement is compact it."

131

Questions

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INSPECTOR'S DUTIES - ASPHALT PAVING

Modified by WVDOH, APAWV, and WVU ATP

1

Work Includes…

- **Resurfacing Projects**
  - State Funded
  - Federal Funded
  - Purchase Order Paving
  - Bond Projects (Roadway Reconstruction)
- **New Projects**
  - New Roads
  - Bridge Approaches
  - Road Widening
  - Intersection Improvements
  - Bond Projects (Construction)

2

Funding Programs

- ***Federal Aid Funding (National Highway System)***
  - Interstate
  - APD (Appalachian Development System)
  - Federal Aid Other
    - US routes
    - State NHS routes
- ***State Funding***
  - **SLS** – State and Local service Routes (County Routes)
  - Non-NHS State Routes

Inspector duties vary depending on the funding program, route, compaction method

3

Basic HMA Applications

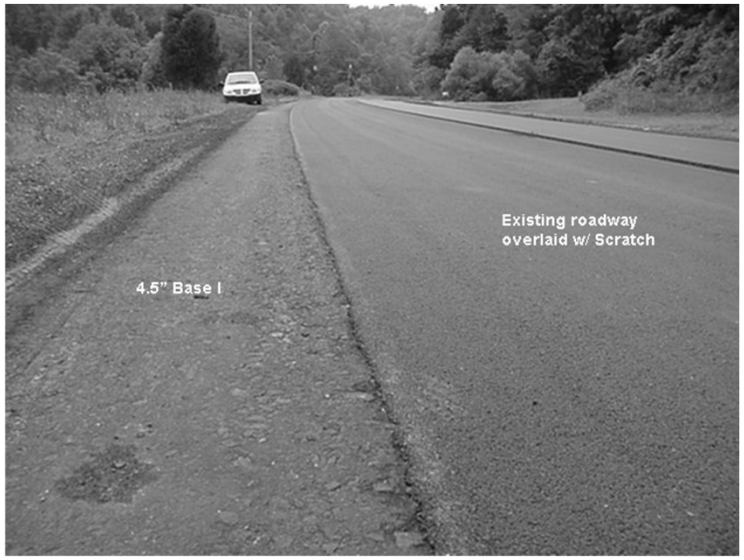
- **Base Course** – stone or HMA course placed above the subgrade or subbase of a road and helps to further distribute the load and improve the overall structure of the pavement section.
  - Marshall Base 1 and 2
  - Superpave Base 37.5 mm, 25 mm and 19 mm
- **HMA Wearing Course** – a single lift of constant thickness that is to be placed over the entire pavement surface and serves as the riding surface, receives the highest concentration of stress.
  - Marshall Wearing 1, 3, and 4
  - Superpave 4.75 mm, 9 mm and 12.5 mm
- SEE SECTION 401

4

Basic HMA Applications

- **Patch & Level (P&L)** – placed at various locations throughout the project to remove irregularities in the existing pavement, such as dips, or to raise the outside edge of pavement to improve the template prior to placing a base or wearing course.
- **Scratch Course** – a leveling course used for deviations less than an inch and can be placed over the entire length of the project.

5



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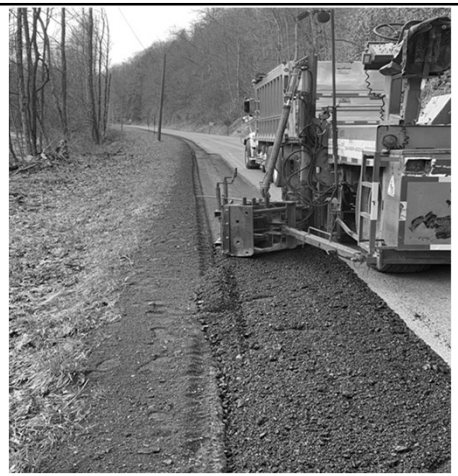

Edge Failure Repairs

8

1" thin overlay

9

1.5" Overlay with paved shoulders

10

Activities Prior to and during Construction…

- Bond and Insurance Checked – Issue NTP
- All Requested Pertinent Paperwork
  - Key Personnel
  - EEO
  - DBE Plan for Participation
  - Waste and/or Borrow Pit Agreements (SHPO)
  - Pollution and Erosion Control Plan
  - QC Plan - Available? Approved?

Resurfacing Inspector may be requested to verify these items on the project.

11

Activities Prior to Construction…

- Construction Layout
  - Staking the project
  - Mark Heel-ins
  - On larger projects this is usually included in contract
- Maintenance Finished?
  - Have all pipes been placed, ditches pulled, mowed, etc
- Verify Quantities In plans with Actual Field Measurements.

12

Activities Prior to Construction…

13

Activities Throughout the Project…

14

Activities Throughout the Project…

15

Activities Throughout the Project…

16

Activities Throughout the Project…

17

Activities Throughout the Project…

18

Activities Throughout the Project…

19

Activities Throughout the Project…

20

Activities Throughout the Project…

21

HMA Inspector's Requirements

- Generally needs to be trained in all aspects of materials and construction
  - Hot-mix Asphalt
  - PCC
  - Soils and Compaction
  - Environmental
  - Traffic Control
- **However, it is not a good idea to serve as the Project inspector and the Compaction Technicnian**

22

HMA Inspector's Requirements

- Must have an understanding of the entire paving operation
  - Plant Operations
  - Hauling Limitations
    - Bridge Postings
    - Truck weights
  - Paving Equipment
    - Paver (Screed)
    - Rollers

23

HMA Inspector's Requirements

- HMA Inspector has the same general duties regarding execution of the contract, but they do not have a field office. All forms, typicals, specs, etc. are kept in the "mobile field office."
- Good Inspector can visualize the entire job from beginning to end
  - Foresee contract issues ahead of time so that a plan of attack can be implemented right away

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HMA Inspector's Requirements

- Materials and the JMF – Job Mix Formula (Approved Mix Design)
  - Temperature Range established for the mix
  - Maintain communication with the plant inspector regarding other properties as well
    - Max Density
    - Lab Number
  - All mix designs are "Verified" at the beginning of each season

25

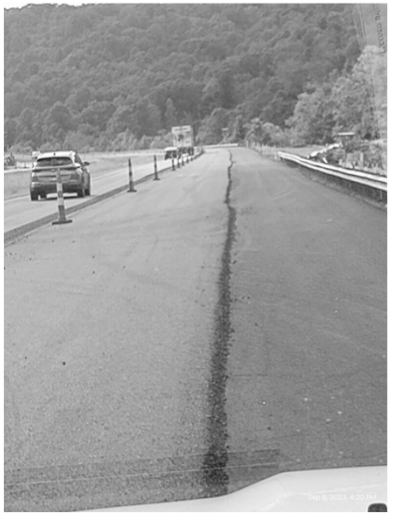
Good Workmanship

26

Proper Edge

27

What you don't want to see



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What you don't want to see

29

What you don't want to see

30

What you don't want to see

31

Night Work

- More work is being done during night hours than in the past
  - Especially in congested areas on major routes
  - Everything is more difficult to inspect at night
- Challenge the inspector faces is much greater
- Cooler temperatures can affect compaction
- Cooler temperatures can also affect the workablitly of the HMA mix

32

Night Work

33

Contractor's Requirements

- Contractor should have an overall paving plan including…
  - Production Rate
  - Haul Distance
  - Number of Trucks
- Properly staffed paving crew
  - Paving operator
  - Screed person
  - Broom
  - Compaction
  - Laborers

34

Contractor's Requirements

- On-site QC technician
  - Fully understands the process of density compliance and the operation of a nuclear gauge
    - Do they know the difference between "Lot-by-lot" and "Rollerpass" testing?
    - Are they capable of implementing the thin lift correction factors properly?
  - *Field Sampling Requirements for PWL*
  - Good technician understands the limitations of the JMF and has a general understanding of the nature of the specific mix

35

Activities Prior to Construction (the day of paving)…

- Traffic Control Check – need to maintain a good flow of traffic but maintain a *SAFE WORKZONE*.
  - Check all arrow boards and message boards, Type B lights
  - Make sure flaggers understand the scope of traffic
  - Remember *Night-time* Limitations
- Check Heel-ins
- Check surface conditions
- Tack Distributor – good condition
- Other Equipment?

36

Activities Prior To and During Construction

- Check traffic control
- Check ground and air temperatures
- Check delivery tickets for correct Mix Design, Materials, and Project Number
- Check HMA temperature in the truck
- Check the depth of HMA as being placed

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Inspector's Daily Duties…

- Collect tickets (now typically digital)
  - JMF# and target density, truck weights
- Verify Rollerpass or Lot-by-lot
- Observe mix characteristics – mat texture, segregation, flushing, contamination (*Night-time!*)
- Mat - screed setting and mat thickness
- Paver must maintain a constant head of flow
  - Best to stop and start quickly

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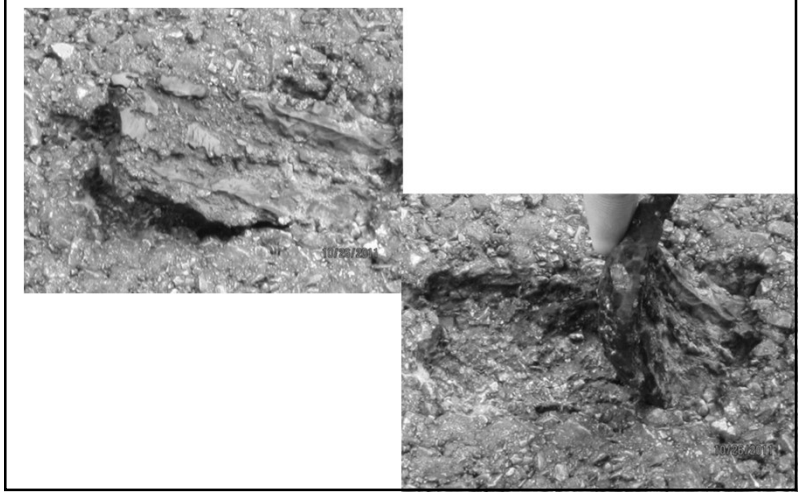
Contamination!!!



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Contamination!!!

40

Issues Caught During Construction Can Be Corrected

41

Inspector Daily Duties…

- Be on the project from before work begins to after everything is off the road for the day.
- Get with the contractor's foreman at the end of the day to agree on quantities and hours.
- Document any changes made on project in your DWR whether big or small and note if someone authorized the changes.

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Inspector Daily Duties…

- Throughout day check flagger placement and pilot truck return times to keep traffic flowing as smooth as possible.
- Document any issues that come up during the day on your DWR. Issues might not seem important at the time but could be something major down the road.

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Inspector's Daily Duties…

- Is compaction being done properly and are density readings acceptable
- Application rates at minimum 2500' intervals
- Placement of temporary tape and temporary markings as needed/required
- Throughout day check your Traffic Control to make sure signs are kept up in proper work zone specifications

44

Inspector Daily Duties

- Most flagging subcontractors have sheets to sign daily for their time, if not make sure you talk to the one in charge of the crew to let them know their hours for the day.
- Keep a notebook for yourself of quantities placed daily to easily reference back to on project.
- Get DWR submitted daily!

45

Inspectors Office Duties

- Check payrolls for contracts to verify correct pay.
- Initiate change orders for projects
- Make sure all samples taken and approved sources are entered in Site Manager
- Correct mistakes on DWR in a timely manner so estimates can be run.

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Verifying Quantities

- Tack Application Rate
- Proper HMA Application Rate

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Proper Tack Application

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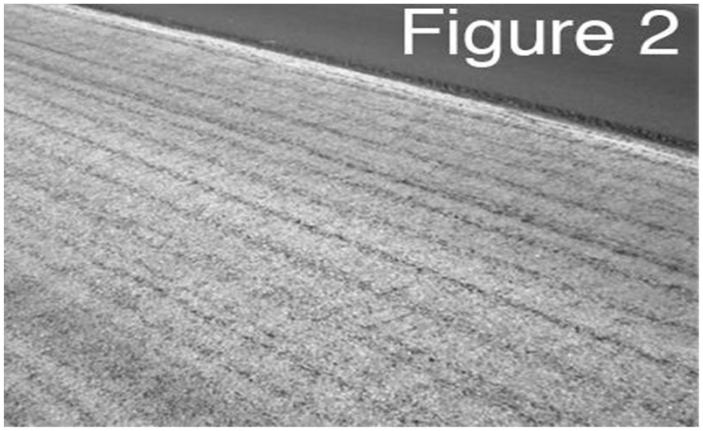
Proper Tack Application

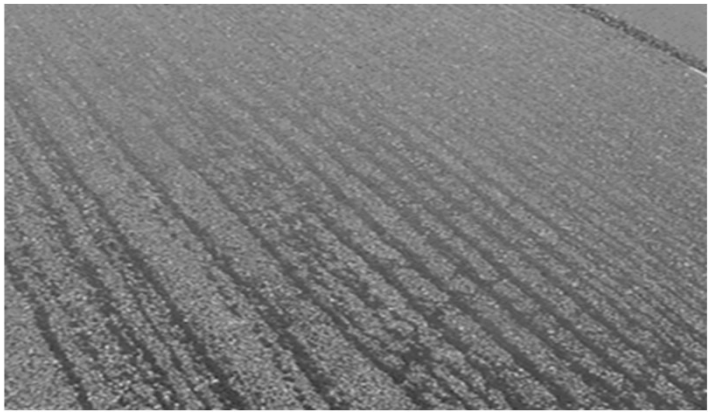
49

Poor Tack Application



50

Poor Tack Application



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Verifying Quantities

- What is the Proper Rate for Tack?

52

What is the Proper Rate for Tack?

- Tack Coat Specification (408)
  - Gives guidance regarding “break” and “set”
  - Discusses rate of dilution
  - Shows a table with application rates based on paving surface
- We want to achieve a *desirable* “residual” asphalt content
- How do you calculate tack application rate?

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Table 408.11. See page 197 of the spec. book

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	0.07 – 0.10	0.13 – 0.20
Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

Note 2: Application rates are for slow setting emulsions grades (SS and CSS) that contain approximately 60% asphalt material. Rapid setting emulsion grades may contain slightly higher or lower asphalt contents, but can usually be applied within the same application range.

Note 3: Dilution rate only applies to SS and CSS grades.

Note 4: Tack coat is normally not needed over a layer of new HMA that has been placed within the last few days, as long as the underlying new layer has not become dirty under traffic or from windblown dust.

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Example Tack Calculation 1

- CALCULATE THE APPLICATION RATE FOR TACK
  - ❑ Existing roadway has a milled surface.
  - ❑ Road width is an average of 12’.
  - ❑ The initial dial reading is 750 gallons. Tack is undiluted.
  - ❑ Tack is placed from Sta. 0+00 to Sta. 15+00.
  - ❑ Final gauge reading is 525 gallons after tack placement.

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Example Tack Calculation 1

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	0.07 – 0.10	0.13 – 0.20
Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

Note 2: Application rates are for slow setting emulsions grades (SS and CSS) that contain approximately 60% asphalt material. Rapid setting emulsion grades may contain slightly higher or lower asphalt contents, but can usually be applied within the same application range.

Note 3: Dilution rate only applies to SS and CSS grades.

Note 4: Tack coat is normally not needed over a layer of new HMA that has been placed within the last few days, as long as the underlying new layer has not become dirty under traffic or from windblown dust.

408.12-METHOD OF MEASUREMENT:

No materials shall be removed from the Project for any purpose until the operation has been completed and the quantities of materials incorporated into the operations have been determined, except when authorized by the Engineer.

The quantity of “Asphalt Material” for tack coat shall be the number of gallons, prior to dilution, incorporated into the completed work. Any applicable dilution rates, shall be supplied to the Engineer by the Contractor on the material delivery ticket.

Dry sand or stone chips used as a blotter course due to excessive use of tack coat shall be considered incidental to the work.

When items for maintaining traffic are included in the Contract, they will be measured and paid as provided in Section 636.

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Example Tack Calculation 1

- Calculate the tack used:
  PAY QTY. = 750 gal – 525 gal = 225 GALLONS
- LETS CHECK THE APPLICATION RATE:
  - 12 ft x 1500 ft = 18,000 ft^2
    - ➢To convert sq. ft to sq. yd.: 9 ft^2 = 1 SY
  - 18,000 ft^2 ÷ 9 ft^2/sy = 2,000 SY
- Calculate Rate of Application
  - 225 gal ÷ 2,000 SY = ***0.1125 = 0.11 gal/ sy***

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	0.07 – 0.10	0.13 – 0.20
Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

57

Example Tack Calculation 2

- Existing roadway is very old, dried, and cracked. "Oxidized" from Table 408.11.
- Road width is an average of 12'.
- Prior to tack placement, dial gauge reads 450 gallons. Tack is diluted.
- Tack is placed from Sta. 0+00 to Sta. 10+00.
- Dial gauge reads 300 gallons after tack placement.

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Example Tack Calculation 2

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	0.07 – 0.10	0.13 – 0.20
Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

Note 2: Application rates are for slow setting emulsions grades (SS and CSS) that contain approximately 60% asphalt material. Rapid setting emulsion grades may contain slightly higher or lower asphalt contents, but can usually be applied within the same application range.
Note 3: Dilution rate only applies to SS and CSS grades.
Note 4: Tack coat is normally not needed over a layer of new HMA that has been placed within the last few days, as long as the underlying new layer has not become dirty under traffic or from windblown dust.

408.12-METHOD OF MEASUREMENT:

No materials shall be removed from the Project for any purpose until the operation has been completed and the quantities of materials incorporated into the operations have been determined, except when authorized by the Engineer.

The quantity of "Asphalt Material" for tack coat shall be the number of gallons, prior to dilution, incorporated into the completed work. Any applicable dilution rates, shall be supplied to the Engineer by the Contractor on the material delivery ticket.

Dry sand or stone chips used as a blotter course due to excessive use of tack coat shall be considered incidental to the work.

When items for maintaining traffic are included in the Contract, they will be measured and paid as provided in Section 636.

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Example Tack Calculation 2

- Calculate the tack used
  PAY QTY. = 450 gal – 300 gal = 150 GALLONS
- LETS CHECK THE APPLICATION RATE:
  - 12ft x 1000ft = 12,000 sq. ft
    - ➢ To convert sq. ft to sq. yd: 9 ft^2 = 1 SY
    - ➢ 12,000 ft^2 ÷ 9 $^{ft2}/_{SY}$ = 1,333.33 SY
- Calculate Rate of Application
  - 150 gal ÷ 1,333.33 sy = 0.1125 = ***0.11 gal/ sy***
    (This does NOT meet Specs.)

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
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Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

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CALCULATING HMA APPLICATION RATE

HMA Approximate Rate and Lift Thickness

- 1.0” Compacted = 110 PSY
- 1.5” Compacted = 165 PSY
- 2.0” Compacted = 220 PSY

61

Verifying Quantities

- Given: A Two Lane Road is 1 mile long, has an average width of 28’, and a 1.5” Overlay is being placed. How many Tons per lane of HMA?

62

Verifying Quantities

- Given: A Two Lane Road is 1 mile long, has an average width of 28’, and a 1.5” Overlay is being placed. How many Tons per lane of HMA?
  - Convert miles to Lineal Ft (1 mile x 5280 ft/ mi)
    = 5,280 ft (End Station would be 52+80)

63

Verifying Quantities

- Given: A Two Lane Road is 1 mile long, has an average width of 28’, and a 1.5” Overlay is being placed. How many Tons per lane of HMA?
  - Convert miles to Lineal Ft (1 mile x 5280 ft/ mi)
    = 5,280 ft (End Station would be 52+80)
  - 5280 ft x 28 ft width = 147,840 sq. ft

64

Verifying Quantities

- Given: A Two Lane Road is 1 mile long, has an average width of 28', and a 1.5" Overlay is being placed. How many Tons per lane of HMA?
  - Convert miles to Lineal Ft (1 mile x 5280 ft/ mi)
    = 5,280 ft (End Station would be 52+80)
  - 5280 ft x 28 ft width = 147,840 sq. ft
    - To convert sq. ft to sq. yd: 9 ft^2 = 1 SY

65

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- 147,840 ft^2 ÷ 9 = 16,426.67 SY

66

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- 147,840 ft^2 ÷ 9 = 16,426.67 SY
- = $\frac{16{,}426.67 \text{ SY} \times 165 \text{ LB/SY}}{2000 \text{ LB/TN}}$
  = 1,355.2 TN

67

Verifying Quantities

- Given: A Two Lane Road is 1 mile long, has an average width of 28', and a 1.5" Overlay is being placed. How many Tons per lane of HMA?
  - Convert miles to Lineal Ft (1 mile x 5280 ft/ mi)
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- 147,840 ft^2 ÷ 9 = 16,426.67 SY
- = $\frac{16{,}426.67 \text{ SY} \times 165 \text{ LB/SY}}{2000 \text{ LB/TN}}$
  = 1,355.2 TN

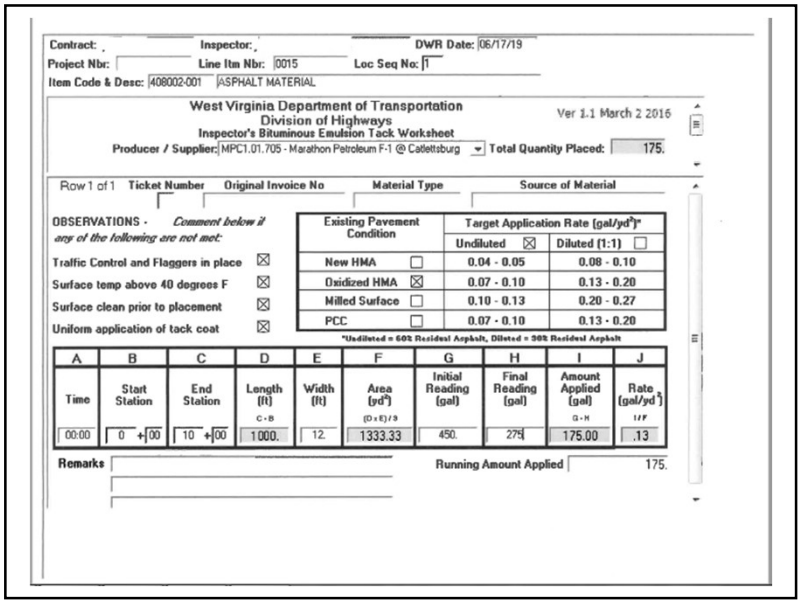
ANSWER = 1,355.2 TN / 2 lanes = <u>677.6 TN per lane</u>

68

After Project Completion

- Verify all payrolls are received and checked for compliance.
- Get final paperwork done in a timely manner.
- Get Over/under change order ready to be processed.
- Make sure any outstanding change orders are paid when they complete the process.

69



Contract: , Inspector: , DWR Date: 06/17/19
Project Nbr: , Line Itm Nbr: 0015 Loc Seq No: 1
Item Code & Desc: 408002-001 ASPHALT MATERIAL

West Virginia Department of Transportation
Division of Highways
Inspector's Bituminous Emulsion Tack Worksheet
Ver 1.1 March 2 2016

Producer / Supplier: MPC1.01.705 - Marathon Petroleum F-1 @ Catlettsburg Total Quantity Placed: 175.

Row 1 of 1 | Ticket Number | Original Invoice No | Material Type | Source of Material

OBSERVATIONS - *Comment below if any of the following are not met:*

- Traffic Control and Flaggers in place ☒
- Surface temp above 40 degrees F ☒
- Surface clean prior to placement ☒
- Uniform application of tack coat ☒

Existing Pavement Condition	Target Application Rate (gal/yd²)* Undiluted ☒	Diluted (1:1) ☐
New HMA ☐	0.04 - 0.05	0.08 - 0.10
Oxidized HMA ☒	0.07 - 0.10	0.13 - 0.20
Milled Surface ☐	0.10 - 0.13	0.20 - 0.27
PCC ☐	0.07 - 0.10	0.13 - 0.20

*Undiluted = 60% Residual Asphalt, Diluted = 30% Residual Asphalt

A	B	C	D	E	F	G	H	I	J
Time	Start Station	End Station	Length (ft) C - B	Width (ft)	Area (yd²) (D x E) / 9	Initial Reading (gal)	Final Reading (gal)	Amount Applied (gal) G - H	Rate (gal/yd²) I / F
00:00	0 +00	10 +00	1000.	12.	1333.33	450.	275	175.00	.13

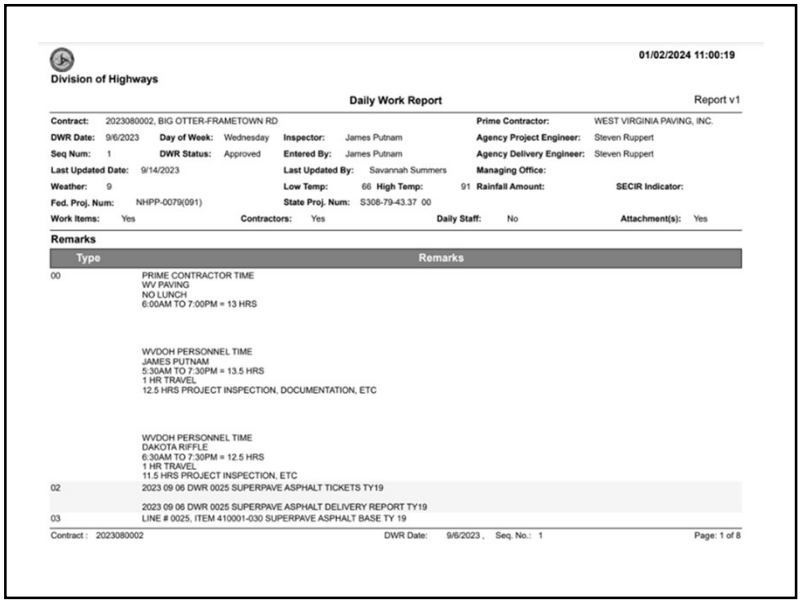
Remarks

Running Amount Applied 175.

70

EXAMPLE DWR ENTRY

71



01/02/2024 11:00:19

Division of Highways

Daily Work Report Report v1

Contract: 2023080002, BIG OTTER-FRAMETOWN RD
DWR Date: 9/6/2023 Day of Week: Wednesday Inspector: James Putnam
Seq Num: 1 DWR Status: Approved Entered By: James Putnam
Last Updated Date: 9/14/2023 Last Updated By: Savannah Summers
Weather: 9 Low Temp: 66 High Temp: 91 Rainfall Amount:
Fed. Proj. Num: NHPP-0079(091) State Proj. Num: S308-79-43.37 00
Work Items: Yes Contractors: Yes Daily Staff: No
Prime Contractor: WEST VIRGINIA PAVING, INC.
Agency Project Engineer: Steven Ruppert
Agency Delivery Engineer: Steven Ruppert
Managing Office:
SECIR Indicator:
Attachment(s): Yes

Remarks

Type	Remarks
00	PRIME CONTRACTOR TIME WV PAVING NO LUNCH 6:00AM TO 7:00PM = 13 HRS WVDOH PERSONNEL TIME JAMES PUTNAM 5:30AM TO 7:30PM = 13.5 HRS 1 HR TRAVEL 12.5 HRS PROJECT INSPECTION, DOCUMENTATION, ETC WVDOH PERSONNEL TIME DAKOTA RIFFLE 6:30AM TO 7:30PM = 12.5 HRS 1 HR TRAVEL 11.5 HRS PROJECT INSPECTION, ETC
02	2023 09 06 DWR 0025 SUPERPAVE ASPHALT TICKETS TY19 2023 09 06 DWR 0025 SUPERPAVE ASPHALT DELIVERY REPORT TY19
03	LINE # 0025, ITEM 410001-030 SUPERPAVE ASPHALT BASE TY 19

Contract: 2023080002 DWR Date: 9/6/2023, Seq. No.: 1 Page: 1 of 8

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01/02/2024 11:00:19

Division of Highways

Daily Work Report

Report v1

Item Postings

Item Description	Item ID	Seq. Num	Cont Ln	Project	Category	Proj Ln	Quantity Posted	Unit	From Station - To Station Location
SUPERPAVE ASPHALT BASE CRSE, TY 19	410001-030	1	0025	2023080002	0001	0025		SY	BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location
19 mm Asphalt Mix, Superpave		TN		

Contractor: WEST VIRGINIA PAVING, INC.

Comments: PAY FOR THIS ITEM WILL BE MADE AT A LATER DATE ON COMPLETION OF PWL SAMPLE TESTING.

AT THE FOLLOWING LOCATIONS, THE CONTRACTOR USES A TRANSFER MACHINE AND A RUBBER TIRE PAVER TO PLACE ASPHALT BASE FOLLOWED BY 3 STEEL DRUM ROLLERS FOR COMPACTION. TERRADON TECHNICIAN, JUSTIN WHITTINGTON, ON SITE FOR DENSITY. WV PAVING, JAMEY PROPPS ON SITE FOR PWL CORE DRILLING. WVDOH TECHNICIAN DAVID SCHOOLCRAFT ON SITE.

(PAYMENT WILL BE REQUESTED FOR A 12FT LANE)

SB SLOW LANE
2611+75 TO 2596+70 = 1505
EQUALITY
2595+78 TO 2516+35 = 7943

1505 + 7943 = 9448

((9,448 X 12 = 113,376) / 9 = 12,597.333)

NB SLOW LANE
2516+35 TO 2522+80 = 645

((645 X 12 = 7,740) / 9 = 860)

12,597.333 + 860 = 13,457.333 SY

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01/02/2024 11:00:19

Division of Highways

Daily Work Report

Report v1

PAY QUANTITY = 0 SY

TRAFFIC CONTROL DEVICE 636011-001 1 0140 2023080002 0001 0140 0 UN BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location
Traffic Control Devices	0	EA		

Contractor: HIGHWAY SAFETY, INC.

Comments: ALL TRAFFIC CONTROL DEVICES ARE PROPERLY LOCATED THROUGHOUT THE PROJECT. THE SIGNS ARE CLEAN, LEGIBLE, AND CLEARLY VISIBLE. SPEED TRAILERS AND ARROW BOARDS ARE ALSO UTILIZED IN EACH LANE AS PART OF THE REQUIRED SPECIFICATIONS FOR THE TRAFFIC CONTROL SET UP AS LISTED PER THE PLAN SHEET. REFER TO THE DAILY CHECK LIST FOR ADDITIONAL INFORMATION.

PAY QUANTITY = 0 UN

TRAFFIC DIRECTOR 636014-002 1 0155 2023080002 0001 0155 11.5 HR BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location

Contractor: WEST VIRGINIA PAVING, INC.

Comments: CONTRACTOR USES A TRAFFIC DIRECTOR ON THIS DATE FOR THE SAFETY OF THE TRAVELING PUBLIC. PATROL VEHICLE FOLLOWED THE OPERATIONS THROUGHOUT THE PROJECT AS PER THE CONTRACTOR'S REQUEST. THE OFFICER ON DUTY THIS DATE IS BRIAN YOUNG.

HOURS ON SITE 7:00AM TO 6:30PM = 11.5 HRS

PAY QUANTITY = 11.5 HR

ELECTRIC ARROW 636021-001 1 0160 2023080002 0001 0160 2 DA BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location

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01/02/2024 11:00:19

Division of Highways

Daily Work Report

Report v1

Comments: CONTRACTOR UTILIZES 32 TYPE B WARNING LIGHTS. ALL TYPE B WARNING LIGHTS ARE PLACED PROPERLY. ALL TYPE B LIGHTS ARE ON AND WORKING PROPERLY. AS PER THE PLANS, B LIGHT PAYMENT WILL BE REQUESTED FOR PLACEMENT ON ROAD WORK 2 MILES SIGNS, ROAD WORK 1 MILE SIGNS, AND 55 MPH SIGNS.

ALL B-LIGHTS ARE WORKING THIS DATE

PAY QUANTITY = 32 DA

SHADOW VEHICLE 636028-002 1 0175 2023080002 0001 0175 MO BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location

Contractor: WEST VIRGINIA PAVING, INC.

Comments: CONTRACTOR UTILIZES A SHADOW VEHICLE WHILE PERFORMING WORK. I PREVIOUSLY ADVISED WV PAVING TO HAVE THE SHADOW VEHICLE SET UP TO MEET SPECIFICATIONS LISTED IN THE STANDARD DETAILS. THE SHADOW VEHICLE HAS BEEN EQUIPPED WITH FLASHING BEACONS AND A TRUCK MOUNTED ATTENUATOR. SPOKE WITH VERN WALKER, WV PAVING, ABOUT HAVING 2 SHADOW VEHICLES ON THE PROJECT WHEN PROJECT SCHEDULED FOR 1 AS PER THE PLANS. WV PAVING AGREED HAVING PAYMENT FOR THE USE OF 1 UNLESS 2 BECOMES NEEDED. ONLY 1 IS BEING UTILIZED AT THIS TIME.

PUT IN SERVICE ON 07/25/2023. NEXT PAYMENT REQUEST 9/25/2023

PAY QUANTITY = 0 MO

SPEED MONITORING TRAILER 636030-001 1 0180 2023080002 0001 0180 2 DA BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location
Traffic Control Devices	0	EA		

Contractor: HIGHWAY SAFETY, INC.

Comments: THERE ARE 2 SPEED MONITORING TRAILERS PLACE ON THIS PROJECT. ONE PLACED ON THE SB SIDE OF THE PROJECT AND ONE ON THE NB SIDE OF

75

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
INSPECTOR'S ASPHALT PAVEMENT WORKSHEET

AUTH NO: _____ PROJECT NO: _____ IDR NO: _____

LINE NO: _____ ITEM NO: _____ DATE: _____

LOAD	TICKET #	TONS / MG	CUM. TOTAL	LOAD	TICKET #	TONS / MG	CUM. TOTAL
1				25			
2				26			
3				27			
4				28			
5				29			
6				30			
7				31			
8				32			
9				33			
10				34			
11				35			
12				36			
13				37			
14				38			
15				39			
16				40			
17				41			
18				42			
19				43			
20				44			
21				45			
22				46			
23				47			
24				48			

REMARKS: _____

TOTAL Tons (Mg) THIS DATE: _____ INSPECTOR: _____

Signature

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ROLLER PASS DATA _____ PCF SPEED OF ROLLER _____ MPH TYPE OF ROLLER _____
ROLLER PASS DATA _____ PCF SPEED OF ROLLER _____ MPH TYPE OF ROLLER _____
PLAN THICKNESS _____

CALCULATION OF APPLICATION RATE (ONE CALCULATION PER EACH 762 m (2500 LF))

BEGIN STATION						
END STATION						
WIDTH						
Gm (SY)						
Mg (TONS)						
Mg/Gm (LB/SY)						

OBSERVED SIMILARITY TESTS (ONE OBSERVATION PER EACH 305 m (1000 LF))

LOT NUMBER						
TEST NUMBER						
Mg/CH (LB/CY)						
STATION						

MAT THICKNESS (PRIOR TO COMPACTION) & MAT TEMPERATURE (AT TIME OF FINAL COMPACTION PASS) CHECKS (ONE CHECK PER 305 m (1000 LF))

TIME						
MAT TEMPERATURE						
MAT THICKNESS						
STATION						

TIME						
MAT TEMPERATURE						
MAT THICKNESS						
STATION						

ROLLER SPEED CHECKS (FOUR CHECKS - TWO AM AND TWO PM)

TIME						
ROLLER SPEED						

CHECKS ☐ VERIFIED PRIOR TO PLACEMENT CHECKS ☐ VERIFIED DURING PLACEMENT

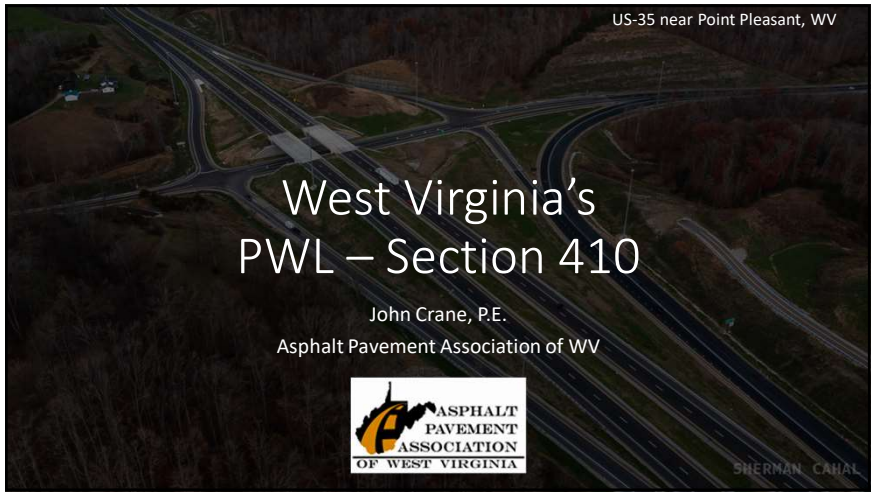
- ☐ SEQUENCE OF OPERATION VERIFIED
- ☐ TRUCKS COVERED AND INSULATED WITH NO OIL LEAKS OR DAMAGED SIDES
- ☐ TRAFFIC CONTROL DEVICES AND FLAGGERS IN PLACE
- ☐ OPERATION CONTINUOUS AND PAVER SPEED COMPATIBLE TO PLANT PRODUCTION
- ☐ MILL-IN JOINTS CUT AND POTHOLES CORRECTED
- ☐ VIBRATING SCREED ON AND TEXTURE OF MAT CORRECT
- ☐ SURFACE CLEAN AND STRINGLINE PLACED
- ☐ CORRECT ROLLING SEQUENCE BEING USED
- ☐ ROLLER(S) AND PAVER(S) VERIFIED FOR COMPLIANCE
- ☐ STRAIGHT EDGE CHECKS BEING MADE
- ☐ CONTRACTORS DENSITY TECHNICIAN ON SITE
- ☐ COMPLIANCE WITH QUALITY CONTROL PLAN MAINTAINED
- ☐ LONGITUDAL JOINTS PINCHED / NO OVERLAPPED
- ☐ TEMPERATURE OF MATERIAL RECORDED ON TICKETS ONCE PER HOUR MINIMUM

AIR TEMP ____ °C (°F) AT (TIME) ____ BASE TEMP ____ °C (°F) AT TIME ____
AIR TEMP ____ °C (°F) AT (TIME) ____ BASE TEMP ____ °C (°F) AT TIME ____

77

At the end of the day we want the same result.

78



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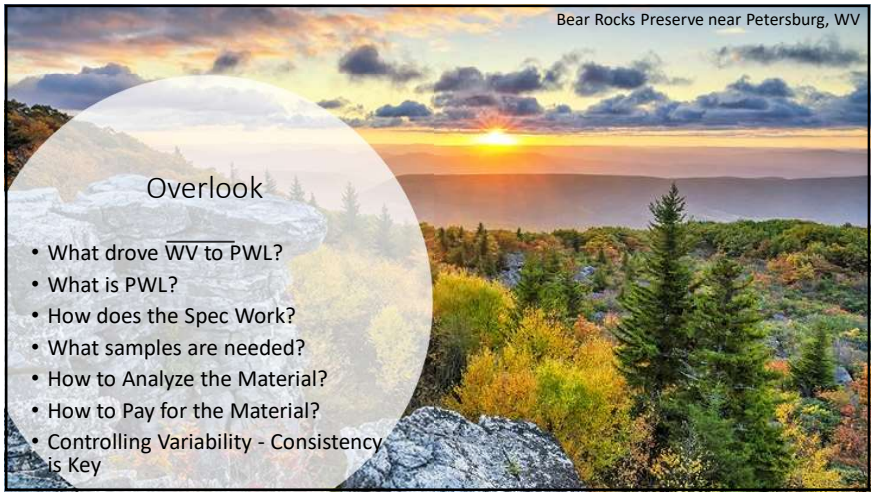
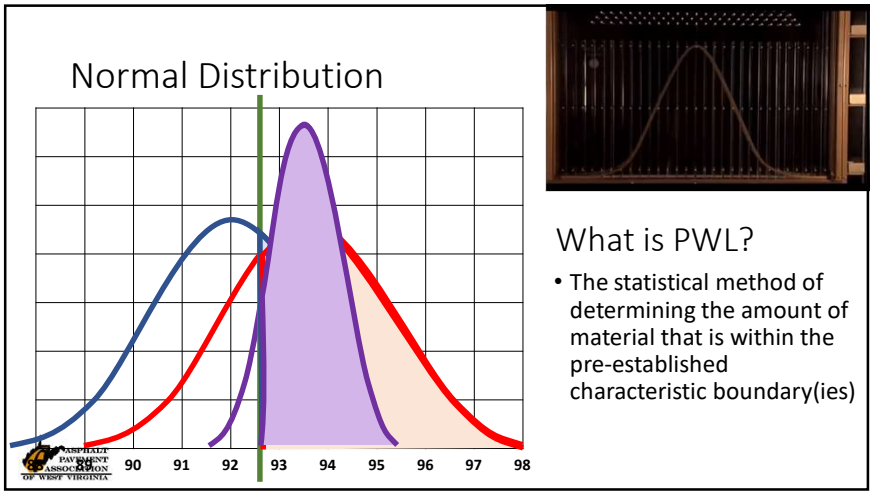


2

Why West Virginia Changed their specs?

- Poor performing pavements with ineffective specification to combat issues
- FHWA's ~2011 Stewardship Review
  - Improve QA/QC procedures
  - Higher focus on DOH performing Acceptance testing of Materials
- DOH was investigating ways of achieve higher performing, longer lasting roadways
  - F&T testing
  - Standard Deviation Driven
  - Percent within Limitation (PWL)

3



What is PWL?

- The statistical method of determining the amount of material that is within the pre-established characteristic boundary(ies)

4

Lets have some fun with statistics!

5

Why did WV go with PWL?

- Desired a more robust methods to Evaluate Overall Quality
- WVDOH's standard Asphalt QC/QA was based on moving average
  - Straight Average and Moving Average is not the best measure of quality
  - Lacks enforcement to stay on Target
- WVDOH wanted to focus on end results Specification drawing data from the field
  - Materials properties along with Mat and Joint Density
- Promote consistency throughout the project

6

PWL Paving – WV Overview

- This is the Method of QA for NHS routes and above
- Material samples are taken from the roadway
  - Asphalt Content / Gradation / Mat Density / Joint Density /Bond Strength / Thickness
- PWL statistical analysis
  - Based on average, standard deviation, and specified limits
  - Theoretical percentage of all data that is statistically within the overall specification limits
  - Not just an average or a moving average
- Pay Factors are established
- Payment is by the SY, not by the Ton
  - Eliminates the need for change orders and over runs

7

What's **required** and What's not Quality Control (QC)

- Plant
  - Volumetric Mixture Control – Air Void, VMA, Asphalt Content, Gradation
    - Per tonnage basis – 1000-ton sublot (750 tons during mixture verification)
  - Samples must satisfy single sample tolerance and moving average tolerance
- Field
  - None*

8

What's required and What's not? Quality Assurance (QA)

- The WVDOH does all the Acceptance testing
- Field Sampled – 2500-ton Lots w/ 5 sublots
  - Thickness – Cores
  - Density Mat – Cores
  - Bond Strength – Cores
  - Asphalt Content – Loose Mix
  - Gradation(Dust Content) – Loose Mix
- Density Joint – Cores 10,000 FT Lot w/ 5 sublots
- Inspection @ Plant
  - Minimal involvement

Test	Limits
Asphalt Content	JMF ± 0.4%
Gradation (-%200)	JMF ± 2.0%
Density	91.5 – 97.0% G_{mm}
Joint Density	> 89.0% G_{mm}
Bond Strength	> 100 psi
Thickness	Design – 0.04"

9

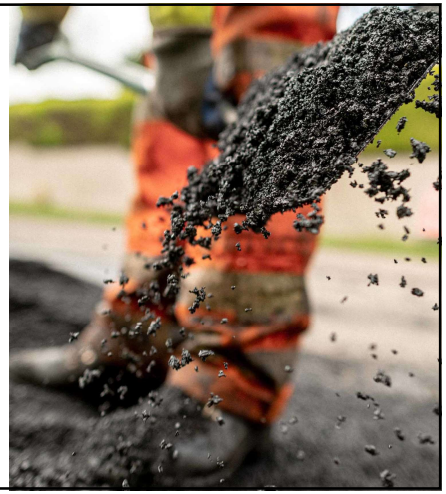
PWL Paving – Loose Mix Samples

- Sampling Location
  - "Loose Mix" sample behind the paver for Pay
  - Still truck samples for plant QC/QA
  - https://www.youtube.com/watch?v=lTZeDmYojuM
  - https://www.youtube.com/watch?v=to8C-iesXkY

10

PWL – Asphalt & Dust Content

- All materials arriving on the project are expected to be **quality** and stay **consistent**.
- Importance of Asphalt and Dust
- Asphalt and Gradations tests are performed in the lab
- Statistical Evaluation



11

PWL Paving – Core Samples

- Must use a 6-inch Core bit – **Inside Diameter**
- Cores are used to determine
  - In-place Density
  - Bond Strength
  - In-place Thickness
- Care should be taken to ensure the viability of the core
  - Drill as deep as reasonable possible
  - Do not pry or push on the layer to be tested.

12

PWL Paving – Density Analysis

- Mat and Longitudinal Joint Evaluations
- Coring the finished pavement
- No field density testing is required
  - Still a good Practice for QC
  - Can use non-nuclear
- Density tests in the lab
- Statistical Evaluation

13

PWL Paving – Bond Strength

- Poor tack coats and surface prep can lead to premature failures
  - Layer slip / Delamination / Cracking
- Cores are tested in a Shear device
  - Lower limit of 100psi
- Statistical Evaluation

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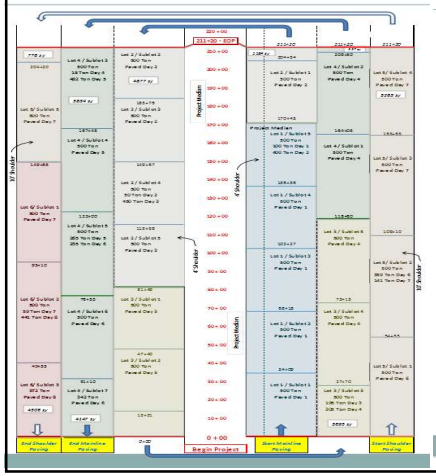
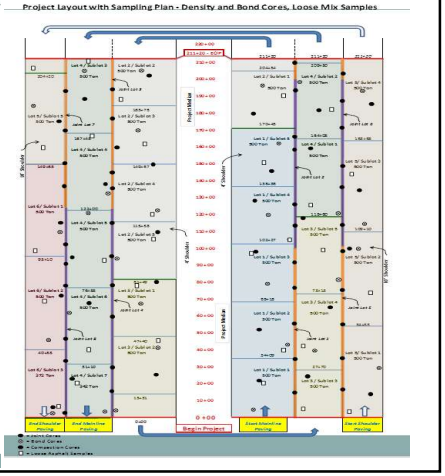
How Do We Know Where to Get These Samples

- Prior to Construction
- Lot Layout
  - Production lots are 2500 tons
  - Constructed joints have 10,000’ lots
- Pre-paving Meeting
  - Agree on paving sequence – Layout Lots in field for sampling
  - Loose mix locations at beginning of day
  - Cores marked after finish roller…notify contractor!

15





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PWL Paving – Example Setup

- Two lane, 3.0 mile road, 1.5 inch design thickness, 12 ft lanes. Example mix is 156.7 lb/CF max. How many tons?

Determine	Method	Answer
Thickness (ft)	**Thickness / 12**	
Length (ft)	**Length(mi) x 5280**	
Area (SF)	**Length x Width x Lanes**	
Volume (CF)	**Area x Thickness**	
Field Density	**Max Density x 94%**	
Pounds required	**Field Density x Volume**	
Tons required	**Pounds / 2000**	

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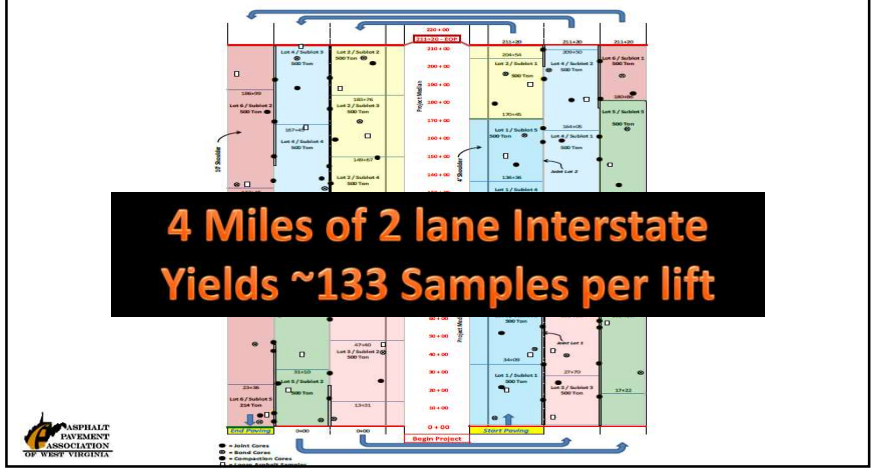
PWL Paving – Example Setup

- **3500 ton project, single "extended" lot**
  - **Sublot = 500 ton…. Therefore 3500/500 = 7**

Determine	Method	Answer
Loose Samples	**One per mat sublot**	
Mat Density Samples	**One per mat sublot**	
Bond Strength Samples	**One per mat sublot**	
Length (ft)	**Length(mi) x 5280**	
Joint Density Samples	**One per JOINT sublot**	
Thickness Samples	**Use Bond Strength & Mat Density Cores**	

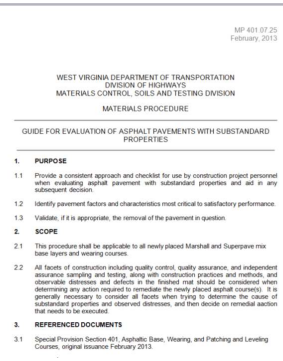
18



19

20

Significant Changes
Field Evaluations – Pavement Distresses



MP 401.07.25
February, 2013

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

GUIDE FOR EVALUATION OF ASPHALT PAVEMENTS WITH SUBSTANDARD PROPERTIES

1. **PURPOSE**

1.1 Provide a consistent approach and checklist for use by construction project personnel when evaluating asphalt pavement with substandard properties and aid in any subsequent decision.

1.2 Identify pavement factors and characteristics most critical to satisfactory performance.

1.3 Validate, if it is appropriate, the removal of the pavement in question.

2. **SCOPE**

2.1 This procedure shall be applicable to all newly placed Marshall and Superpave mix base layers and wearing courses.

2.2 All facets of construction including quality control, quality assurance, and independent assurance sampling and testing, along with construction practices and methods, and observable distresses and defects in the finished mat should be considered when determining any action required to remediate the newly placed asphalt course(s). It is generally necessary to consider all facets when trying to determine the cause of substandard properties and observed distresses, and then decide on remedial aaction that needs to be executed.

3. **REFERENCED DOCUMENTS**

3.1 Special Provision Section 401, Asphaltic Base, Wearing, and Patching and Leveling Courses, original issuance February 2013.

21

The Fork in the Road (New in 2023)

Interstates and Divided NHS Routes

- PWL Calculations on:
  - Mat Density
  - Joint Density
  - Bond Strength
  - Asphalt Content
  - #200(Dust) Content
- Lot Average
  - Thickness of cores

Two-Lane and Non-divided NHS Route Exceptions

- PWL Calculations on:
  - Asphalt Content
  - #200(Dust) Content
- Lot Average on:
  - Mat Density
  - Joint Density
  - Bond Strength
  - Thickness of Cores

Commonalities:

- Main Lot Payment is always based on Mat Density, Asphalt Content, and Dust Content. With the Total Lot payment calculated the same regardless of how the Payment Factors are generated
  - 50% Mat Density, 25% each Asphalt content and Dust content
- Thickness, Bond Strength and Joint Density are each stand alone adjustments based on their individual equations

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PWL Paving – Pay Adjustment

- **Lot Payment**

$$\boldsymbol{CP(2PD + PB + PA)/400}$$

- **Contract Price, Pay Density, Pay Binder, Pay Aggregate**
- **Payment for each component can reach 102%, but the average density must be greater than 93.0%**

Incentives have been removed from the specification on projects let on of after January 1st, 2023.

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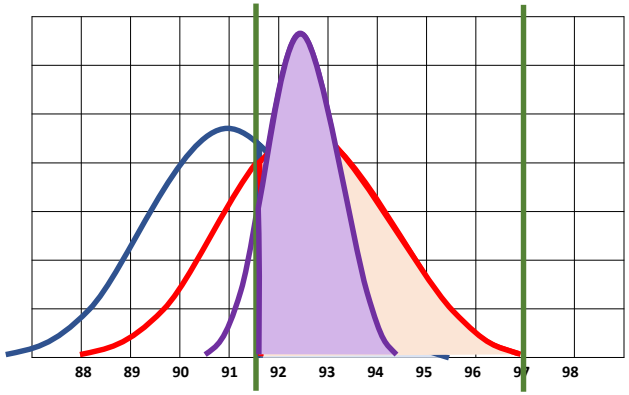
Recap… what does PWL mean?



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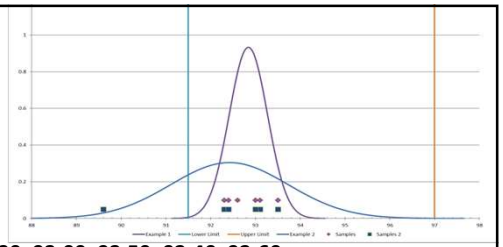
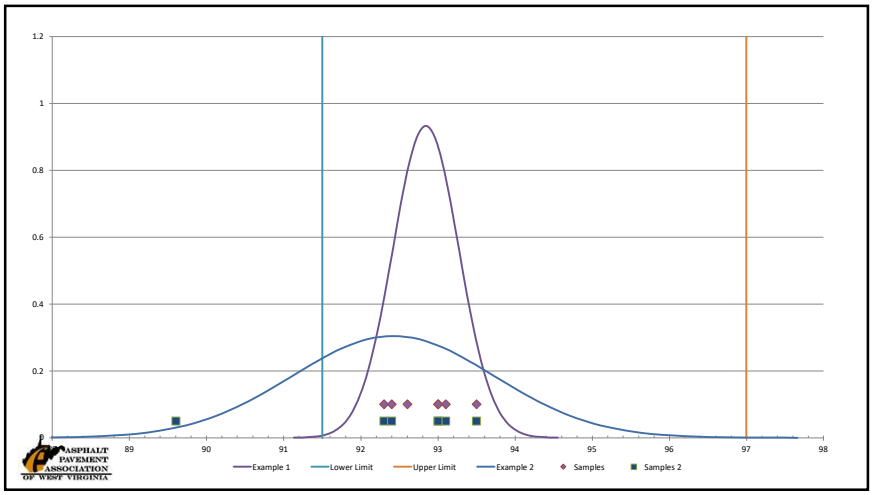
PWL Paving – Example



- Mat Density (91.5 – 97.0)
- Example 1:
  - 7 Cores - 93.00, 93.10, 92.30, 93.00, 93.50, 92.40, 92.60
    - Avg = 92.84 Stdev = .43
  - PWL = 100
- Example 2:
  - 7 Cores - 93.00, 93.10, 92.30, 93.00, 93.50, 92.40, 89.60
    - Avg = 92.42 Stdev = 1.31
  - PWL = 75

25



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PWL Paving – Pay Adjustment

Interstates and Divided NHS Routes

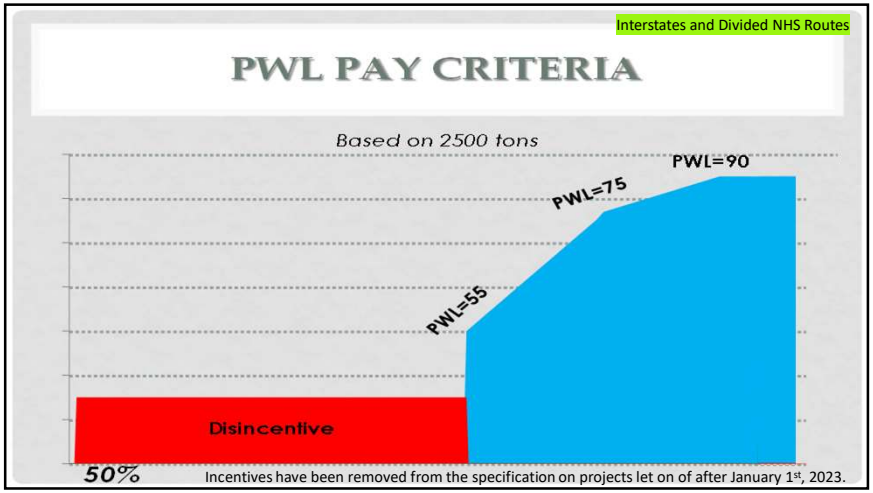
TABLE 410.13.3.1

Percentage of Material Within Specification Limits (PWL)	Lot Pay Factor (Percent of Contract Unit Price)
90-100	100
75-89	[(0.5)PWL]+55
55-74 Note 1	[(1.4)PWL]-12

Jobs let prior to January 1st, 2023 are still eligible for an incentives up to 2% for a PWL between 96-100

27

Interstates and Divided NHS Routes



Incentives have been removed from the specification on projects let on of after January 1st, 2023.

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PWL Paving – Pay Adjustment

- Lot Payment

$$CP(2PD + PB + PA)/400$$

- Contract Price, Pay Density, Pay Binder, Pay Aggregate
- Payment for each component can reach 102%, but the average density must be greater than 93.0%

Incentives have been removed from the specification on projects let on of after January 1st, 2023.

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Interstates and Divided NHS Routes

PWL Paving – Pay Adjustment Example

- Determine the pay factors for this example lot

Property	PWL	Pay Factor
Density	87	
Asphalt Content	90	
Gradation	86	

- What is the Lot payment
  - $CP(2PD + PB + PA)/400$

TABLE 410.13.3.1

Percentage of Material Within Specification Limits (PWL)	Lot Pay Factor (Percent of Contract Unit Price)
90-100	100
75-89	[(0.5)PWL]+55
55-74 Note 1	[(1.4)PWL]-12

30

Interstates and Divided NHS Routes

PWL Paving – Pay Adjustment

- Thickness Payment

$$\%\ Adjustment = \frac{t}{T}\ x\ 100$$

- T = Total Plan Thickness
- t = average lot thickness + 0.04

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Interstates and Divided NHS Routes

PWL Paving – Pay Adjustment

- Joint Payment
  - When PWL > 60 there is no adjustment

$$Disincentive(\$) = \frac{60-PWL}{60}\ x\ 12,500 \quad \text{(When} \leq 60\text{)}$$

Jobs let prior to January 1st, 2023 are still eligible for up to a $4000 incentives for PWL ≥ 80

$$Incentive(\$) = \frac{PWL-80}{20}\ x\ 4000$$

(When ≥ 80)

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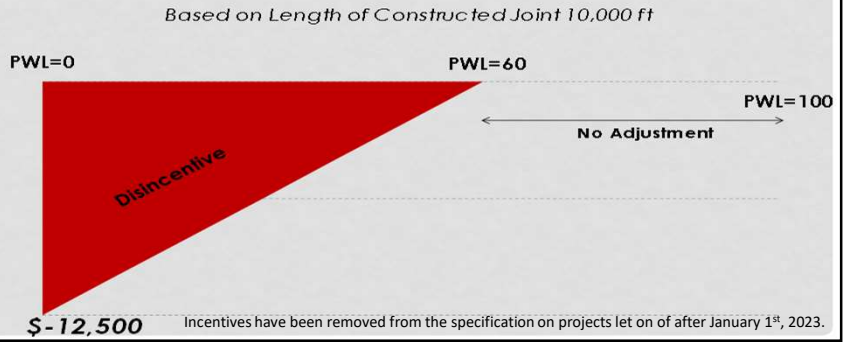
Interstates and Divided NHS Routes

JOINT DENSITY PAY CRITERIA (TARGET= 89%)



Incentives have been removed from the specification on projects let on of after January 1st, 2023.

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Interstates and Divided NHS Routes

PWL Paving – Pay Adjustment Example

- **Joint Density PWL is 57. What is the Adjustment?**

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PWL Paving – Pay Adjustment Example

- **Thickness target is 2 inches, and average is 1.92 inches. What is the pay adjustment?**

$$\%\ \boldsymbol{Adjustment} = \frac{\boldsymbol{t}}{\boldsymbol{T}}\ \boldsymbol{x}\ \mathbf{100}$$

$$\%\boldsymbol{Adjustment\ Of\ Unit\ Price} = \qquad \boldsymbol{x}\ \mathbf{100}$$

$$\%\ \boldsymbol{Adjustment\ Of\ Unit\ Price} =$$

- **Unit price = $10/sqyd**
- **Therefore an Additional Standalone Adjustment for inadequate thickness**
  - **Lot Area*(100-98%)/100*Unit Cost = 42,240*(.02)*$10 = $8448 Penalty**

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The Fork in the Road (New in 2023)

Interstates and Divided NHS Routes

- PWL Calculations on:
  - Mat Density
  - Joint Density
  - Bond Strength
  - Asphalt Content
  - #200(Dust) Content
- Lot Average
  - Thickness of cores

Two-Lane and Non-divided NHS Route Exceptions

- PWL Calculations on:
  - Asphalt Content
  - #200(Dust) Content
- Lot Average on:
  - Mat Density
  - Joint Density
  - Bond Strength
  - Thickness of Cores

Commonalities:

- Main Lot Payment is always based on Mat Density, Asphalt Content, and Dust Content. With the Total Lot payment calculated the same regardless of how the Payment Factors are generated
  - 50% Mat Density, 25% each Asphalt content and Dust content
- Thickness, Bond Strength and Joint Density are each stand alone adjustments based on their individual equations

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Two Lane Exceptions

- AC, Gradation, and Thickness are still calculated the same as Interstate PWL
- Mat Density, Joint Density, and Bond Strength are calculated based on the lot average

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Mat Density PD

TABLE 410.13.7.2

Payment Factors for Pavement Mat Density	
Average Lot Percent Density	**Payment Factor (PD)**
Greater than 98 %	Note 1
91.50% to 98.00%	100
88.00% to 91.49%	= 100 – 4*(91.50% - Percent density)
Less than 88%	= 84 – 10*(88% - Percent density) Note 2

Example 1:

7 Cores - 93.00, 93.10, 92.30, 93.00, 93.50, 92.40, 92.60

Avg = 92.84 Stdev = .43

PWL=100 -> PD = 100

Example 2:

7 Cores - 93.00, 93.10, 92.30, 93.00, 93.50, 92.40, 89.60

Avg = 92.42 Stdev = 1.31

PD = 100

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Joint Density Adjustment

TABLE 410.13.7.3

Pay Adjustment for Pavement Joint Density per Linear Foot	
Average Lot Percent Density	Price Adjustment ($ / LF)
Greater than 97 %	Note 3
89.00 % to 97.00%	0
88.00% to 88.99%	-0.20
Less than 88%	= [{0.50*(Percent Density – 88.00)} – 0.20]

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Bond Strength Adjustment

TABLE 410.13.7.4

Pay Adjustment for Bond Strength per 2500 Ton Lot	
Average Lot Bond Strength (PSI)	**Price Adjustment ($ / Lot)**
100.00 and Greater	0
75.00 to 99.99	= [{1,000*(PSI - 75.00)} – 25,000]
Less than 75.00	– 25,000

40

Confused??

PWL boils down to controlling variability

41

Let's tie this back to yesterday… Understanding the Variability

- Material Variations
- Testing Variations
- Plant Operations
- Environmental Conditions
- Delivery of Material
- Field Prep
- Paving Operations
- Rolling Operations

42

Materials and Testing Variations

- Aggregates
  - Stockpiles Gradation
  - Aggregate Texture
  - Daily if not multiple daily moisture checks
  - Stockpile size
- RAP
  - Project Stockpile Creation
  - Fractionation

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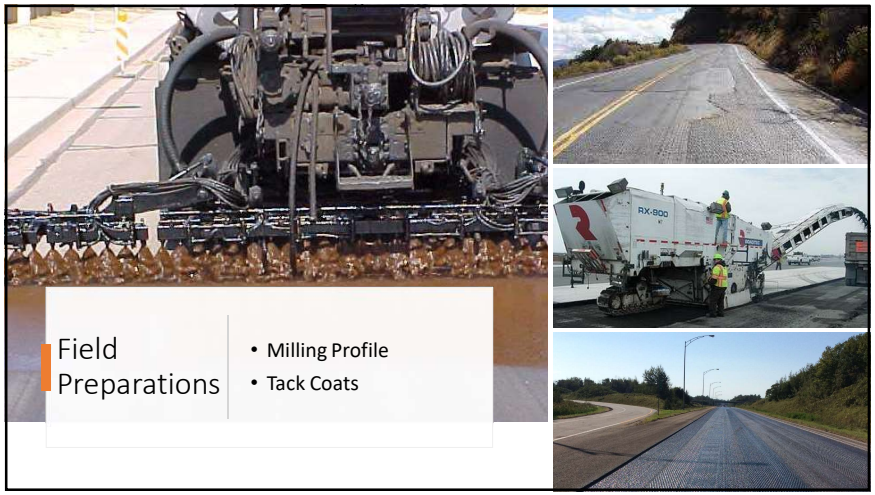
Plant Operations

- Material Feed
- Bag house Control
  - Dust Creation
- Liquid and belt Calibration
- Moisture Control
- Temperature Control
- Starts and Stops/Job Switching
  - Material waste
- Inspection – Plant wear

44


Environmental Conditions
• Cold Days vs Hot Days
• Weather
• Canopy cover

45


Field Preparations
• Milling Profile
• Tack Coats

46


Delivery of Material
• Insulated Trucks
• Sound Tarps on Trucks
• Constant Material Delivery
• Haul distance
• Use of an MTV

47


Paving Operations
• Paver Setup
• Auger Extension
• Tunnel Extension
VÖGELE

48

Paving Operations

- Constant Paver Speed throughout the day
  - DO NOT STOP
  - Constant Material Delivery
- Thickness of the Lift
  - Consistent Lift = Consistent Compaction

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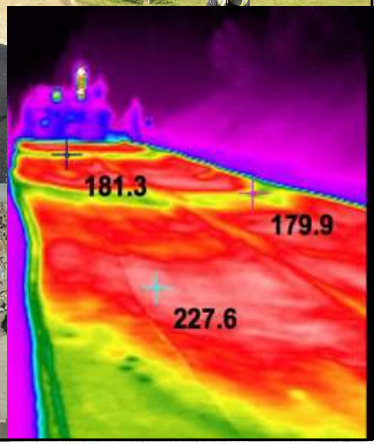
Rolling Operations

- Patterns
  - Establish a roller pa
  - If conditions chang
- Types – Pneumatic,
- Number of Rollers
- Temperatures



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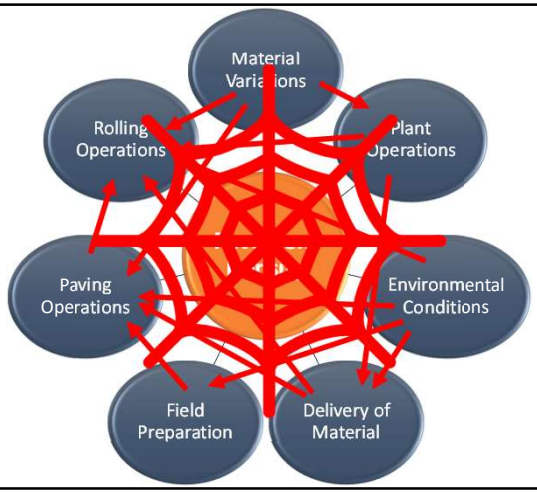

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Communication

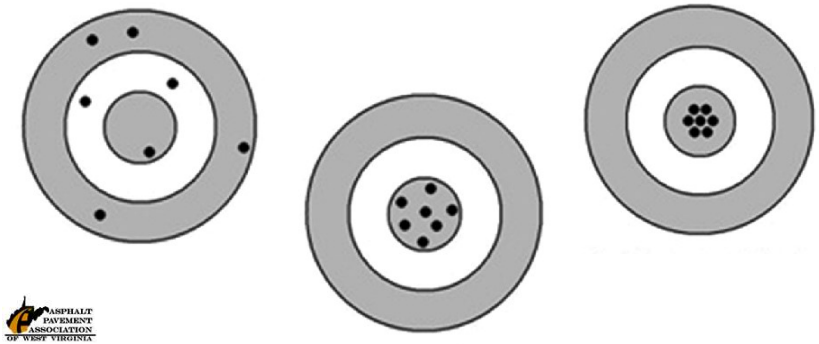
- Everyone needs to be involved/ Communicate with everyone Involved
  - Plant Personnel – especially your loader operator
  - Lab Tech and field Tech
  - Truckers
  - Roller Operators
  - Paving Operators
- Sample Data needs to be communicated to the project personnel

52

WHY YOU SHOULD CARE ABOUT THIS!!!

53

Remember it is all about CONSISTENCY



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55

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HMA Construction Program

Troubleshooting

1

2

Learning Objectives

1. State the objective of effective troubleshooting
2. List the steps needed to effectively troubleshoot
3. Analyze situations and recommend action to be taken

3

Objective of Effective Troubleshooting?

- Isolating the problem so that an appropriate solution can be arrived at quickly and efficiently.

4

AAPTP
Airport Asphalt Pavement Technology Program

Asphalt Paving Handbook

2025 Edition

Updated with Video Links

5

Table 13. Mat Problems and Their Causes

PG 288

PROBLEM	PAVER-RELATED CAUSES																															OTHER RELATED CAUSES														
	Fluctuating Head of Material	Feeder Screws Overloaded	Finisher Speed Too Fast	Too Much Lead Crown in the Screed	Too Little Lead Crown in the Screed	Overcorrection of Thickness Control	Excessive Player Screed Mechanical	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates Not Tight	Cold Screed	Moldboard On Stike-off Too Low	Running Hopper Empty Between Loads	Feeder Gates Set Incorrectly	Kicker Screws Worn Out or Installed	Incorrect Nailing of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity Too	Grade Control Wand Bouncing on	Grade Reference Inadequate	Sitting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Mix, Agg. Size	Trucks Bumping Finisher	Truck Holding Brakes	Improper Base Preparation	Improper Rolling Operation	Reversing or Too Rapidly Turning Rollers	Parking of Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Mix Temperature	Cold Mix Temperature
Wavy Surface: Short Waves (Ripples)	✓	✓	✓					✓	✓		✓									✓	✓	✓											X	X	X	X		X							
Wavy Surface: Long Waves	✓	✓	✓				✓	✓	✓				✓	✓						✓			✓	✓			X	X	X		X	X			X		X						
Tearing of Mat: Full Width			✓							✓		✓														X							X	X	X	X	X	X	X				
Tearing of Mat: Center Streak					✓					✓		✓		✓	✓																								X				
Tearing of Mat: Outside Streaks				✓						✓			✓																										X				
Mat Texture: Non-Uniform	✓	✓	✓					✓	✓	✓	✓	✓		✓				✓	✓						✓	X			X				X	X	X		X	X				
Screed Marks							✓																				X	X															
Screed Not Responding to Correction			✓				✓	✓		✓										✓						X			X										X	X			
Auger Shadows		✓																															X	X	X							
Poor Pre-compaction			✓							✓										✓						X			X										X				
Poor Longitudinal Joint	✓	✓					✓			✓										✓	✓	✓			✓					X									X				
Poor Transverse Joint		✓						✓	✓		✓					✓	✓													X									X				
Transverse Cracking (Checking)																														X	X			X	X		X	X				
Mat Shoving Under the Roller																														X	X	X		X	X		X	X				
Bleeding or Fat Spots in the Mat																																		X	X		X	X				
Roller Marks																														X	X	X	X				X					
Poor Mix Compaction																														X	X	X	X	X	X		X	X	X			

Find problem above: ✓ indicates causes related to the paver and X indicates other problems to be investigated

NOTE: Many times a problem can be caused by more than one item; therefore, it is important that each cause listed be eliminated to ensure that the problem will be solved.

6

Problem	Causes																																											
	Fluctuating head of material	Feeder Screws Overload	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Over correction of Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates not Tight	Cold Screed	Moldboard on Screed Too Low	Running Hopper Empty Between Loads	Feed Gates Set Incorrectly	Kicker Screws Worn Out or Mounted Incorrectly	Incorrect Nailing of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity too High)	Grad Control Wand Bouncing on Reference	Grade Reference Inadequate	Sitting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Aggregate Size	Trucks Bumping Finisher	Truck Holding Brakes	Improper Base Preparation	Improper Roller Operation	Reversing or Too Rapidly Turning Rollers	Parking of Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Temperature of Mix	Cold Mix Temperature
Wavy Surface – Short Waves (Ripples)	√	√	√					√	√		√									√	√	√							×	×					×	×	×		×				
Wavy Surface – Long Waves	√	√	√					√	√				√	√						√			√	√						×	×					×	×	×		×				
Tearing of Matt – Full Width			√							√		√																				×	×	×	×	×	×						
Tearing of Matt – Center Streaks					√					√		√		√	√																								×				
Tearing of Matt – Outside Streaks				√						√		√	√																										×				
Mat Texture Nonuniform	√	√	√					√	√	√	√	√		√					√	√					√		×		×				×	×	×			×	×				
Screed Marks							√																				×	×																
Screed Not Responding to correction			√				√	√		√		√									√						×												×	×				
Auger Shadows		√																															×	×	×							
Poor Percompaction			√					√												√						×			×										×				
Poor Longitudinal Joint	√	√					√	√													√	√	√		√				×									×				
Poor Transverse Joint		√					√	√			√						√	√											×									×				
Transverse Cracking (Checking)																													×	×				×	×		×	×				
Mat Shoving Under Roller																													×	×	×			×	×		×	×				
Bleeding or Fat Spots in Mat																																		×	×		×	×				
Roller Marks																													×	×	×	×										
Poor Mix Compaction																													×	×	×	×	×	×	×		×	×	×			

√ Indicates a paver problem; × indicates a problem to be investigated

There can be multiple causes of problems, investigate each one.

7-7

7

How to Troubleshoot

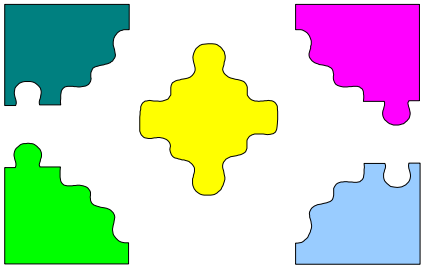
- Step One:

  Stop, step back, look at the big picture

8

How to Troubleshoot

- Step Two:
  Break the problem down into pieces



9

How to Troubleshoot

- Step Three:
  Eliminate the obvious factors first

10

How to Troubleshoot

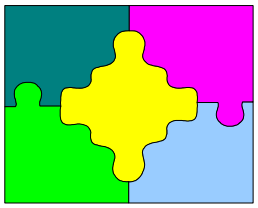
- Step Four:
  Analyze each remaining element in full detail

11

How to Troubleshoot

- Step Five:
  Re-combine the pieces of puzzle

Stop, Step back, Look at big picture



Break the problem down in pieces

Analyze each element in full detail

Eliminate the obvious factors first

12

How to Troubleshoot

- Step Six:
  Make recommendations based on facts

13

How to Troubleshoot

- Step Seven:
  Make changes “one at a time;” then analyze results

14

How to Troubleshoot

- Step Eight:
  Take notes every step of the way

15

How to Troubleshoot

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Causes

Problem	Fluctuating head of material	Feeder Screws Overload	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Over correction of Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates not Tight	Cold Screed	Moldboard on Strikeoff Too Low	Running Hopper Empty Between Loads	Feed Gates Set Incorrectly	Kicker Screws Worn Out or Mounted Incorrectly	Incorrect Nulling of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity too High)	Grad Control Wand Bouncing on Reference	Grade Reference Inadequate	Sitting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Aggregate Size	Trucks Bumping Finisher	Truck Holding Brakes	Improper Base Preparation	Improper Roller Operation	Reversing or Too Rapidly Turning Rollers	Parking of Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Temperature of Mix	Cold Mix Temperature
Wavy Surface – Short Waves (Ripples)	√	√	√				√	√		√										√	√	√	√						×	×			×	×	×		×	
Wavy Surface – Long Waves	√	√				√	√	√					√	√						√			√	√			×	×	×		×	×			×		×	
Tearing of Matt – Full Width			√						√		√															×							×	×	×	×	×	×
Tearing of Matt – Center Streaks					√				√		√			√	√																							×
Tearing of Matt – Outside Streaks				√					√		√	√		√				√																				×
Mat Texture Nonuniform	√	√	√					√	√	√	√		√					√	√					√		×			×				×	×	×		×	×
Screed Marks							√																				×	×										
Screed Not Responding to correction			√				√	√		√										√						×											×	×
Auger Shadows		√																															×	×	×			
Poor Percompaction			√					√											√							×			×									×
Poor Longitudinal Joint	√	√				√		√												√	√	√			√					×								×
Poor Transverse Joint		√					√	√		√						√	√													×								×
Transverse Cracking (Checking)																													×	×			×	×		×	×	
Mat Shoving Under Roller																													×	×	×		×	×		×	×	
Bleeding or Fat Spots in Mat																																	×	×		×	×	
Roller Marks																													×	×	×	×					×	
Poor Mix Compaction																													×	×	×	×	×	×		×	×	×

√ Indicates a paver problem; × indicates a problem to be investigated

There can be multiple causes of problems, investigate each one.

7-17

17

18

19

Causes

Problem	Fluctuating head of material	Feeder Screws Overload	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Over correction of Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates not Tight	Cold Screed	Moldboard on Strikeoff Too Low	Running Hopper Empty Between Loads	Feed Gates Set Incorrectly	Kicker Screws Worn Out or Mounted Incorrectly	Incorrect Nulling of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity too High)	Grad Control Wand Bouncing on Reference	Grade Reference Inadequate	Sitting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Aggregate Size	Trucks Bumping Finisher	Truck Holding Brakes	Improper Base Preparation	Improper Roller Operation	Reversing or Too Rapidly Turning Rollers	Parking of Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Temperature of Mix	Cold Mix Temperature
Wavy Surface – Short Waves (Ripples)	√	√	√				√	√		√										√	√	√	√						×	×			×	×	×		×	
Wavy Surface – Long Waves	√	√				√	√	√					√	√						√			√	√			×	×	×		×	×			×		×	
Tearing of Matt – Full Width			√						√		√															×							×	×	×	×	×	×
Tearing of Matt – Center Streaks					√				√		√			√	√																							×
Tearing of Matt – Outside Streaks				√					√		√	√		√				√																				×
Mat Texture Nonuniform	√	√	√					√	√	√	√		√					√	√					√		×			×				×	×	×		×	×
Screed Marks							√																				×	×										
Screed Not Responding to correction			√				√	√		√										√						×											×	×
Auger Shadows		√																															×	×	×			
Poor Percompaction			√					√											√							×			×									×
Poor Longitudinal Joint	√	√				√		√												√	√	√			√					×								×
Poor Transverse Joint		√					√	√		√						√	√													×								×
Transverse Cracking (Checking)																													×	×			×	×		×	×	
Mat Shoving Under Roller																													×	×	×		×	×		×	×	
Bleeding or Fat Spots in Mat																																	×	×		×	×	
Roller Marks																													×	×	×	×					×	
Poor Mix Compaction																													×	×	×	×	×	×		×	×	×

√ Indicates a paver problem; × indicates a problem to be investigated

There can be multiple causes of problems, investigate each one.

7-20

20

Segregation Troubleshooting

That's 18 possible causes for non-uniform mat texture!

21

How to Troubleshoot

- Stop, step back, look at big picture
  - Break the problem down in pieces
    - Eliminate the obvious factors first
      Analyze each element in full detail
      Re-combine the pieces of puzzle
    - Recommendation based on facts
  - Changes "one at a time;" analyze
- Take notes every step of the way

22

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Airport Asphalt Pavement Technology Program

Asphalt Paving Handbook

2025 Edition

Updated with Video Links

Section 12 -

Mat Problems

23

Problem	Causes																																							
	Fluctuating head of material	Feeder Screws Overload	Feeder Screws Too Fast	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Over correction of Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates not Tight	Cold Screed	Moldboard on Screed Too Low	Running Hopper Empty Between Loads	Kicker Screws Worn Out or Mounted Incorrectly	Feed Gates Set Incorrectly	Incorrect Nailing of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity too High)	Grad Control Wand Bouncing on Reference	Grade Reference Inadequate	Siting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Aggregate Size	Trucks Bumping Finisher	Truck Hooking Brakes	Improper Base Preparation	Improper Roller Operation	Reversing of Too Rapidly Turning Rollers	Parking of Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Temperature of Mix	Cold Mix Temperature
Wavy Surface – Short Waves (Ripples)	√	√	√	√					√	√	√				√	√					√	√	√	√	√								×	×	×	×	×	×	×
Wavy Surface – Long Waves	√	√	√				√		√	√					√	√					√	√	√	√	√								×	×	×	×	×	×	×
Tearing of Matt – Full Width			√							√		√															×						×	×	×	×	×	×	×
Tearing of Matt – Center Streaks					√					√		√			√	√																								×
Tearing of Matt – Outside Streaks				√						√		√	√		√				√																					×
Mat Texture Nonuniform	√	√	√						√	√	√	√		√					√	√				√		×			×				×	×	×		×	×	×
Screed Marks								√																				×	×											
Screed Not Responding to correction			√					√	√			√									√						×											×	×
Auger Shadows		√																																×	×	×				
Poor Percompaction			√						√												√								×										×
Poor Longitudinal Joint	√	√					√		√												√	√	√			√			×										×
Poor Transverse Joint		√						√	√		√						√	√											×										×
Transverse Cracking (Checking)																													×	×			×	×			×	×	
Mat Shoving Under Roller																													×	×	×		×	×			×	×	
Bleeding or Fat Spots in Mat																														×			×	×			×		
Roller Marks																													×	×	×	×						×	
Poor Mix Compaction																													×	×	×	×	×	×			×	×	×

√ Indicates a paver problem; × indicates a problem to be investigated

There can be multiple causes of problems, investigate each one.

24

Example 1

Your paving team has been using a double drum steel wheel roller as the breakdown roller on an 1 ½" of Wearing 1 overlay.

You are experiencing some checking in the mat after the second or third pass.

The mix has been tested at the lab and isn't suspect – Asphalt & Dust contents are good.

25

Example 1

26

Example 1

27

Example 1

- What would cause this?

  Handbook Pages 303 – 307

- What can you do right now to correct this?

  Handbook Pages 303 - 307

28

Example 2

You show up on the Project and see random fat spots and bleeding in the wheel paths on a 1” Wearing 1 overlay placed yesterday .

This is slightly more noticeable at the transverse joints.

The test results from the day before meets the specifications.

You are ready to start paving the same mix on the same stretch of road today.

29

Example 2

30

Example 2

31

Example 2

- What would cause this?
- Should you Pave today?
- What can you do right now to correct this?

32

Example 2

33

Example 3

A test strip of 19 mm Asphalt has been completed on a $2 Million paving Project and you have been comparing roller passes to in-place density – measured with cores.

Even with a double drum vibratory and a 10 ton pneumatic roller, you are barely able to achieve the minimum density on the 2 ½" mat.

The Contractor and Agency are not in agreement of how to proceed.

Yes, the test strip did pass, but do you start paving?

34

Example 3

- As a consultant, what do you recommend?
- What all should you check before proceeding?
- What are your options?

35

Example 3

36

Example 3

37

Example 3

38

Example 3

39

Example 4

You are paving with a 9.5mm Skid mix on a 2 lane road. As a compaction technician, you are struggling with compaction and notice that the surface is “spongy” at 130º F. You can twist your heel into the surface and make a sizable scar.

What could cause this, and what can you do?

40

Example 4

41

Example 4

42

43

44

Example 4

45

Example 4

46

47

WVDOH

DENSITY EVALUATION

MCS&T

Jamie Rose - Quality Control Manager - J.F. Allen Company

1

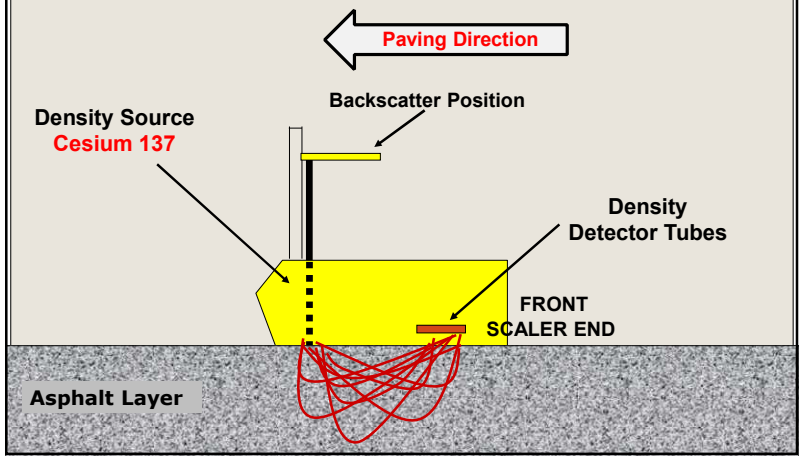
Objectives :

- 401 Compaction Overview
- Gauge Comparisons
- Lot by Lot - Random Locations
- Roller Pass Method

- MP 401.05.20 - Deactivated in 2023
- Section 401 – 2023 Spec Book

2

Troxler 3400 Series Nuclear Gauges



3

Standard Practices

Pre-Operation:

- Has Gauge been Calibrated within the last 24 Months
- Proper Bill Of Lading for Transport
- Is Gauge Properly Charged
- Proper Standard Block in Case
- Gauge and Standard Block Cleaned

4

Standard Practices

Operation – Standardizing the Gauge:

- Verify that the Standard Block and the bottom of the Gauge are clean.
- Place the Gauge on the Standard Block in the correct direction.
- Make sure Standard Block is sitting on a solid surface away from large metal objects such as equipment and trucks.

5

Standard Practices

Operation – Standardizing the Gauge:

- Make sure you don't standardize within 30 feet of another gauge.
- Check to make sure Gauge Standard counts are within limits of the Calibrated Manufacturer's Standard Counts.
- **Density = +/- 2%**
- **Moisture = +/- 4%**
- Standardizing is to be done every 4 hours (Example: 6 am / 10 am / 2 pm)

6

Standard Practices

Gauge Model: 3430
Serial Number: 35998
Calib. Date: 03/18/2020 Expires: 03/18/2021

Density Std. Cnt: 2066
Moisture Std. Cnt: 622
Bay Number: 1

Density Standard

Moisture Standard

Date	From	To
Mar 20	2045	2087
Apr 20	2041	2083
May 20	2037	2079
Jun 20	2034	2075
Jul 20	2030	2071
Aug 20	2026	2067
Sep 20	2022	2063
Oct 20	2018	2059
Nov 20	2014	2055
Dec 20	2010	2051
Jan 21	2006	2047
Feb 21	2002	2043
Mar 21	1999	2039
Apr 21	1995	2035
May 21	1991	2031
Jun 21	1987	2027
Jul 21	1983	2023
Aug 21	1979	2019
Sep 21	1976	2016
Oct 21	1972	2012

2066 x 98% = 2024.68 → 2025

2066 x 102% = 2107.32 → 2107

Range = 2025 → 2107

622 x 96% = 597.12 → 597

622 x 104% = 646.88 → 649

Range = 597 → 649

7

Standard Practices

Operation – Standardizing the Gauge:

- Check to make sure Gauge Standard counts are within limits of the Calibrated Manufacturer's Standard Counts.
- **Density = +/- 2%**
- **Moisture = +/- 4%**

- **Remember - this Range comes from the Calibration Sheets for the Gauge. The numbers from the Gauge when you Standardize must fall into this Range.**

8

Standard Practices

Operation – Testing:

- Verify the settings in the Gauge.
  - Proper Units – Kg/m³
  - Asphalt is always a Wet Density Reading
  - Asphalt is always tested in the Backscatter Position
  - Proper target density set in the gauge
  - Tests for DOH must be 1 Minute tests
- Find test location by using Random Numbers.
- Make sure you don't test within 30 feet of another gauge.
- Make sure Gauge is sitting on a solid area away from large metal objects such as equipment and trucks.

9

Gauge Operation

- Good contact between Gauge and Surface

Fill Voids
- Dry Mortar Sand
- Silica Sand

Remove Excess

10

Gauge in Position

11

Too Much Exposure To The Gauge

12

Gauge Common Sense

DO NOT OPERATE NEAR :

- Large metal objects
  - Equipment
  - Culverts
- Power lines
- Other gauges (minimum of 30 feet)

KEEP GAUGE DRY :

- Cover control panel if possible

13

- **Specifications Section 401**

  Provides the requirements for determining how acceptance will be made.

  1. Lot by Lot Testing
  2. Roller Pass Method

14

Quality Control Testing

- Quality control tests are performed to allow the Contractor to control the material. These tests are not used for acceptance.
- The Contractor is responsible for quality control even when acceptance tests are not required, for example, a Roller Pass.

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Acceptance Testing

- Lot By Lot Testing - 2023 Spec Book
  - Measured Roadway Width > 16'
  - Total New Thickness >/= 1.5"
  - Total Continuous Paving Length >/= ½ Mile

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Acceptance Testing

- Lot By Lot Projects -
  - All Projects Bid in 2023 – 2023 Spec Book - DOH does the Acceptance Testing.
  - Projects Let in 2022 or Prior – 2022 Supplemental Specs - Contractor does the Acceptance Testing.
  - Laydown POs – 2023 Spec Book - DOH does the Acceptance Testing

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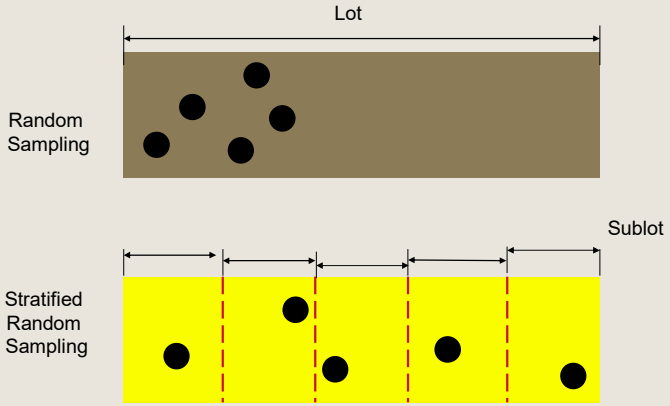
Acceptance Testing

- Roller Pass Projects - The Contractor is responsible for the testing while being observed by the District.
- Roller Pass Method –
  - 2022 & Prior Projects – 2022 Supplemental
  - 2023 Projects & Laydown POs – 2023 Spec Book

18

Lots and Sublots



19

Station Numbers

- Common way of tracking longitudinal distance on Projects
- The " + " Sign is simply a place holder – just like the comma in 10,000
- Beginning of Project (BOP) = 0+00
- End of Project (EOP) = 144+25 (Example)
- 144+25 = 14,425 Feet

20

Offsets

- Common way of tracking left & right distance on Projects
- On Paving Projects, typically measured from the centerline or the center joint
- Never test on the edge of the pavement – pull the gauge 1’ in away from the edge
- Offsets for Joint Testing with the gauge are always 4 inches

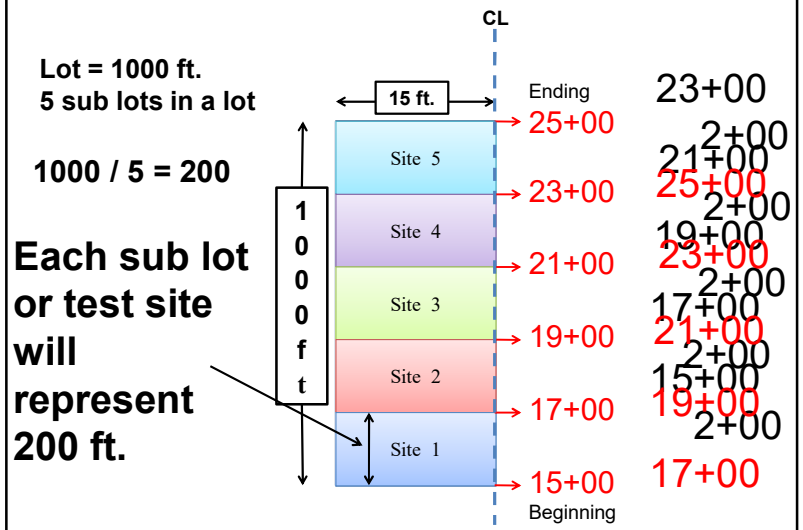
21

22

Sublot Exercise

Handbook – 5 Pages from end

23



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Sublot Exercise

	Random Numbers		Location	
	Length	Width	Distance	Offset Left CL
1	0.683	0.441		
2	0.493	0.155		
3	0.059	0.502		
4	0.996	0.729		
5	0.240	0.972		

25

	Random Numbers		Location	
	Length	Width	Distance	Offset Left CL
1	0.683	0.441	16+37	7 ft.
2	0.493	0.155	17+99	2 ft.
3	0.059	0.502	19+12	8 ft.
4	0.996	0.729	22+99	11 ft.
5	0.240	0.972	23 +48	14 ft.

Site 1

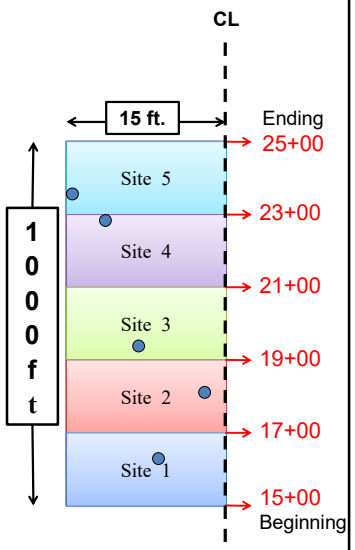
Length

0.683 x 200 =136.6 ⇒ 137

15+00

1+37

16+37



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Testing Process

Testing Forms

- **Lot x Lot -- T401**
- **Gauge Comparison -- T401b**
- **Roller Pass -- T407**
- **All three are located on DOH "Toolbox" Web Page**

http://transportation.wv.gov/highways/mcst/Pages/tbox.aspx

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Gauge Comparison

Comparison of Nuclear Density Gauges In Accordance with Guidelines Contained in

Section 401.6.4.1.1

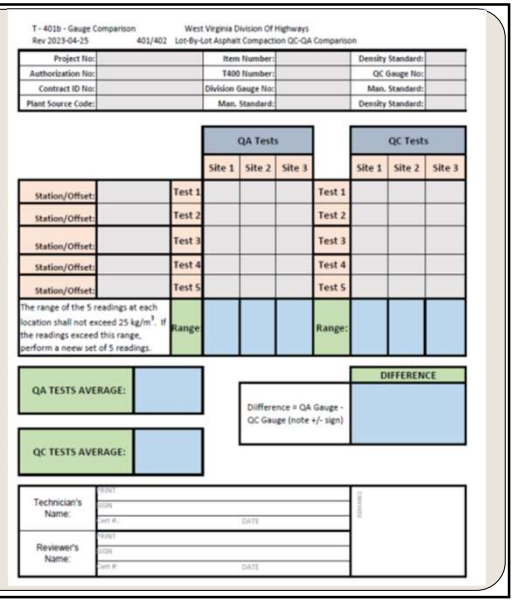
28

2023 Gauge Verification

1. Randomly locate **3** test sites within the first **500 ft** of paving – starting **100 ft** from the take-off Joint & a minimum of **1 ft** from either edge.
2. Take 5 One-Minute readings in the same spot.
3. For each gauge used – the Range of the 5 readings cannot exceed 25 kg/m³.
4. Once all 3 locations are done average the 15 readings for each gauge to compare differences between gauges.
5. This will be used so the Contractor can determine the Density to achieve on their gauge.

29

T-401b Gauge Comparison Form



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T-401b Gauge Comparison Form

Part 1 - Identification and Verification

T - 401b - Gauge Comparison West Virginia Division Of Highways
Rev 2023-04-25 401/402 Lot-By-Lot Asphalt Compaction QC-QA Comparison

Project No:	STP-033-2.22	Item Number:	401002-020	Density Standard:	2479
Authorization No:	AB 2575 G	T400 Number:	2018448	QC Gauge No:	45678
Contract ID No:	1122334	Division Gauge No:	52889	Man. Standard:	2000
Plant Source Code:	XYZ.01.400	Man. Standard:	2500	Density Standard:	1991

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T-401b Gauge Comparison Form

Part 2 - Repeatability & Similarity

			QA Tests Site 1	QA Tests Site 2	QA Tests Site 3		QC Tests Site 1	QC Tests Site 2	QC Tests Site 3
Station/Offset:	1+33 / 4' R	Test 1	2250			Test 1	2290		
Station/Offset:	2+59 / 8' R	Test 2	2255			Test 2	2310		
Station/Offset:	4+62 / 7' R	Test 3	2272			Test 3	2299		
Station/Offset:		Test 4	2270			Test 4	2298		
Station/Offset:		Test 5	2258			Test 5	2297		
The range of the 5 readings at each location shall not exceed 25 kg/m³. If the readings exceed this range, perform a neew set of 5 readings.		Range:	22			Range:	20		

QA TESTS AVERAGE:	2261
QC TESTS AVERAGE:	2299

Diifference = QA Gauge - QC Gauge (note +/- sign)	- 38

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Testing Process

Density Testing – **Lot By Lot**

DOH Laydown POs

Lot = 1,000 Ft long by the Paving Width

Sublot = 200 Ft long by the Paving Width

Acceptance Range = 93% - 97%

Joint Density Testing = 90% - 97%

33

Testing Process

Density Testing – **Lot By Lot**

Lot = 1,000 Ft long by the Paving Width

Sublot = 200 Ft long by the Paving Width

Acceptance Range = 93% - 97%

Joint Density Testing on the "Hot" side

34

Testing Process

Density Testing – **Joint Testing**

Done on the "Hot" side when a second travel lane is constructed.

- 5 Random 1 Minute Wet Density Tests per Lot - 4 Inches off of the Joint.
- Done at the same Station as the Mainline
. Density Test

35

Testing Process

Density Testing – **Joint Testing**

- Calculate the **Average Density** the same as the Mainline Densities.
- Evaluate the Lot – Pass / Fail - **Spec Range = 90% - 97%**

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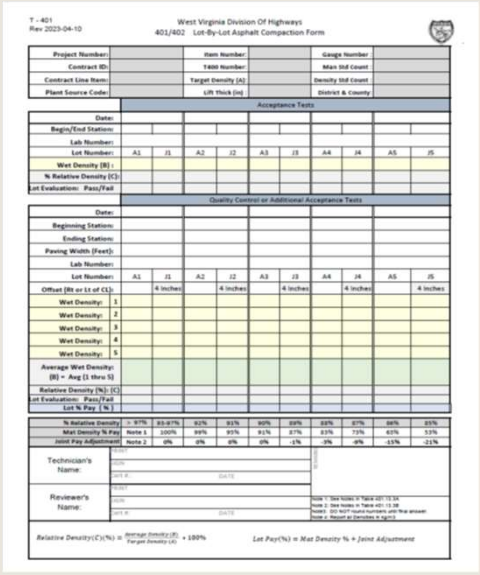
T401 Compaction Form – April 2023 Revision



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T - 401
Rev 2023-04-10

West Virginia Division Of Highways
401/402 Lot-By-Lot Asphalt Compaction Form

Project Number:		Item Number:		Gauge Number :	
Contract ID:		T400 Number:		Man Std Count :	
Contract Line Item:		Target Density (A):	2465	Density Std Count :	
Plant Source Code:		Lift Thick (in) :		District & County:	

T401 Compaction Form – April 2023 Revision

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	Acceptance Tests									
Date:										
Begin/End Station:										
Lab Number:										
Lot Number:	A1	J1	A2	J2	A3	J3	A4	J4	A5	J5
Wet Density (B) :	2277		2288		2305		2291	2251	2295	2187
% Relative Density (C):	92		93		94		93	91	93	89
Lot Evaluation: Pass/Fail	????		Pass		Pass		Pass	Pass	Pass	????

2465 - Gmm

T401 Compaction Form – April 2023 Revision

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	Quality Control or Additional Acceptance Tests									
Date:										
Beginning Station:										
Ending Station:										
Paving Width (Feet):										
Lab Number:										
Lot Number:	A1	J1	A2	J2	A3	J3	A4	J4	A5	J5
Offset (Rt or Lt of CL):		4 Inches		4 Inches		4 Inches		4 Inches		4 Inches
Wet Density: 1	2266									2129
Wet Density: 2	2307									2134
Wet Density: 3	2286									2201
Wet Density: 4	2276									2176
Wet Density: 5	2288									2144
Average Wet Density: (B) = Avg (1 thru 5)	2285									2157
Relative Density (%): (C)	93									88
Lot Evaluation: Pass/Fail	Pass								Pass	Fail
Lot % Pay (%)	100									97

% Relative Density	> 97%	93-97%	92%	91%	90%	89%	88%	87%	86%	85%
Mat Density % Pay	Note 1	100%	99%	95%	91%	87%	83%	73%	63%	53%
Joint Pay Adjustment	Note 2	0%	0%	0%	0%	-1%	-3%	-9%	-15%	-21%

T401 Compaction Form – April 2023 Revision

40

Roller Pass

Select 100 foot **CONTROL SECTION – 100 Ft past the Take-off Joint.**

Divide into TWO equal **SUBLOTS** (50 foot each)

	Random Numbers		Location	
	Length	Width	Distance	Offset (Left)
1	0.338	0.917	1+17	11
2	0.629	0.631	1+81	8

Measure density
Use form T 407

Length

0.338 x 50

16.9 ⇒ 17

1+00

0+17

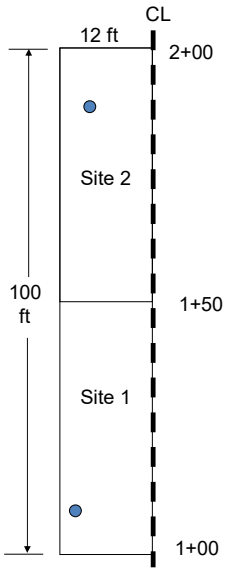
1+17

Site 1

Width

0.917 x 12

11.0 ⇒ 11



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Testing Process

Density Testing – **Roller Pass**

- Control Section - 100 ft to 200 ft from the take-off joint. (100 Feet Long)
- 2 – 50 Ft. sublots with 1 random testing location within.
- Apply 4 Passes, take 1 Minute Test, Mark Gauge Location, record results and temperature - for each location.

42

Testing Process

Control Section – **Roller Pass**

- Add 2 more Passes – Repeat Test in the **same spot** as the first one, record results and temperature.
- Compare second set average wet density to the first set average wet density.

43

Testing Process

Control Section – **Roller Pass**

- Continue process – 2 Passes at a time until one of the following occur :
- Less than **5 kg/m³** increase in Average Wet Density.
- One or Both test Locations "Break Over"
- The Relative Density exceeds 97% of the Theoretical Max Gravity (Gmm)
- The Mat Temperature Reaches 175 Degrees

44

Testing Process

Density Testing – **Roller Pass**

Proving Section – Area after Roller Passes are established to validate it is the correct number.

Daily Roller Passes to be established per Project

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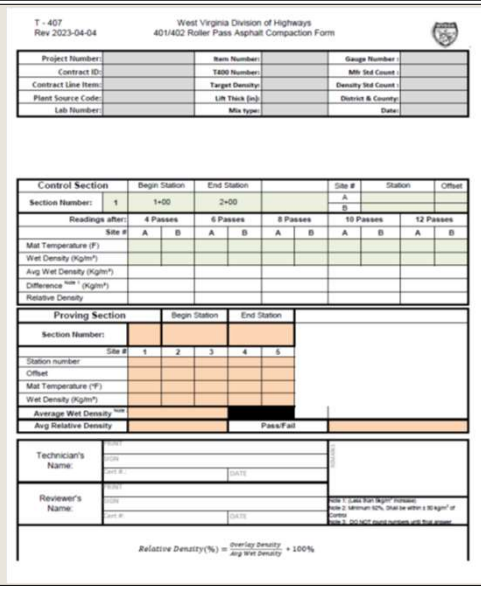
Roller Pass T407 Compaction Form - April 2023 Revision



T - 407
Rev 2023-04-04

West Virginia Division of Highways
401/402 Roller Pass Asphalt Compaction Form

Project Number:		Item Number:		Gauge Number :	
Contract ID:		T400 Number:		Mfr Std Count :	
Contract Line Item:		Target Density:	2480	Density Std Count :	
Plant Source Code:		Lift Thick (in):		District & County:	
Lab Number:		Mix type:		Date:	

Roller Pass T407 Compaction Form - April 2023 Revision

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Control Section		Begin Station		End Station			Site #	Station		Offset	
Section Number:	1	1+00		2+00			A	1+33		3' R	
							B	1+89		9' R	
Readings after:		4 Passes		6 Passes		8 Passes		10 Passes		12 Passes	
Site #		A	B	A	B	A	B	A	B	A	B
Mat Temperature (F)		220	218	211	208	211	201	192	190	180	182
Wet Density (Kg/m³)		2209	2233	2226	2255	2258	2269	2278	2298	2283	2299
Avg Wet Density (Kg/m³)		2221		2241		2264		2288		2291	
Difference Note 1 (Kg/m³)		----		20		23		24		3	
Relative Density		90		90		91		92		92	

2480 - Gmm

Roller Pass T407 Compaction Form - April 2023 Revision

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Testing Process

Control Section – **Roller Pass**

- Continue process – 2 Passes at a time until one of the following occur :
- Less than **5 kg/m³** increase in Average Wet Density.
- One or Both test Locations "Break Over"
- The Relative Density exceeds 97% of the Theoretical Max Gravity (Gmm)
- The Mat Temperature Reaches 175 Degrees

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Control Section		Begin Station		End Station				Site #	Station	Offset
Section Number:	1	1+00		2+00				A	1+33	3' R
								B	1+89	9' R
Readings after:		4 Passes		6 Passes		8 Passes		10 Passes		12 Passes	
Site #		A	B	A	B	A	B	A	B	A	B
Mat Temperature (F)		220	218	211	208	211	201	192	190	180	182
Wet Density (Kg/m³)		2209	2233	2226	2255	2258	2269	2278	2298	2298	2290
Avg Wet Density (Kg/m³)		2221		2241		2264		2288		2294	
Difference Note 1 (Kg/m³)		----		20		23		24		6	
Relative Density		90		90		91		92		93	

2480 - Gmm

Roller Pass T407 Compaction Form - April 2023 Revision

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Testing Process

Control Section – **Roller Pass**

- Continue process – 2 Passes at a time until one of the following occur :
- Less than **5 kg/m³** increase in Average Wet Density.
- One or Both test Locations "Break Over"
- The Relative Density exceeds 97% of the Theoretical Max Gravity (Gmm)
- The Mat Temperature Reaches 175 Degrees

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Control Section		Begin Station		End Station				Site #	Station	Offset
Section Number:	1	1+00		2+00				A	1+33	3' R
								B	1+89	9' R
Readings after:		4 Passes		6 Passes		8 Passes		10 Passes		12 Passes	
Site #		A	B	A	B	A	B	A	B	A	B
Mat Temperature (F)		220	218	211	208	211	201	192	190	172	168
Wet Density (Kg/m³)		2209	2233	2226	2255	2258	2269	2278	2298	2298	2299
Avg Wet Density (Kg/m³)		2221		2241		2264		2288		2299	
Difference Note 1 (Kg/m³)		----		20		23		24		11	
Relative Density		90		90		91		92		93	

2480 - Gmm

Roller Pass T407 Compaction Form - April 2023 Revision

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Testing Process

Control Section – **Roller Pass**

- Continue process – 2 Passes at a time until one of the following occur :
- Less than **5 kg/m³** increase in Average Wet Density.
- One or Both test Locations "Break Over"
- The Relative Density exceeds 97% of the Theoretical Max Gravity (Gmm)
- The Mat Temperature Reaches 175 Degrees

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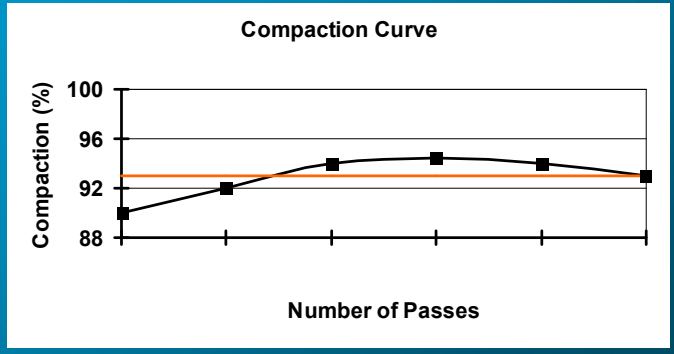
Roller Pattern Problem #1

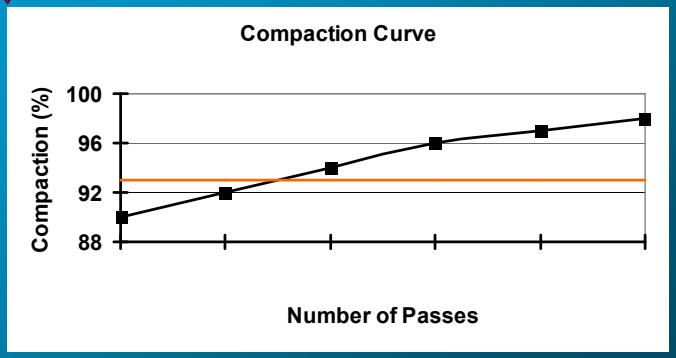


Decreasing Temperature

8-54

54

Roller Pattern Problem #2

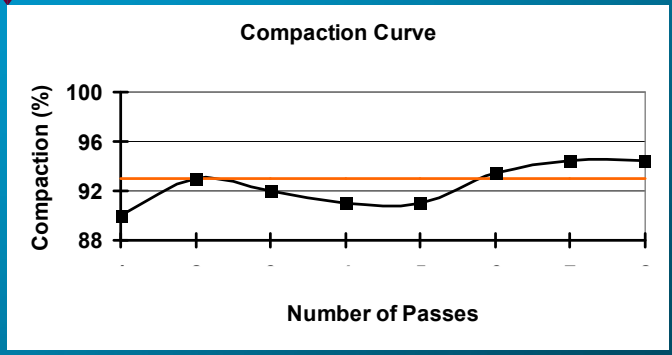


Decreasing Temperature

8-55

55

Roller Pattern Problem #3



Decreasing Temperature

8-56

56

Testing Process

Proving Section – **Roller Pass**

- **1000** Feet long beginning at the end of the Control Section.
- **5** Random Wet Density Tests
- Average Density must be 92% or greater
- Average must be within **50** Kg/m³ of
. the Control Section Density.

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Proving Section		Begin Station		End Station	
Section Number:	1	2+00		12+00	
Site #	1	2	3	4	5
Station number	2+43	5+08	6+59	9+92	11+11
Offset	2'	5'	7'	4'	9'
Mat Temperature (°F)	182	179	188	185	184
Wet Density (Kg/m³)	2296	2244	2279	2266	2290
Average Wet Density [Note 1]	2275				
Avg Relative Density	92			Pass/Fail	Pass

2299 - Control Section

Roller Pass T407 Compaction Form - April 2023 Revision

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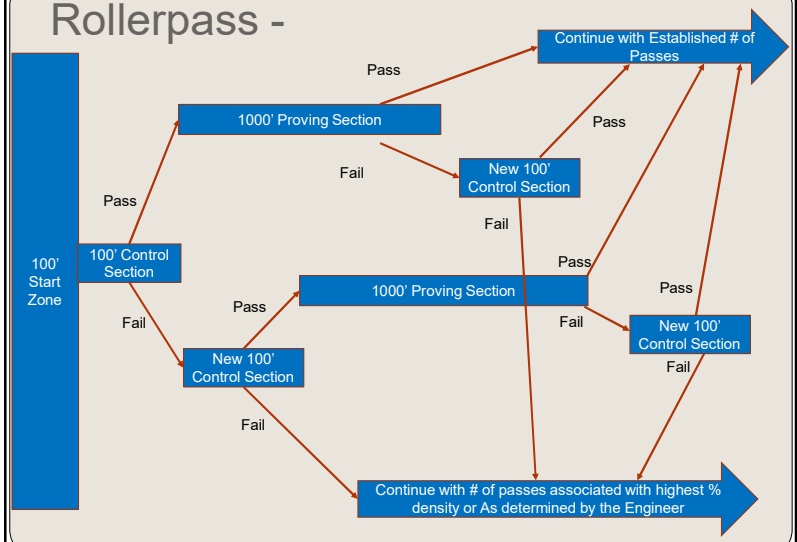
Rollerpass -



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Nuclear Gauge Testing Summary

1. Use random numbers to locate test sites according to MP 712.21.26.
2. Must have a void free surface, fill voids with dry silica sand or mortar sand. Surface must be smooth and flat.
3. Take a ONE minute WET DENSITY Reading in BACKSCATTER Position.
4. Be careful that your gauge doesn't get damaged by construction equipment etc.
5. Check with District prior to Project to make sure of which testing Specs to use.

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Example Tack Calculation

Problem: The existing roadway is very old, dried, cracked, etc. (Oxidized). Prior to tack placement, the dial gauge reads 450 gallons. The tack is diluted (1:1). Tack is placed from Sta. 0+00 to Sta. 10+00. The dial gauge reads 275 gallons after tack placement. Average road width is 12ft.

Is the tack application rate within specification limits?

Step 1: **Determine Length of Section**

Sta. 0+00 → Sta. 10+00 = 1000 ft

Step 2: **Determine Amount (gallons) of Tack Used**

450 gallons - 275 gallons = 175 gallons

Step 3: **Determine Area of Section**

$$Area = \frac{width\ x\ length}{9\ ft.^2/yd.^2} \rightarrow \frac{12ft.\ x\ 1000ft.}{9\ ft.^2/yd.^2} = 1333.3\ yd^2$$

Step 4: **Calculate Application Rate**

$$Rate = \frac{gallons}{yd^2} \rightarrow \frac{175\ gal}{1333.3\ yd^2} = 0.13\ gal/yd^2$$

Step 5: **Verify with Standard Specifications**

TABLE 408.11

Condition of Existing Pavement	Application Rate (gal/sy) (Note 2)	
	Undiluted	Diluted (1:1) (Note 3)
New HMA (Note 4)	0.04 – 0.05	0.08 – 0.10
Oxidized HMA	0.07 – 0.10	0.13 – 0.20
Milled Surface	0.10 – 0.13	0.20 – 0.27
PC Concrete	0.07 – 0.10	0.13 – 0.20

Within Limits

Contract: Inspector: DWR Date: 06/17/19

Project Nbr: Line Itm Nbr: 0015 Loc Seq No: 1

Item Code & Desc: 408002-001 ASPHALT MATERIAL

West Virginia Department of Transportation
Division of Highways
Inspector's Bituminous Emulsion Tack Worksheet

Ver 1.1 March 2 2016

Producer / Supplier: MPC1.01.705 - Marathon Petroleum F-1 @ Catlettsburg Total Quantity Placed: 175.

Row 1 of 1 Ticket Number | Original Invoice No | Material Type | Source of Material

OBSERVATIONS - *Comment below if any of the following are not met:*

- Traffic Control and Flaggers in place ☒
- Surface temp above 40 degrees F ☒
- Surface clean prior to placement ☒
- Uniform application of tack coat ☒

Existing Pavement Condition	Target Application Rate (gal/yd²)*	
	Undiluted ☒	Diluted (1:1) ☐
New HMA ☐	0.04 - 0.05	0.08 - 0.10
Oxidized HMA ☒	0.07 - 0.10	0.13 - 0.20
Milled Surface ☐	0.10 - 0.13	0.20 - 0.27
PCC ☐	0.07 - 0.10	0.13 - 0.20

*Undiluted = 60% Residual Asphalt, Diluted = 30% Residual Asphalt

A	B	C	D	E	F	G	H	I	J
Time	Start Station	End Station	Length (ft) C - B	Width (ft)	Area (yd²) (D x E) / 9	Initial Reading (gal)	Final Reading (gal)	Amount Applied (gal) G - H	Rate (gal/yd²) I / F
00:00	0 +00	10 +00	1000.	12.	1333.33	450.	275	175.00	.13

Remarks

Running Amount Applied 175.

EXAMPLE DWR ENTRY

Division of Highways

Daily Work Report

Report v1

Contract: 2023080002, BIG OTTER-FRAMETOWN RD
Prime Contractor: [redacted]

DWR Date: 9/6/2023 **Day of Week:** Wednesday **Inspector:** [redacted]
Agency Project Engineer: [redacted]

Seq Num: 1 **DWR Status:** Approved **Entered By:** [redacted]
Agency Delivery Engineer: [redacted]

Last Updated Date: 9/14/2023 **Last Updated By:** [redacted]
Managing Office:

Weather: 9 **Low Temp:** 66 **High Temp:** 91 **Rainfall Amount:** **SECIR Indicator:**

Fed. Proj. Num: NHPP-0079(091) **State Proj. Num:** S308-79-43.37 00

Work Items: Yes **Contractors:** Yes **Daily Staff:** No **Attachment(s):** Yes

Remarks

Type	Remarks
00	PRIME CONTRACTOR TIME [redacted] NO LUNCH 6:00AM TO 7:00PM = 13 HRS WVDOH PERSONNEL TIME [redacted] 5:30AM TO 7:30PM = 13.5 HRS 1 HR TRAVEL 12.5 HRS PROJECT INSPECTION, DOCUMENTATION, ETC WVDOH PERSONNEL TIME [redacted] 6:30AM TO 7:30PM = 12.5 HRS 1 HR TRAVEL 11.5 HRS PROJECT INSPECTION, ETC
02	2023 09 06 DWR 0025 SUPERPAVE ASPHALT TICKETS TY19 2023 09 06 DWR 0025 SUPERPAVE ASPHALT DELIVERY REPORT TY19
03	LINE # 0025, ITEM 410001-030 SUPERPAVE ASPHALT BASE TY 19

Division of Highways

Daily Work Report

Report v1

Item Postings

Item Description	Item ID	Seq. Num	Cont Ln	Project	Category	Proj Ln	Quantity Posted	Unit	From Station - To Station Location
SUPERPAVE ASPHALT BASE CRSE, TY 19	410001-030	1	0025	2023080002	0001	0025		SY	BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location
19 mm Asphalt Mix, Superpave		TN		

Contractor: WEST VIRGINIA PAVING, INC.

Comments: PAY FOR THIS ITEM WILL BE MADE AT A LATER DATE ON COMPLETION OF PWL SAMPLE TESTING.

AT THE FOLLOWING LOCATIONS, THE CONTRACTOR USES A TRANSFER MACHINE AND A RUBBER TIRE PAVER TO PLACE ASPHALT BASE FOLLOWED BY 3 STEEL DRUM ROLLERS FOR COMPACTION. [redacted] TECHNICIAN, [redacted] ON SITE FOR DENSITY. [redacted] ON SITE FOR PWL CORE DRILLING. WVDOH TECHNICIAN [redacted] ON SITE.

(PAYMENT WILL BE REQUESTED FOR A 12FT LANE)

SB SLOW LANE
2611+75 TO 2596+70 = 1505
EQUALITY
2595+78 TO 2516+35 = 7943

1505 + 7943 = 9448

((9,448 X 12 = 113,376) / 9 = 12,597.333)

NB SLOW LANE
2516+35 TO 2522+80 = 645

((645 X 12 = 7,740) / 9 = 860)

12,597.333 + 860 = 13,457.333 SY

PAY QUANTITY = 0 SY

TRAFFIC CONTROL DEVICE	636011-001	1	0140	2023080002	0001	0140	0	UN	BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location
Traffic Control Devices	0	EA		

Contractor: [redacted]

Comments: ALL TRAFFIC CONTROL DEVICES ARE PROPERLY LOCATED THROUGHOUT THE PROJECT. THE SIGNS ARE CLEAN, LEGIBLE, AND CLEARLY VISIBLE. SPEED TRAILERS AND ARROW BOARDS ARE ALSO UTILIZED IN EACH LANE AS PART OF THE REQUIRED SPECIFICATIONS FOR THE TRAFFIC CONTROL SET UP AS LISTED PER THE PLAN SHEET. REFER TO THE DAILY CHECK LIST FOR ADDITIONAL INFORMATION.

PAY QUANTITY = 0 UN

TRAFFIC DIRECTOR	636014-002	1	0155	2023080002	0001	0155	11.5	HR	BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location

Contractor: [redacted]

Comments: CONTRACTOR USES A TRAFFIC DIRECTOR ON THIS DATE FOR THE SAFETY OF THE TRAVELING PUBLIC. PATROL VEHICLE FOLLOWED THE OPERATIONS THROUGHOUT THE PROJECT AS PER THE CONTRACTOR'S REQUEST. THE OFFICER ON DUTY THIS DATE IS [redacted]

HOURS ON SITE 7:00AM TO 6:30PM = 11.5 HRS

PAY QUANTITY = 11.5 HR

ELECTRIC ARROW	636021-001	1	0160	2023080002	0001	0160	2	DA	BIG OTTER FRAMETOWN RD PROJECT

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location

Comments: CONTRACTOR UTILIZES 32 TYPE B WARNING LIGHTS. ALL TYPE B WARNING LIGHTS ARE PLACED PROPERLY. ALL TYPE B LIGHTS ARE ON AND WORKING PROPERLY. AS PER THE PLANS, B LIGHT PAYMENT WILL BE REQUESTED FOR PLACEMENT ON ROAD WORK 2 MILES SIGNS, ROAD WORK 1 MILE SIGNS, AND 55 MPH SIGNS.

ALL B-LIGHTS ARE WORKING THIS DATE

PAY QUANTITY = 32 DA

SHADOW VEHICLE	636028-002	1	0175	2023080002	0001	0175	MO	BIG OTTER FRAMETOWN RD PROJECT	

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location

Contractor: [redacted]

Comments: CONTRACTOR UTILIZES A SHADOW VEHICLE WHILE PERFORMING WORK. I PREVIOUSLY ADVISED WV PAVING TO HAVE THE SHADOW VEHICLE SET UP TO MEET SPECIFICATIONS LISTED IN THE STANDARD DETAILS. THE SHADOW VEHICLE HAS BEEN EQUIPPED WITH FLASHING BEACONS AND A TRUCK MOUNTED ATTENUATOR. SPOKE WITH [redacted], ABOUT HAVING 2 SHADOW VEHICLES ON THE PROJECT WHEN PROJECT SCHEDULED FOR 1 AS PER THE PLANS. [redacted] AGREED HAVING PAYMENT FOR THE USE OF 1 UNLESS 2 BECOMES NEEDED. ONLY 1 IS BEING UTILIZED AT THIS TIME.

PUT IN SERVICE ON 07/25/2023. NEXT PAYMENT REQUEST 9/25/2023

PAY QUANTITY = 0 MO

SPEED MONITORING TRAILER	636030-001	1	0180	2023080002	0001	0180	2 DA	BIG OTTER FRAMETOWN RD PROJECT	

Materials:

Material Name	Installed Quantity	Unit	Source	Work Location
Traffic Control Devices	0	EA		

Contractor: [redacted]

Comments: THERE ARE 2 SPEED MONITORING TRAILERS PLACE ON THIS PROJECT. ONE PLACED ON THE SB SIDE OF THE PROJECT AND ONE ON THE NB SIDE OF

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
INSPECTOR'S ASPHALT PAVEMENT WORKSHEET

AUTH NO: _____ PROJECT NO: _____ IDR NO: _____

LINE NO: _____ ITEM NO: _____ DATE: _____

LOAD	TICKET #	TONS / MG	CUM. TOTAL	LOAD	TICKET #	TONS / MG	CUM. TOTAL
1				25			
2				26			
3				27			
4				28			
5				29			
6				30			
7				31			
8				32			
9				33			
10				34			
11				35			
12				36			
13				37			
14				38			
15				39			
16				40			
17				41			
18				42			
19				43			
20				44			
21				45			
22				46			
23				47			
24				48			

REMARKS: _____

TOTAL Tons (Mg) THIS DATE: _____ INSPECTOR: _____

5/19/2009 Signature

ROLLER PASS DATA _____ PCF SPEED OF ROLLER _____ MPH TYPE OF ROLLER _____

ROLLER PASS DATA _____ PCF SPEED OF ROLLER _____ MPH TYPE OF ROLLER _____

PLAN THICKNESS _____

CALCULATION OF APPLICATION RATE (ONE CALCULATION PER EACH 762 m (2500 LF))

BEGIN STATION						
END STATION						
WIDTH						
Sm (SY)						
Mg (TONS)						
Mg/Sm (LB/SY)						

OBSERVED SIMILARITY TESTS (ONE OBSERVATION PER EACH 305 m (1000 LF)

LOT NUMBER						
TEST NUMBER						
Mg/Cm (LB/CY)						
STATION						

MAT THICKNESS (PRIOR TO COMPACTION) & MAT TEMPERATURE (AT TIME OF FINAL COMPACTION PASS) CHECKS (ONE CHECK PER 305 m (1000 LF)

TIME						
MAT TEMPERATURE						
MAT THICKNESS						
STATION						

TIME						
MAT TEMPERATURE						
MAT THICKNESS						
STATION						

ROLLER SPEED CHECKS (FOUR CHECKS - TWO AM AND TWO PM)

TIME						
ROLLER SPEED						

CHECKS ____ VERIFIED PRIOR TO PLACEMENT CHECKS ____ VERIFIED DURING PLACEMENT

- ☐ SEQUENCE OF OPERATION VERIFIED
- ☐ TRAFFIC CONTROL DEVICES AND FLAGGERS IN PLACE
- ☐ HEEL-IN JOINTS CUT AND POTHOLES CORRECTED
- ☐ SURFACE CLEAN AND STRINGLINE PLACED
- ☐ ROLLER(S) AND PAVER(S) VERIFIED FOR COMPLIANCE
- ☐ CONTRACTORS DENSITY TECHNICIAN ON SITE
- ☐ LONGITUDAL JOINTS PINCHED / NO OVERLAPPED
- ☐ TRUCKS COVERED AND INSULATED WITH NO OIL LEAKS OR DAMAGED SIDES
- ☐ OPERATION CONTINUOUS AND PAVER SPEED COMPATIBLE TO PLANT PRODUCTION
- ☐ VIBRATING SCREED ON AND TEXTURE OF MAT CORRECT
- ☐ CORRECT ROLLING SEQUENCE BEING USED
- ☐ STRAIGHT EDGE CHECKS BEING MADE
- ☐ COMPLIANCE WITH QUALITY CONTROL PLAN MAINTAINED
- ☐ TEMPERATURE OF MATERIAL RECORDED ON TICKETS ONCE PER HOUR MINIMUM

AIR TEMP _____ °C (°F) AT (TIME) _____ BASE TEMP _____ °C (°F) AT TIME _____

AIR TEMP _____ °C (°F) AT (TIME) _____ BASE TEMP _____ °C (°F) AT TIME _____

T - 401
Rev 2023-04-10

West Virginia Division Of Highways
401/402 Lot-By-Lot Asphalt Compaction Form

Project Number:		**Item Number:**		**Gauge Number :**	
Contract ID:		**T400 Number:**		**Man Std Count :**	
Contract Line Item:		**Target Density (A):**		**Density Std Count :**	
Plant Source Code:		**Lift Thick (in) :**		**District & County:**	

Acceptance Tests

Date:										
Begin/End Station:										
Lab Number:										
Lot Number:	A1	J1	A2	J2	A3	J3	A4	J4	A5	J5
Wet Density (B) :										
% Relative Density (C):										
Lot Evaluation: Pass/Fail										

Quality Control or Additional Acceptance Tests

Date:										
Beginning Station:										
Ending Station:										
Paving Width (Feet):										
Lab Number:										
Lot Number:	A1	J1	A2	J2	A3	J3	A4	J4	A5	J5
Offset (Rt or Lt of CL):		4 Inches		4 Inches		4 Inches		4 Inches		4 Inches
Wet Density: 1										
Wet Density: 2										
Wet Density: 3										
Wet Density: 4										
Wet Density: 5										
Average Wet Density: (B) = Avg (1 thru 5)										
Relative Density (%): (C)										
Lot Evaluation: Pass/Fail										
Lot % Pay (%)										

% Relative Density	> 97%	93-97%	92%	91%	90%	89%	88%	87%	86%	85%
Mat Density % Pay	**Note 1**	100%	99%	95%	91%	87%	83%	73%	63%	53%
Joint Pay Adjustment	**Note 2**	**0%**	**0%**	**0%**	**0%**	**-1%**	**-3%**	**-9%**	**-15%**	**-21%**

Technician's Name:	PRINT SIGN Cert #.: DATE	REMARKS
Reviewer's Name:	PRINT SIGN Cert #: DATE	Note 1: See Notes in Table 401.13.3A Note 2: See Notes in Table 401.13.3B Note3: DO NOT round numbers until final answer. Note 4: Report all Densities in kg/m3

$$Relative\ Density(C)(\%) = \frac{Average\ Density\ (B)}{Target\ Density\ (A)} * 100\%$$

$$Lot\ Pay(\%) = Mat\ Density\ \% + Joint\ Adjustment$$

T - 407
Rev 2025-09-15

West Virginia Division of Highways
401/402 Roller Pass Asphalt Compaction Form

Project Number:		**Item Number:**		**Gauge Number :**	
Contract ID:		**T400 Number:**		**Mfr Std Count :**	
Contract Line Item:		**Target Density:**	2531	**Density Std Count :**	
Plant Source Code:		**Lift Thick (in):**		**District & County:**	
Lab Number:		**Mix type:**		**Date:**	

Control Section		Begin Station	End Station		Site #	Station	Offset
Section Number:	**1**	1+00	2+00		A		
					B		

Readings after:	**4 Passes**		**6 Passes**		**8 Passes**		**10 Passes**		**12 Passes**	
Site #	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Mat Temperature (F)										
Wet Density (Kg/m³)										
Avg Wet Density (Kg/m³)										
Difference Note 1 (Kg/m³)										
Relative Density										

Proving Section		Begin Station	End Station		
Section Number:					
Site #	**1**	**2**	**3**	**4**	**5**
Station number					
Offset					
Mat Temperature (°F)					
Wet Density (Kg/m³)	2311	2317	2337	2294	2314
Average Wet Density Note 2	**2315**				
Avg Relative Density	**91%**		**Pass/Fail**		

Technician's Name:	PRINT		REMARKS
	SIGN		
	Cert #.:	DATE	
Reviewer's Name:	PRINT		
	SIGN		
	Cert #:	DATE	

Note 1: (Less than 5kg/m^3 increase)
Note 2: Minimum 92%, Shall be within ± 50 kg/m^3 of Control
Note 3: DO NOT round numbers until final answer.

$$Relative\ Density(\%) = \frac{Overlay\ Density}{Avg\ Wet\ Density} * 100\%$$

Problem	Causes																																				
	Fluctuating head of material	Feeder Screws Overload	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Over correction of Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates not Tight	Cold Screed	Moldboard on Strikeoff Too Low	Running Hopper Empty Between Loads	Feed Gates Set Incorrectly	Kicker Screws Worn Out or Mounted Incorrectly	Incorrect Nulling of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity too High)	Grad Control Wand Bouncing on Reference	Grade Reference Inadequate	Sitting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Aggregate Size	Trucks Bumping Finisher	Truck Holding Brakes	Improper Base Preparation	Improper Roller Operation	Reversing or Too Rapidly Turning Rollers	Parking of Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Temperature of Mix	Cold Mix Temperature
Wavy Surface – Short Waves (Ripples)	√	√	√				√	√		√										√	√	√	√					×	×				×	×	×	×
Wavy Surface – Long Waves	√	√				√	√	√					√	√						√			√	√		√	×	×	×					×	×	×
Tearing of Mat – Full Width			√						√		√														×							×	×	×	×	×	×
Tearing of Mat – Center Streaks					√				√		√			√	√																						×
Tearing of Mat – Outside Streaks				√					√		√	√		√				√																			×
Mat Texture Nonuniform	√	√	√					√	√	√	√		√					√	√					√		×		×				×	×	×	×	×	×
Screed Marks							√																			×	×										
Screed Not Responding to correction			√				√	√		√										√						×										×	×
Auger Shadows		√																															×	×	×		
Poor Precompaction			√					√											√							×			×								×
Poor Longitudinal Joint	√	√				√		√												√	√	√			√					×							×
Poor Transverse Joint		√					√	√		√						√	√													×							×
Transverse Cracking (Checking)																													×	×			×	×			
Mat Shoving Under Roller																												×	×	×			×	×			
Bleeding or Fat Spots in Mat																																	×	×			
Roller Marks																												×	×	×	×				×		
Poor Mix Compaction																												×	×	×	×	×	×	×	×	×	×

√ Indicates a paver problem; × indicates a problem to be investigated

There can be multiple causes of problems, investigate each one.