ODOT MATERIALS & INSPECTION

ACP Inspector Training Manual

2024-2025

INSERT TAB

Performance Theory

ACP Inspector

1

Housekeeping Items

- Restrooms
- We will take breaks often
- Lunch on your own
- Contact Information
  - ODOT Construction Training Team 503-508-4444
  - odotconstructiontraining@odot.Oregon.gov

2

Class Rules

- Informal format – participate…Ask questions as they arise.
- Respect others
- Follow along in class binder
- Turn cell phone ringer off
- If you are experiencing Covid or Flu like symptoms, please stay home.

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Self Introductions

- Name
- Who you work for
- What your job duties are
- How long you've been in this field

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Class Purpose

- The purpose of the ACP Inspector class is to provide each participant with information and tools to be an effective ACP inspector.
- Attention will be focused on items that can be inspected that are critical to the performance of ACP and necessary for fulfilling contract documentation requirements.
- Best practices will be covered to a limited degree and related to the specifications.

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Agenda

- Module 1: ACP Performance Theory
- Module 2: Specifications/Inspectors Role
- Module 3: Quantity Calculations
- Module 4: Surface Preparation
- Module 5: Delivery
- Module 6: Pavers & Mix Laydown
- Module 7: Compaction Fundamentals

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Agenda

- Module 8: Compaction Equipment & Operations
- Module 9: Compaction Testing
- Module 10: Smoothness Testing
- Module 11: Joints
- Module 12: Miscellaneous Issues
- Module 13: Critical Inspection Items

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Introduction to Performance Theory

Module 1

8


Dynatest
Falling Weight Deflectometer
CAUTION
DEC 15 2002

9


PG-64-22
Albina
4/26/02
1/2
3/8
DEC 12 2002

10


CAUTION
DO NOT OPERATE WITHOUT GUARDS IN PLACE
6

11


INGERSOLL-RAND

12

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Terminology

- In-Place Air Voids
  - In-Place Air Voids = 100 - Compaction
- Compaction
  - If Compaction is 93%, then In-Place Air
  - Voids is ___7 %___

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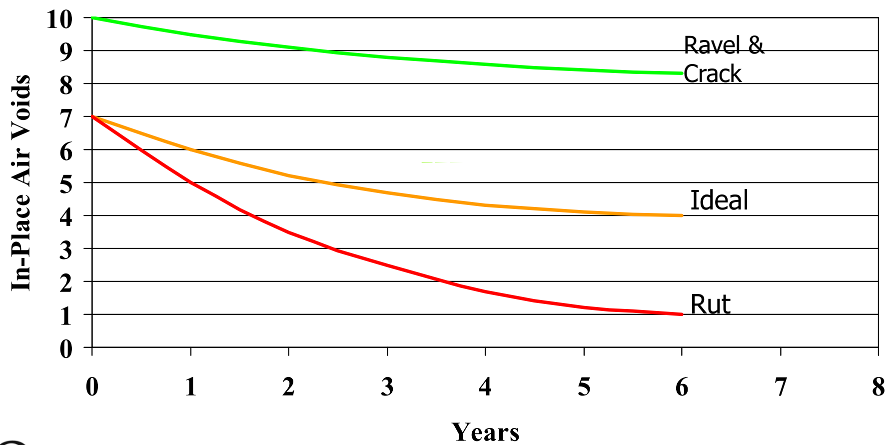
Performance Theory



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Performance Theory

Over time…

- If In-Place Air Voids < 3%, then the pavement will
  ___**Rut**___

- If In-Place Air Voids > 8%, then the pavement will
  ___**Ravel**___, ___**Crack**___, and ___**Strip**___

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Performance Theory

- Washington DOT Study
- For every 1% In-Place Air Voids in excess of 7%…
  - Lose __10__% Fatigue Life
  - Fatigue = Alligator Cracking

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Rutting

When the total pavement structure is ok, but rutting occurs due to an unstable mix…

The rutting is confined mostly to the top __4 inches__ of mix

Mix deeper than __4 inches__ will not compact substantially more over time

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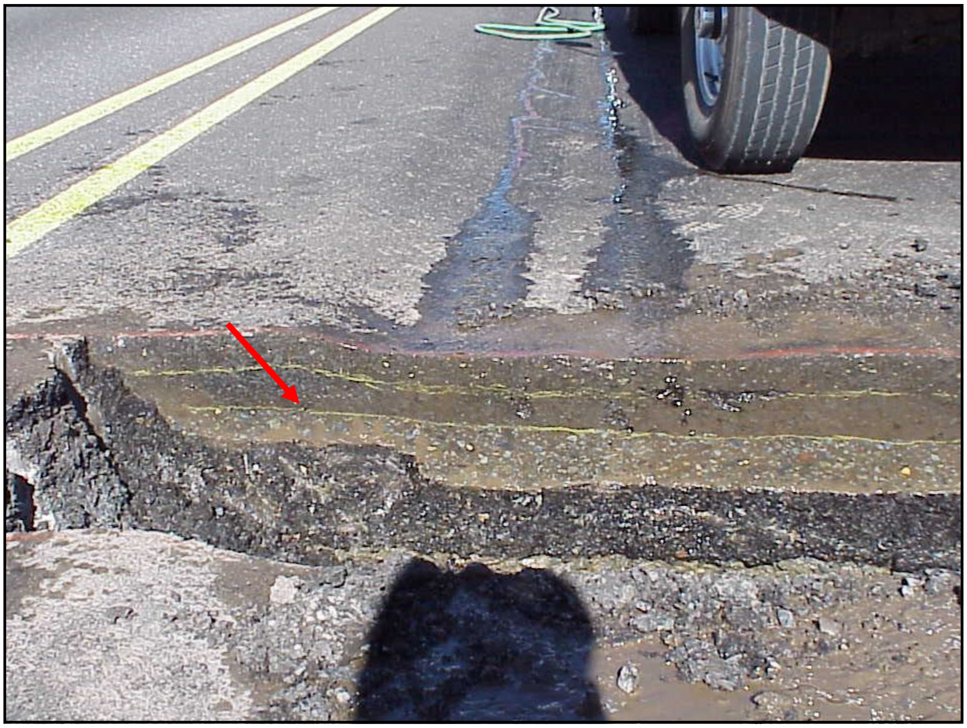

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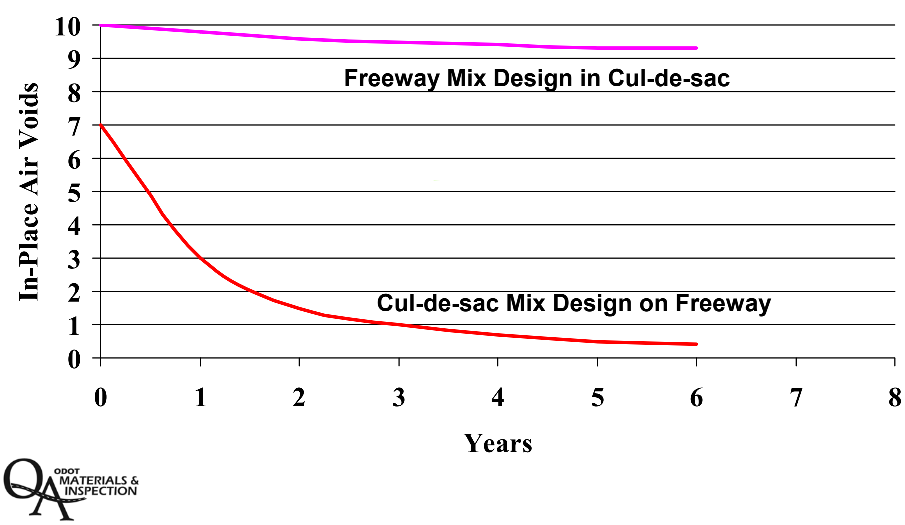
Mix Design Selection



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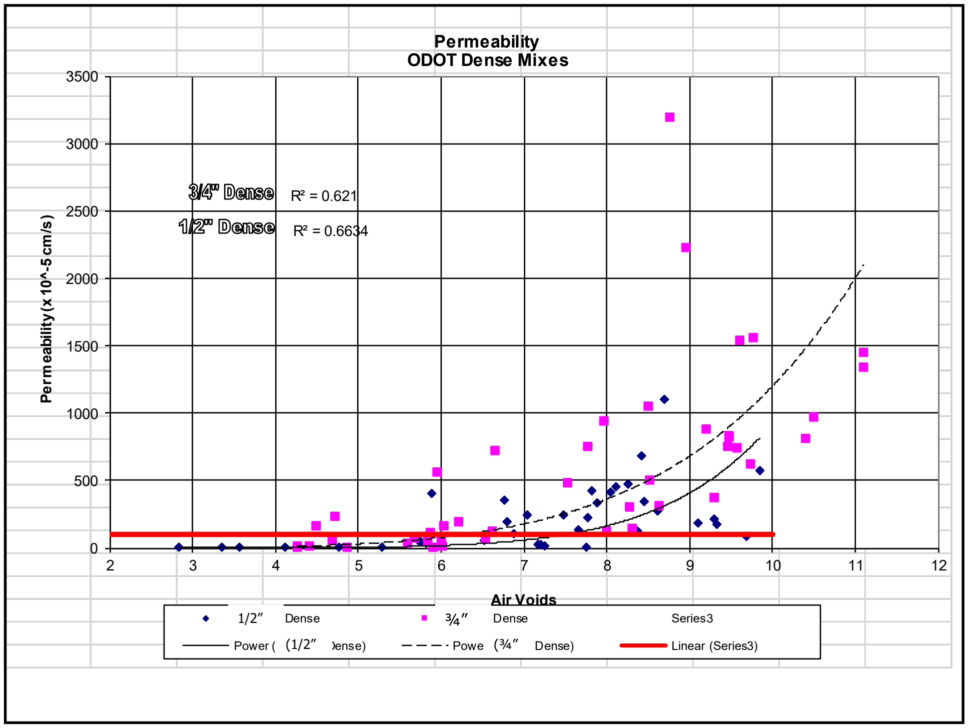

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Goals of ACP System

- Design overall pavement structure thickness to carry the traffic loadings over the intended life
- Design and construct ACP that will ultimately compact to 4 to 5% In-Place Air Voids over time and under traffic

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Warm Mix Asphalt

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What is WMA

- Technologies that allow a reduction in temperatures at which asphalt mixes are produced and placed.
- Viscosity of the asphalt are reduced to allow a drop of 35 to 100° F.
- Approved technologies and processes are in ODOT publication "Approved WMAC Technologies."

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Foaming Process

- Add pressurized water to binder injection at drum
- Expands volume of binder
- Provides better coating
- Less aging (stiffening) of binder from heat

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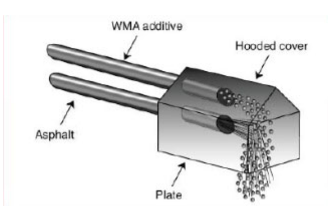
Additives

- Coat aggregate with binder at reduced temperatures
- Lubricate the mix to improve workability and compaction
- Add at ACP plant or at binder supplier terminal



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Best Practices for Producing WMA

- Reduce stockpile moisture content
- Tune burner to ensure complete combustion
- Drying aggregate while maintaining baghouse temperatures

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Why Warm Mix?

- Paving benefits
  - Compaction aid
  - Cold weather paving
  - Longer haul distances
  - Use of higher percentage of RAP
- Reduced fuel usage
- Reduced emissions
- Improved working conditions

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WMA Startup

WMA – Separate JMF is issued

- HMAC design with WMA process identified and temperature range changed
- HMAC must meet start-up requirements in 745.16(b-1-d) before WMA can begin production
  - Goal is to complete any JMF adjustments before WMA starts – then see volumetrics with WMA production
- Pb changes limited to 0.3% for WMA production
- WMA production may be stopped and changed back to HMA at the discretion of the Engineer

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WMA Lesson Learned

Compaction Drives Temperature Change

- Most successful Contractors start with 10-degree temperature drops, while CDT closely monitors compaction
- Temperature drops range from 10 to as high as 40, typical target is 30.

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AASHTOWare Project

odoteconstruction@odot.oregon.gov

AWPAdmin@odot.oregon.gov

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What type of data will Inspectors input?

Civil Rights & Labor

- Field Interviews
  - Employee Interviews

Construction & Materials

- Daily Work Report (DWR)
  - Formerly General Daily Progress Reports
  - Weigh memos attachments
- Pay notes generated from DWR
- Sample Tests

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What type of data will Externals input?

Civil Rights & Labor

- Certified Payrolls

Primes have ability to review data submitted by subs and technicians in AWP prior to ODOT's review.

Construction & Materials

- Subcontracts
- Daily Source Reports (DSR)
  - Updating production quantity
  - Identify how much material has been produced
- Submit mix designs
- Managing testing labs testers
- Sample Records - access to create records and enter test data
- View Sources and source material

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AASHTOWare Project

Visit the APOST Website:

https://www.oregon.gov/odot/Construction/Pages/AW-Construction.aspx

Subscribe to The APOST Times:

https://public.govdelivery.com/accounts/ORDOT/subscriber/new?topic_id=ORDOT_863

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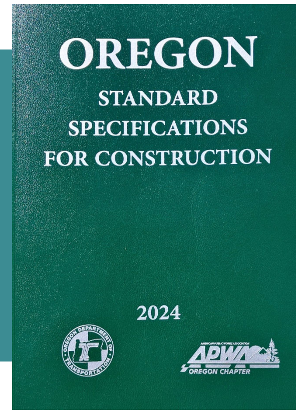
Specifications & Inspector's Role

Specifications & Inspector's Role

Module 2

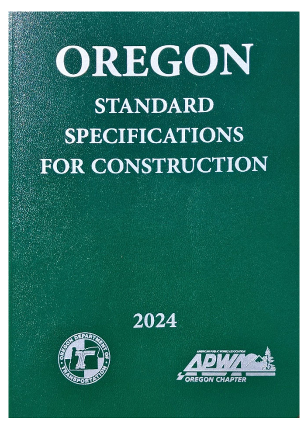


ODOT MATERIALS & INSPECTION

1

Module Topics

- Format & Order of Precedence
- ODOT Inspector's Manual
- Inspector's Role



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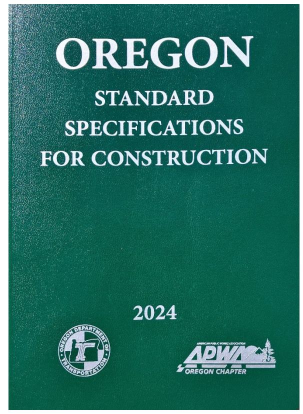
Specifications Format

Sections of focus for paving

- Part 00100 General Conditions
- Part 00600 Bases
- Part 00700 Wearing Surfaces



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Specifications Format

Parts (00700, etc.)

Sections

….

Section 00730 Emulsified Asphalt Tack Coat

…

Section 00745 Asphalt Concrete Pavement – Statistical Acceptance

4

Specifications Format

Parts (00700, etc.)

Sections (00745, etc.)

Subsections

.00-.09	Description
.10-.19	Materials
.20-.29	Equipment
…	…
…	…

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Specifications Format
Subsections 00200 through 01999

Description	**X.00 to X.09**
Materials	**X.10 to X.19**
Equipment	**X.20 to X.29**
Labor	**X.30 to X.39**
Construction	**X.40 to X.49**
Temporary	**X.50 to X.59**
Maintenance	**X.60 to X.69**
Finishing and Cleaning Up	**X.70 to X.79**
Measurement	**X.80 to X.89**
Payment	**X.90 to X.99**

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Specifications to be Covered

Section 00150	Control of Work
Section 00190	Measurement of Pay Quantities
Section 00620	Cold Plane Pavement Removal
Section 00730	Emulsified Asphalt Tack Coat
Section 00745	Asphalt Concrete Pavement – Statistical Acceptance

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Order of Precedence

00150.10 Coordination of Contract Documents - The Contract Documents, including, but not limited to, Contract Change Orders, the Special Provisions, the Plans, and the Standard Specifications are intended to collectively describe all of the items of Work necessary to complete the Project.

(a) Order of Precedence - The Engineer will resolve any discrepancies between these documents in the following order of precedence:

- Contract Change Orders;
- Special Provisions;
- Stamped Agency-prepared drawings specifically applicable to the Project and bearing the Project title;
- Reviewed and accepted, stamped Working Drawings;
- 3D Engineered Models and supplemental Agency-prepared line, grade and Cross Section data applicable to the Project;
- Standard Drawings;
- Approved unstamped Working Drawings and 3D Construction Models;
- Standard Specifications; and
- All other Contract Documents not listed above.

Notes on a drawing shall take precedence over drawing details.

Dimensions shown on the drawings, or that can be computed, shall take precedence over scaled dimensions.

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Materials Specifications and Test Method References

00165.20 Materials Specifications and Test Method References - References to materials specifications and test methods of ODOT, WAQTC, AASHTO, ASTM, other governmental agencies, or other recognized organizations mean those officially adopted and in current use by the agency or organization on the date of Advertisement.

If there are conflicting references, or if no reference is made to materials specifications, sampling and testing frequencies, or test method, the Engineer will resolve any discrepancies between these documents in the following orders of precedence:

Field-Tested Materials:

- Contract Change Orders;
- Special Provisions;
- ODOT Laboratory Manual of Test Procedures;
- MFTP; and
- Standard Specifications.

Nonfield-Tested Materials:

- Contract Change Orders;
- Special Provisions;
- ODOT Laboratory Manual of Test Procedures; and
- Standard Specifications.

Material test methods:

- ODOT;
- WAQTC;
- AASHTO;
- ASTM;
- Other recognized national organizations, such as ANSI, AWPA, IMSA, ISSA, and UL; and
- Industry standards in the location where the Work is being performed.

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Materials Specifications and Test Method References

00165.20 Materials Specifications and Test Method References - References to materials specifications and test methods of ODOT, WAQTC, AASHTO, ASTM, other governmental agencies, or other recognized organizations mean those officially adopted and in current use by the agency or organization on the date of Advertisement.

00165.20 Materials Specifications and Test Method References

Field-Tested Materials:

- Contract Change Orders;
- Special Provisions;
- ODOT Laboratory Manual of Test Procedures;
- MFTP; and
- Standard Specifications.

- AASHTO;
- ASTM;
- Other recognized national organizations, such as ANSI, AWPA, IMSA, ISSA, and UL; and
- Industry standards in the location where the Work is being performed.

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ODOT Inspector's Manual

- Provides guidelines to the Inspector for inspecting and documenting work on ODOT contracts.

https://www.oregon.gov/odot/Construction/Pages/Inspectors-Manual.aspx

- Sections specific to ACP are:
  - Section 730 – Emulsified Asphalt Tack Coat
  - Section 735 – Emulsified Asphalt Concrete Pavement
  - Section 744 – Asphalt Concrete Pavement
  - Section 745 – Asphalt Concrete Pavement – Statistical Acceptance

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ODOT Inspector's Manual

- Each Section may have the following topics:
  - Quality
  - Safety
  - Construction
  - Measurement

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ODOT Inspector's Manual

- The following slides provide examples from Section 700 of the Inspector's manual.
- The entire Section 700 is included as an attachment to this chapter in the ACP Inspector Manual.

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ODOT Quality Assurance Materials & Inspection Inspector's Manual

Construction

A key element in constructing a quality pavement is ensuring that the mixture is consistently and uniformly produced.

Document daily the workers, hours, equipment, stations paved, course depth, width, tonnage, yield, weather, temperature, tack spread rate, and problems encountered. Complete the General Daily Progress Report (form 734-3474) or the attached Paving Inspectors Daily Report to document this information.

Complete the HMAC Checklist for your information.

Check that:

- Prior to starting paving work, appropriate Contractor and ODOT personnel meet for the required pre-paving conference.
- For delivery of the MHMAC and HMAC mixture to the paving machine:
    - A document or documents identifying that the delivered mix matches the approved JMF is provided with the deliveries.
    - Mixture is loaded into the haul vehicles such that segregation is minimized. (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix.)
    - Mixture is unloaded without segregation or bumping or moving the paving machine.
    - Mixture is delivered to the paving machine with no detrimental change in its characteristics.
    - Haul vehicle beds are clean and treated with an approved release agent – use of diesel oil is prohibited for M/HMAC.
    - Loads are covered, as specified, or otherwise protected to maintain specified temperature of the mixture.
    - Estimate the required number of delivery trucks using the attached Mix Delivery Production Calculation Form.
    - For M/HMAC, the number of haul vehicles is sufficient to allow mixture placement to be performed as continuously as possible. If the number of vehicles is not sufficient, suspend operations until sufficient vehicles are provided or sufficient mixture is supplied to resume normal operation.
    - M/HMAC is rejected before placing if it is below the specified placing temperature limit, slumping, separating, solidifying, crusting or absorbing moisture.
- For placement and compaction of the MHMAC and HMAC mixture:
    - Calculate the anticipated length paved for the first 10 loads (plan length X plan width X plan thickness X specific gravity of mix X 62.4 X (%

Section 700 7-13 May 2014

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Check that:

- Prior to starting paving work, appropriate Contractor and ODOT personnel meet for the required pre-paving conference.
- For delivery of the MHMAC and HMAC mixture to the paving machine:
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  - Mixture is delivered to the paving machine with no detrimental change in its characteristics.
  - Haul vehicle beds are clean and treated with an approved release agent – use of diesel oil is prohibited for M/HMAC.
  - Loads are covered, as specified, or otherwise protected to maintain specified temperature of the mixture.

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Inspector's Role

00150.01 – The Project Manager shall have the authority to appoint Inspectors and other personnel as required to assist in the administration of the Contract.

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Inspector's Role

00150.02 Inspector's Authority and Duties – To the extent delegated under 00150.01, Inspectors are authorized to represent the Engineer and Project Manager to perform the following:

- Inspect Work performed and Materials furnished, including, without limitation, the preparation, fabrication, or manufacture of Materials to be used;
- Orally reject defective Materials and to confirm such rejection in writing;
- By oral order, temporarily suspend the Work for improper prosecution pending the Engineer's decision; and
- Exercise additional delegated authority.

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Inspector's Role

Inspectors are not authorized to:

- Accept Work or Materials.
- Alter or waive provisions of the Contract.
- Give instructions or advice inconsistent with the Contract Documents.

Make sure you:

- Confirm what authority your PM delegates to you.
- Contractor is aware of your delegated authority.

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Expectations of Paving Inspectors “Critical Items”

1. Milling & Clean Surface
2. Uniform Tack
3. Continuous Paving
4. Segregation
5. Uniform Surface Texture
6. **<u>Compaction</u>**
7. Smoothness
8. Approaches & Utilities
9. Joints – *tight, even, straight*
10. Late Season & Weather

4: SURFACE PREP

5 & 6: DELIVERY, PAVERS & LAYDOWN

7, 8, 9 & 10: COMPACTION & SMOOTHNESS

11: JOINTS

12: MISC ISSUES

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Expectations of Paving Inspectors “Critical Items”

6. Compaction

- Spec Equipment
- Proper Temperature
- Adequate Compactive Effort
- Achieve Required Density
- Monitor Rolling Pattern
- Proper Compacted Thickness

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Expectations of Paving Inspectors

- Lay out quality and workmanship expectations at pre-paving meeting
- Point out problems to the Contractor while they are occurring, not after the fact
- Work with Contractors to resolve problems
- Apply good common sense

ODOT MATERIALS & INSPECTION

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700’s – Wearing Surfaces

The pavement wearing surface is a key aspect of how the public judges the quality of a construction project. Because of that, the finished wearing surface must provide a smooth ride. If work on the wearing surface is not producing a smooth ride, require the Contractor to modify processes and procedures such that it produces a smooth riding surface, as well as meets other requirements.

Section 00705 – Emulsified Asphalt Prime Coat and Emulsified Asphalt Fog Coat

This work consists of applying asphalt, with or without aggregate cover materials, to a prepared surface. The prime coat is a penetration treatment applied to aggregate surfaces to bind the material with a hard surface like asphalt concrete pavement. A fog coat is a treatment applied to existing asphalt concrete pavement surfaces to renew and seal the pavement surface.

Quality

Quality requirements are specified and in the *Manual of Field Test Procedures* – Field Tested Materials Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality, performs sampling and testing as specified, and provides copies of test results to the Quality Control Compliance Specialist (QCCS).
- The Contractor samples the liquid asphalt and submits the sample to ODOT, as specified.
- ODOT performs verification sampling and testing as specified

Gather and submit required quality documentation.

Construction

Ensure that:

- Limits for the work are identified and marked and both the Contractor and Inspector understand the markings.
- Cover aggregates, if required, comply with specified requirements.

- A document accompanies shipment of emulsified asphalt showing delivered material matches the approved material.
- The Contractor's equipment is applying the material uniformly and at the specified application rate.
- The distributor's spray bar is set at the correct height to provide triple lap coverage of liquid asphalt.
- Weather conditions are as specified to perform the work and to allow the asphalt to cure or set.
- Emulsified asphalt is applied to only one designated lane at a time.
- The surfaces, upon which the application is to be made, meet the conditions specified.
- Cover aggregate, if required, is applied immediately after the emulsified asphalt is spread and before the emulsified asphalt starts to cure or set.
- Only the fog coat surface may be power broomed, as required, to remove loose aggregate.
- If traffic or construction equipment is running on the treated surface, the Contractor repairs and maintains the treated surface as needed.

Measurement

Unless specified otherwise, measurement for emulsified asphalt will be by weight. As work is performed, gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. If only a partial load is used, ensure that the vehicle is weighed and the weight used is properly determined. If possible, weigh the vehicle on the project before it returns to the plant. Calculate the sum of all emulsified asphalt used daily and submit that calculation, with the weight ticket or Weigh Memo - Material Receipt form as a source document to justify payment.

Section 00706 – Emulsified Asphalt Slurry Seal Surfacing

This work consists of applying one or more layers of slurry seal consisting of asphalt, water, aggregate, and additives on a prepared surface.

Quality

Quality requirements are specified and in the *Manual of Field Test Procedures*– Field Tested Materials Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality, has qualified technicians to perform sampling and testing as required, and provides copies of test results to the QCCS.
- The Contractor samples the liquid asphalt, as specified, and submits the sample to ODOT.
- The Contractor submits the Job Mix Formula (JMF) to ODOT for approval, as specified.
- ODOT performs verification sampling and testing as specified.

Gather and submit required quality documentation.

Construction

Ensure that:

- The surface and air temperature are above 45° F and rising before placing slurry seal, and it is not raining or predicted to rain before the slurry seal has cured.
- A document or documents identifying that the delivered mix matches the approved JMF is provided with the deliveries.
- Limits for the work are identified and marked and both the Contractor and Inspector understand the markings
- The Project Manager has accepted the sample strip and street cleaning details before slurry seal surfacing proceeds.
- The surfaces, upon which the application is to be made, meet the conditions specified. The surfaces may be wetted by fogging, as specified.
- The mixer is specifically designed for slurry seal. Concrete transit mixer trucks are not used as mixers.
- There is a back-up mixer on-site and another off-site.
- Aggregates comply with specified requirements.
- The Project Manager has accepted the mixer calibration before proceeding with slurry seal surfacing.
- The Contractor's equipment is applying the material uniformly and at the specified application rate.
- Both the emulsified asphalt and the aggregate are applied uniformly at appropriate rates to leave a streak free surface.
- The spreading equipment has a steering device, flexible strike-off, adjustable width, only one tail rubber, and a Project Manager approved drag.

- The slurry does not segregate, lump, ball, or cure (break) in the spreading equipment.
- Only self-propelled steel-wheeled or pneumatic-tired type rollers with a water spray system are used, if specified.
- If specified, the surfaced areas receive a minimum of two full coverage passes by the roller.
- If construction equipment is running on the treated surface, the Contractor repairs and maintains the treated surface as needed.
- Hand work is limited to the beginning and end of panels.
- The treated area is protected from traffic for the full cure period, or as specified otherwise.

Measurement

Measurement for slurry seal surfacing will be by area, unless specified otherwise. As work is performed sketch and calculate the area of slurry seal surfacing placed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

Section 00710 – Single Application Emulsified Asphalt Surface Treatment

Section 00715 – Multiple Application Emulsified Asphalt Surface Treatment

This work consists of applying emulsified asphalt and graded aggregates, either in a single application or multiple applications.

Quality

Quality requirements are specified and in the *Manual of Field Test Procedures* – Field Tested Materials Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality, has qualified technicians to perform sampling and testing as required, and provides copies of test results to the QCCS.
- The Contractor samples the liquid asphalt, as specified, and submits the sample to ODOT for approval. Sampling should be witnessed by the Inspector or QCCS for proper sampling technique, container, etc.

- ODOT performs verification sampling and testing as specified.

Gather and submit required quality documentation.

Construction

Ensure that:

- Limits for the work are identified and marked and both the Contractor and Inspector understand the markings.
- Aggregates comply with specified requirements and are stockpiled as specified.
- A document accompanies shipment of emulsified asphalt showing delivered material matches the approved material.
- The Contractor’s equipment is applying the emulsified asphalt uniformly and at the specified application rate.
- The distributor’s spray bar is set at the correct height to provide a triple lap coverage of liquid asphalt.
- The surfaces, upon which the application is to be made meet the conditions specified and are approved by the Project Manager.
- The application process works toward the aggregate stockpile from the furthest section of the project, unless otherwise approved by the Project Manager.
- The Contractor schedules and performs its operations as specified to ensure that the required widths of travel lanes and roadway are completed daily.
- Longitudinal joints are not placed within the travel lane, unless approved by the Project Manager.
- The emulsified asphalt is applied to completely cover the intended surface, but does not overlap adjacent coverages. If overlaps occur, ensure that excess asphalt is removed with a squeegee, etc. to prevent a bump or area with excess asphalt.
- The moisture content of the aggregate is maintained so that the aggregate is surface damp at the time of placement on the emulsified asphalt.
- Aggregate is spread uniformly at the specified rate on the emulsified asphalt immediately after its application and before the emulsified asphalt starts to set or cure (break).
- The aggregate is applied to completely cover the intended surface, but not to overlap adjacent coverages. If overlaps occur, ensure that excess aggregate is removed to prevent a bump or area with excess aggregate.
- Buildup of aggregate (piles) is immediately removed.
- Compaction is performed immediately behind the aggregate application.

- Only steel-wheeled or pneumatic-tired rollers are used.
- A minimum of 2 pneumatic-tired and 1 steel-wheeled rollers are used.
- The surfaced areas receive a minimum of 2 coverages with a pneumatic-tired roller and 1 coverage with a steel-wheeled compactor for a Single Application, and 4 full coverage passes by the rollers, as directed by the Project Manager, for a Multiple Application.
- Speed of the compactors is compatible with the surface treatment operation, but no greater than 5 MPH, and the compactors do not pick up aggregates from the surface.
- The treated surface is swept to remove loose aggregate as specified.
- The Contractor measures the finished surface of Multiple Applications as specified with a straightedge to ensure specified smoothness, and corrects all deficiencies in surface tolerance.
- Traffic is controlled until the treatment is cured and the loose aggregate is removed.
- Damage, including that resulting from traffic, is repaired.
- Unless specified otherwise or allowed by the Project Manager, the work is completed at least 3 hours before sunset.
- The pavement is not opened to traffic until authorized by the Project Manager.

Measurement

Measurement for the emulsified asphalt and aggregate will be by weight, unless specified otherwise. As work is performed, gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. If only a partial load is used, ensure that the vehicle is weighed and the weight used is properly determined. Reweigh the vehicle on the project, if possible. Calculate the sum of all emulsified asphalt used daily and submit that calculation, with the Weigh Memo - Material Receipts form, as a source document to justify payment.

Measurement for the asphalt surface treatment of approaches will be by unit basis, unless specified otherwise. Count each location where an approach is treated. Sketch and calculate the number of approaches completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

Section 00730 – Emulsified Asphalt Tack Coat

This work consists of furnishing and placing emulsified asphalt on a prepared surface to ensure bond between lifts of surfacing.

Quality

Quality requirements are specified and in the *Manual of Field Test Procedures* – Field Tested Materials Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality and has qualified technicians to perform sampling as required.
- The Contractor performs sampling, as specified, before additional water is added, and submits the sample to ODOT for approval.
- ODOT performs verification sampling as specified

Ensure that:

- The emulsified asphalt is not contaminated.

Gather and submit required quality documentation.

Construction

Ensure that:

- A document accompanies shipment of emulsified asphalt showing delivered material matches the approved material.
- Emulsified asphalt is diluted as specified and approved by the Project Manager.
- Emulsified asphalt is not excessively pumped prior to application, as specified.
- The distributor is applying the material uniformly and at the specified application rate.
- The distributor's spray bar is set at the correct height to provide triple lap coverage of liquid asphalt.
- Temperature and climatic conditions are as specified.
- Traffic, other than appropriate construction equipment, will not operate over the tacked surface.
- Tack is not applied to more than one half the traveled way width at one time.
- The surface, to receive the application, is cleaned and dry as specified.
- Tack is applied uniformly to the entire surface, including the vertical surfaces, on or against which the surfacing will be placed.
- Asphalt in the material separates from the water (breaks), but the material has not lost its tackiness, before surfacing material is placed on it.

Measurement

Measurement for emulsified asphalt tack coat will be by weight, unless specified otherwise. As work is performed, gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. Ensure that weight of the haul vehicle or distributor is measured to determine the quantity of material used. Calculate the sum of all emulsified asphalt tack coat used daily and submit that calculation, with the Weigh Memo - Material Receipt form, as a source document to justify payment.

Section 00735 – Emulsified Asphalt Concrete Pavement

This work consists of furnishing and placing aggregate and emulsified asphalt material to construct an emulsified asphalt concrete (EAC) pavement.

Quality

Quality requirements are specified and in the *Manual of Field Test Procedures* – Field Tested Materials Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality, has certified technicians to perform sampling and testing as specified, and provides copies of test results to the Inspector.
- The Contractor has developed and submitted a job mix formula (JMF) for approval by the Project Manager.
- The Contractor samples the emulsified asphalt, as specified, and submits the sample to ODOT.
- During aggregate production sampling and testing is done, with copies of test results provided to the QCCS.
- Aggregates are handled in a manner that prevents segregation or intermixing of sizes. (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix.)
- ODOT performs verification sampling and testing as specified.
- Aggregates and asphalt are of the specified quality.
- Material is stockpiled as specified.
- Failing or unacceptable material is separated and not incorporated, as specified.

Ensure that:

- Materials are not contaminated at any time.

- The mixing and placement processes produce a product that meets specified requirements.
- The Contractor measures the finished surface as specified to ensure specified smoothness and corrects all deficiencies in surface tolerance.

Gather and submit required quality documentation.

Construction

A key element in constructing a quality pavement is ensuring that the mixture is consistently and uniformly delivered and placed.

Check that:

- Prior to starting paving work, appropriate Contractor and ODOT personnel meet for the required pre-paving conference.

Ensure that:

- For delivery of the mixture to the paving machine:
    - A document or documents identifying that the delivered mix matches the approved JMF is provided with the deliveries.
    - Mixture is delivered to the paving machine with no detrimental change in its characteristics.
    - Haul vehicle beds prevent leakage of hauled EAC or any liquids.
    - Haul vehicle beds are clean and treated with an approved release agent – use of diesel oil is prohibited.
    - Mixture is loaded into the haul vehicles such that segregation is minimized (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix.)
    - The number of haul vehicles is sufficient to allow EAC placement to be performed as continuously as possible. If the number of vehicles is not sufficient, suspend operations until sufficient vehicles are provided or sufficient mixture is supplied to resume normal operation.
    - Mixture is unloaded without segregation, or bumping or moving the paving machine.
- For placement and compaction of the EAC mixture:
    - Paving limits are clearly marked, including location and dimensions for approaches, road or driveway connections, guardrail flares, and mailbox

turnouts, etc., and both the Contractor and Inspector understand the markings.

- Longitudinal joints for successive lifts are offset as specified.
- Longitudinal joints in the wearing course do not occur within the area or width of a travel lane, unless approved by the Project Manager.
- There is enough equipment to ensure that the paving machine can place EAC without stopping, as nearly as possible.
- Weather and surface conditions are as specified for construction of EAC pavement.
- The underlying surface is finished and has been cleaned and tack coat applied, as specified.
- If required, depressions, potholes, etc. have been prepared and filled.
- The pick-up machine, if used, picks up substantially all mixture from roadway.
- EAC is uniformly coated, does not segregate or otherwise result in a non-uniform finished product, and all defects are repaired. Involve the Project Manager, who may involve the Region QAC or the Pavement Quality Engineer, if unable to resolve this or other issues. (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix. Areas with segregation have a rougher surface texture appearance than the surrounding areas.)
- EAC that has segregated, separated, is solidifying, or is crusting is rejected.
- The Contractor and Inspector verify the pavement is constructed to the specified width, thickness, line, grade, cross section, and smoothness.
- Compaction is performed with a steel-wheeled or pneumatic-tired roller, as specified, including:
    - The Contractor develops and performs rolling patterns to ensure uniform and adequate coverage, as specified.
    - Rollers are operated at acceptable speeds, but no greater than 3 MPH.
    - The drive wheel of each roller is nearest the paver.
    - All roller marks are removed.
    - Areas not accessible to rollers are compacted by other means to specified density.
- The Contractor removes or disposes of unacceptable material and replaces it with acceptable material.
- Choke aggregate is applied as specified and does not create unacceptable dust under traffic.

  - o Loose choke aggregate is removed as specified.
  - o Choke aggregate, or other acceptable material, is used to control excess asphalt on the pavement surface.
  - o The Contractor measures surface smoothness and corrects deficiencies and roughness, as specified.
  - o Each lift of EAC cures for at least 72 hours before the next lift is placed.
  - o The mat has a uniform appearance and is free of longitudinal seams, tears, or other blemishes or defects.
- The Contractor cleans up and disposes of unwanted materials – use of diesel oil to coat or clean equipment is prohibited.

Measurement

Refer to the specifications for the method of measurement.

If measurement is by weight, ensure that the Contractor has a scale to measure the weight of each load. Ensure that overweight loads are not allowed on the roadway.

Establish a procedure to safely gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. Calculate the sum of all loads delivered each day and submit that calculation, with the Weigh Memo - Material Receipt form as a source document to justify payment.

If measurement is by volume in the haul vehicle, measure each haul vehicle and record those measurements. As work is performed calculate the volume of aggregate placed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

Section 00744 – Minor Hot Mixed Asphalt Concrete (MHMAC) Pavement

Section 00745 – Hot Mixed Asphalt Concrete (HMAC)

This work consists of constructing a hot plant mixed, uniformly coated mixture of asphalt cement, graded aggregate and additives to result in an asphalt concrete (HMAC) pavement.

It is expected that the Inspector be a Certified Hot Mixed Asphalt Concrete Inspector to inspect this work.

Quality

Quality requirements are specified and in the *Manual of Field Test Procedures* – Field Tested Materials Guide. Unless specified otherwise, acceptance of the MHMAC mixture will be by visual inspection by the Project Manager.

For HMAC check that:

- The Contractor is aware of its responsibilities regarding material quality, has certified technicians to perform sampling and testing as required, and provides copies of test results to the QCCS.
- The Contractor has developed and submitted a job mix formula (JMF) for approval by the Project Manager.
- ODOT performs verification sampling and testing as specified.
- For production of the aggregates:
    - Material is stockpiled as specified.
    - Failing or unacceptable material is separated and not incorporated, as specified.
- For production of the HMAC mixture:
    - The Contractor performs required testing and takes appropriate corrective action if test results or other indicators show that the mixture is deviating from specified or JMF requirements.
    - Aggregates are handled in a manner that prevents segregation or intermixing of sizes. (Segregation is defined as separation of the coarse aggregate particles in the mix from the fine aggregate particles.)

For HMAC, ensure that:

- Material is not contaminated.
- The mixing and placement processes produce a product that meets specified requirements.
- The Contractor measures the finished surface as specified to ensure specified smoothness, and corrects all deficiencies in surface tolerance .

Gather and submit required quality documentation.

Construction

A key element in constructing a quality pavement is ensuring that the mixture is consistently and uniformly produced.

Document daily the workers, hours, equipment, stations paved, course depth, width, tonnage, yield, weather, temperature, tack spread rate, and problems encountered. Complete the General Daily Progress Report (form 734-3474) or the attached Paving Inspectors Daily Report to document this information.

Complete the HMAC Checklist for your information.

Check that:

- Prior to starting paving work, appropriate Contractor and ODOT personnel meet for the required pre-paving conference.
- For delivery of the MHMAC and HMAC mixture to the paving machine:
  - A document or documents identifying that the delivered mix matches the approved JMF is provided with the deliveries.
  - Mixture is loaded into the haul vehicles such that segregation is minimized. (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix.)
  - Mixture is unloaded without segregation or bumping or moving the paving machine.
  - Mixture is delivered to the paving machine with no detrimental change in its characteristics.
  - Haul vehicle beds are clean and treated with an approved release agent – use of diesel oil is prohibited for M/HMAC.
  - Loads are covered, as specified, or otherwise protected to maintain specified temperature of the mixture.
  - Estimate the required number of delivery trucks using the attached Mix Delivery Production Calculation Form.
  - For M/HMAC, the number of haul vehicles is sufficient to allow mixture placement to be performed as continuously as possible. If the number of vehicles is not sufficient, suspend operations until sufficient vehicles are provided or sufficient mixture is supplied to resume normal operation.
  - M/HMAC is rejected before placing if it is below the specified placing temperature limit, slumping, separating, solidifying, crusting or absorbing moisture.
- For placement and compaction of the MHMAC and HMAC mixture:
  - Calculate the anticipated length paved for the first 10 loads (plan length X plan width X plan thickness X specific gravity of mix X 62.4 X (%

compaction/100) / 2000 = tons of mix). Compare with actual tons placed to check yield. Document yield calculation on [Material Delivery and Yield Check Sheet (form 734-2792).]

- o Paving limits are clearly marked, including location and dimensions for approaches, road or driveway connections, guardrail flares, and mailbox turnouts, etc., and both the Contractor and Inspector understand the markings.
- o Longitudinal joints for successive lifts are offset as specified.
- o Longitudinal joints in the wearing course do not occur within the area or width of a travel lane, unless approved by the Project Manager.
- o There is enough equipment to ensure that the paving machine can place M/HMAC without stopping, as nearly as possible.
- o Weather and surface conditions are as specified for construction of M/HMAC pavement.
- o The underlying surface is finished and has been cleaned, tack coat applied with triple lap coverage, and approved, as specified, prior to the start of paving.
- o The entire paving train (mixture delivery, pick-up machine, paver hopper, paver augers, paver screed, paver screed operator, raker, breakdown roller, intermediate roller and finish roller) is observed.
- o The pick-up machine, if used, picks up substantially all mixture from roadway.
- o M/HMAC that is below the specified placing temperature limit, slumping, separating, solidifying, crusting or absorbing moisture is rejected.
- o The longitudinal and transverse joints are tight, even and straight.
- o Compaction is performed with a steel wheeled or vibratory roller to achieve the specified density, including:
  - ▪ Vibratory rolling is not performed for lifts thinner than 2 times the maximum aggregate size.
  - ▪ The Contractor, its workers, and its testing technicians are working together to achieve the required product quality and are resolving all problems.
  - ▪ Performing breakdown and intermediate rolling before the M/HMAC drops below 180° F, or as otherwise specified.
  - ▪ The Contractor develops and performs rolling patterns to ensure uniform coverage and compaction, accelerating or delaying rolling patterns as necessary to resolve tenderness problems.
  - ▪ Rollers are operated at acceptable speeds.
  - ▪ Rollers are not parked on the pavement when it is hot.

        - The drive wheel of each roller is nearest the paver.
        - All roller marks are removed.
        - Areas not accessible to rollers are compacted to specified density by other methods.
        - If the Contractor cannot achieve the required density and other requirements, it must modify its processes to achieve an acceptable product. Involve the Project Manager, who may involve the Region QAC or the Pavement Quality Engineer, if this or other problems cannot be resolved.
        - Contractor notifies the Project Manager if compaction exceeds 95% of maximum density.
    - The Contractor and Inspector verify the pavement is constructed to the specified width, thickness, line, grade, cross section, and smoothness.
    - The Contractor removes or disposes of unacceptable material and replaces it with acceptable material as needed.
    - The mixture does not segregate or otherwise result in an improper finished product and all defects are repaired. Ensure that the Contractor immediately addresses and resolves the cause of the segregation and other defects. (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix. Areas with segregation have a rougher surface texture appearance than the surrounding areas.)
    - The mat has a uniform appearance and is free of longitudinal seams, tears, or other blemishes or defects. Clumps, crusted mix, etc. are removed and replaced with acceptable mixture.
    - Locations, where a connection, flare, turnout, etc. must be constructed, are constructed in such a condition to allow a good joint and connection to the future work.
    - The pavement is protected from damage and all damage is acceptably repaired.
- For placement and compaction of the MHMAC mixture:
    - Compaction is performed to achieve the required density, including:
        - Performing breakdown and intermediate rolling until the entire surface has been compacted by at least 6 coverages of the roller.
    - MHMAC is removed and replaced if it is loose, broken, mixed with dirt, too much/too little asphalt, or is defective in any way.
- For placement and compaction of the HMAC mixture:
    - The base/foundation is approved by the Project Manager prior to placement of HMAC.

- o HMAC in transit at the time adverse conditions occur is placed only if it has been covered during transit, the HMAC temperature is satisfactory, it is placed on a foundation free from pools or flow of water, and all other requirements are met.
- o Temperature behind the paver is as specified.
- o The Contractor performs all specified compaction testing.
- o Compaction is performed to achieve the specified density, including:
  - Pneumatic rollers are operated no faster than 3 MPH and vibratory rollers are operated at frequencies of at least 2,000 vibrations per minute.
  - For thin pavement (leveling, patches, or less than 2″ thickness) performing breakdown and intermediate rolling until the entire surface has been compacted by at least 4 coverages of the roller, but not to a specified density.
  - For open graded HMAC use of only steel-wheeled rollers and performing breakdown and intermediate rolling until the entire surface has been compacted by at least 4 coverages of the roller, but not to a specified density.

Measurement

Unless specified otherwise, measurement for M/HMAC is by weight. Ensure that the Contractor has a scale to measure the weight of each load. Ensure that overweight loads are not allowed on the roadway.

Establish a procedure to gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. Record the load data on the Material Delivery Record and Tally Sheet (form 734-2792), the General Daily Progress Report (form 734-3474), or the Paving Inspectors Daily Report. As work is performed a sketch of where the loads are placed may also be prepared on an Installation Sheet (form 734-2605). Calculate the sum of all loads delivered each day and submit that calculation, with the Weigh Memo - Material Receipt form, Material Delivery and Yield Check Sheet and/or Installation Sheet as a source document to justify payment.

Section 00758 – Reinforced Concrete Pavement Repair

This work consists of saw cutting and removing existing concrete pavement and constructing new reinforced and continuously reinforced portland cement concrete pavement repairs as shown and specified.

Quality

Quality requirements are specified and in the Manual of Field Test Procedures, along with Non-Field Tested Materials Acceptance Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality and has qualified technicians to perform sampling as required for production.
- The Contractor performs sampling, as specified, and submits the sample to ODOT for approval.
- ODOT performs verification sampling as specified
- The concrete mix design is a 1½ inch concrete mix as specified.

Gather and submit required quality documentation.

Preparation

Ensure that:

- Saw cuts are full depth through the concrete pavement before the contractor starts to remove the pavement. The depth of existing pavement is shown in the project plans.
- The saw cuts are in the locations shown on the plans or as marked by the Agency and not moved by the contractor for convenience.
- The contractor DOES NOT saw into the adjacent lane, and has the proper equipment listed in the specifications to prevent this from occurring.
- The Contractor removes existing reinforced concrete pavement full depth as shown or directed.
- Removal of concrete pavement is with equipment approved by the Engineer and does not damage remaining pavement.
- The Contractor removes the existing terminal expansion joint steel W-beam top flange and web as shown or as directed.
- The Contractor cuts the steel web so that no more than 1/4 inch remains above the existing sleeper slab.
- The Contractor repairs any damage to the existing pavement or sleeper slab due to the Contractor's operations.
- If the existing base requires removal, it is replaced it with materials conforming to the applicable parts of this Specification and to the depth shown. Note whether or not the repairs were greater or less than 2 inches deep since this affects payment.

- The Contractor places a non-woven geotextile or liquid curing compound as a bond breaker between the new plain concrete base and the new reinforced concrete pavement as shown or directed.
- If shown on the plans, the Contractor saw cuts the existing reinforced concrete pavement to a nominal depth of 2 inches.
- The Contractor removes existing concrete with jack hammers and chipping hammers that will not damage reinforced concrete pavement to remain in place or the underlying base as directed. Do not use jackhammers heavier than nominal 30 pounds class. Do not use chipping hammers heavier than nominal15 pounds class to remove concrete within 3/4 inch of reinforcing steel.
- The Contractor protects and keeps reinforcing steel clean of grease, oil, dirt, grout, or other contaminants at all times.
- Before placement of concrete, the repair area is blown clean with compressed air and a coat of epoxy grout or bonding agent is applied to all vertical surfaces.
- If full-depth saw cut and texturing with a bush hammer is shown on the plans, the contractor textures the full face of the cut as specified.

Placing Reinforcement

Ensure the Contractor:

- Places reinforcement as shown and specified.
- Laps splices according to Section 00530.
- Uses reinforcement that is straight, clean, and free of scale or other matter which would interfere with its bonding to the concrete.
- Places the reinforcement on support devices that maintains it in specified position during concrete placement.
- Ties or clips at every other transverse bar intersection, as a minimum, in a manner that does not allow for displacement.
- Ties or clips every lap splice as shown.
- Obtains approval of the proposed support devices before use.
- Places tie bars required for contact-type longitudinal joints by drilling the hardened concrete section and then inserting and grouting the tie bars into place.
- Does not damage the existing reinforcement when drilling the holes.
- Provides smooth, round dowel bars.
- Coats dowel bars with plastic, heavy oil, or other approved material that will not bond with or be harmful to the PCC.

- Places dowels in supporting framework or support devices that hold dowels parallel with each other, parallel with the surface of the pavement, and perpendicular to the joint.

Placing Concrete

Ensure the Contractor:

- Vibrates throughout the concrete until it is uniformly consolidated and does not segregate.
- Following the vibrating and strike-off operations, floats the concrete.
- Keeps the surface free from laitance, soupy mortar, marks or irregularities.
- Places the concrete in final position in one lift so a minimum of finishing will be necessary to provide a dense, homogenous pavement conforming to true grades and cross sections.

Curing Concrete

Ensure the Contractor:

- Immediately after the final floating, surface finishing and edging have been completed, and while the concrete surface is still moist, applies liquid membrane-forming compound uniformly to the concrete by pressure-spray methods at a rate of at least 1 gallon per 150 square feet so that the concrete is completely white like painting a wall.
- Uses other approved curing methods from the specifications if a curing compound is not used.

Measurement

Pavement repair will be measured on the area basis, and will be determined by measuring the width and length of each constructed panel of pavement. The width will be measured from edge-to-edge on the surface of the pavement, perpendicular to the centerline. The length will be measured from end-to-end of the pavement along the centerline, including the length of bar lap splices.

If depths are other than those specified then a proportionate volume ratio will be used for an equivalent number of square yards.

Bar lap areas will be measured on the unit basis. The reinforced bar lap area consists of an area of one 12-foot lane width and from 24 inches to 30 inches long. Where the bar lap areas consist of an area less than one lane width, the quantity of bar lap area will be adjusted by converting to a proportionate quantity based on a 1- foot lane width. A 6-foot wide pavement repair will be counted as one-half of a bar lap area.

Section 00746 – Crack Sealing Flexible Pavements

This work consists of repairing and resealing cracks in pavements.

Quality

Quality requirements are specified and in the Non-Field Tested Materials Acceptance Guide.

Check that the Contractor is aware of those requirements and provides quality documentation before the material is incorporated.

Ensure that the material is protected so that neither it nor vehicles driving over it are damaged. If surfacing will be placed over the material, ensure that the sealing work will not affect the quality of the finished surfacing or smoothness of the ride.

Gather and submit required quality documentation.

Construction

Ensure that:

- All locations for the work are identified.
- Cracks to be sealed are cleaned and dried as specified.
- Sealing material is heated and mixed as specified and recommended by the manufacturer. (Obtain copy of manufacturer's recommendations from the material package or have the Contractor furnish before work begins.)
- Climatic conditions are as specified for installing the sealing material.
- Cracks are completely filled and the surface is finished as specified.
- When crack sealing is performed prior to a pavement overlay, the sealed cracks are completely covered with a clean sanding material, as specified.
- The work is protected from traffic as specified.

Measurement

Refer to the specifications for the method of measurement.

If measurement is by weight, ensure that the Contractor has a scale to measure the weight of each load. Ensure that overweight loads are not allowed on the roadway.

Establish a procedure to safely gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. When possible, use the procedure in the Quantities section (12-D) of the *Construction Manual* to avoid having the material receiver in the work area. Calculate the sum of all loads delivered each day and submit that calculation, with the Weigh Memo - Material Receipt form as a source document to justify payment.

If measurement is by length, measure and record the length of sealed cracks. As work is performed, sketch (as possible) and total the length of cracks sealed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

Section 00748 – Asphalt Concrete Pavement Repair

This work consists of removing existing asphalt concrete surfaces. Replacement of aggregate subbases, aggregate bases and asphalt concrete pavement are covered under Sections 00641, 00735, 00744 and 00745, as applicable.

Quality

Unless specified otherwise acceptance of the asphalt concrete pavement repair will be by visual inspection by the Project Manager. Tests may be requested to verify that the materials meet the appropriate specifications.

Measurement

Measurement for asphalt concrete pavement repair is by area, unless specified otherwise. Verify that material has been placed to the required depth. Where the repair depth is directed to be different than the required depth, adjust the area by converting to an equivalent area on a proportional volume basis. As work is performed, sketch and calculate the area of asphalt concrete pavement repair completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

Section 00749 – Miscellaneous Asphalt Concrete Structures

This work consists of constructing asphalt concrete in road approaches, street connections, driveways, guard rail flares, mailbox turnouts, raised traffic islands, sidewalks, footpaths, gutters, ditch linings, spillways, dikes, and other miscellaneous or minor items of asphalt concrete, except asphalt curbs.

Quality

Quality requirements are specified.

Check that the Contractor is aware of those requirements, performs required testing, and provides acceptable quality documentation before the material is incorporated.

Gather and submit required quality documentation.

Construction

Ensure that:

- The location for each miscellaneous asphalt concrete structure is marked and both the Contractor and Inspector understand the markings and requirements for the structure to be constructed.
- If earthwork will be performed, the earthwork limits include required widening for guard rail flares, mailbox turnouts, and similar construction that requires additional subgrade or roadway width.
- If specified, aggregate base is placed and compacted in the affected area.
- Aggregate or soil materials underlying the structure are compacted, smoothed, and shaped to allow the correct depth and dimension of structure to be constructed, as specified.
- If the underlying surface is concrete or bituminous material, it is dry and free of unsuitable material and a tack coat has been applied to all surfaces that will be contacted by the asphalt concrete, as specified.
- Asphalt concrete mixture has been mixed and is in a condition to allow placement and compaction as specified.
- Asphalt concrete mixture is placed, by mechanical devices or by hand methods, to specified thickness and dimensions.
- Compaction is performed to achieve the required density, including:
    - Performing breakdown and intermediate rolling until the entire surface has been compacted by at least 4 coverages of the roller, but not to a specified density.
    - In areas not practically accessible to rollers compact to a firm, dense mass.
- The Contractor checks the smoothness of the structure and corrects all deficiencies
- As required, the Contractor constructs adjacent slopes with material and smoothes, compacts, and finishes affected areas as specified

Measurement

Refer to the specifications for the method of measurement. Measurement will be by one of the following methods, unless specified otherwise.

If measurement is by the unit basis, count each location where the structure is constructed. Sketch and calculate the number of structures completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

If measurement is by area, verify that material has been placed to the required depth. As work is performed, sketch and calculate the area of asphalt concrete pavement repair completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

If measurement is by length, measure and record the length of structure along its longitudinal axis. As work is performed, sketch and total the length constructed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

If measurement is by weight, ensure that the Contractor has a scale to measure the weight of each load. Ensure that overweight loads are not allowed on the roadway.

Establish a procedure to safely gather the weight ticket or Weigh Memo - Material Receipt (form 734-3082) from each delivery vehicle. Calculate the sum of all loads delivered each day and submit that calculation, with the Weigh Memo - Material Receipt form, as a source document to justify payment.

Section 00755 – Continuously Reinforced Concrete Pavement

Section 00756 – Plain Concrete Pavement

This work consists of constructing portland cement concrete pavement.

Quality

Quality requirements are specified in the *Manual of Field Test Procedures* – Field Tested Materials Guide, and in the Non-Field Tested Materials Acceptance Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality, has certified technicians to perform sampling and testing as required, and provides copies of test reports to the Inspector.

- The Contractor has developed and submitted a mix design, and that mix design has been approved by the Project Manager.
- ODOT performs verification sampling and testing as specified.
- During production of aggregates:
  - Sampling and testing is done and test results are provided to the QCCS.
  - Material is stockpiled as specified.
  - Failing material is separated and not incorporated, as specified.
- For production of the concrete mixture:
  - Prior to starting paving work, appropriate Contractor and ODOT personnel meet for the required pre-paving conference.
  - Concrete mixing occurs in a batch plant mixer only, unless specified otherwise.
  - Aggregates are handled in a manner that prevents segregation and intermixing of sizes. (Segregation is defined as separation of the coarse aggregate particles in the mix from the fine aggregate particles.)
  - The Contractor performs required testing, rejects or modifies all unacceptable material, and provides copies of test results to the QCCS.

Ensure that:

- Material is not contaminated or damaged at any time.
- The mixing and placement processes produce a product that meets specified requirements.
- The Contractor measures the finished surface as specified to ensure specified smoothness, and corrects all deficiencies in surface tolerance.

Gather and submit required quality documentation.

Construction

A key element in constructing a quality pavement is ensuring that the mixture is consistently produced and that the placement is uniformly done such that little handwork is needed.

Check that before proceeding with paving operations a test strip is constructed and accepted by the Project Manager, as specified.

Unless specified otherwise, ensure at least two lanes are constructed in one paving strip, when the pavement consists of two or more traffic lanes.

Complete the Concrete Pavement Pour checklist for your information.

Ensure that:

- For delivery of the concrete mixture to the spreader:
    - Mixture is delivered to the spreader in non-agitating equipment, unless specified otherwise, with no unexpected change in its characteristics and within the timeframe after mixing as allowed by specification.
    - Haul vehicle beds are clean, free of build-up of any material.
    - Concrete mixture is loaded into the haul vehicles such that the mixture does not segregate. (Segregation is defined as separation of the coarse aggregate particles in the mix from the rest of the mix.)
    - Prohibit concrete delivery vehicles from driving on the subgrade or base, except for the minimum number of right angle or near right angle crossings.
    - The number of haul vehicles is sufficient to allow placement to be performed as continuously as possible and mixture is placed within the allowed timeframe after mixing.
    - Mixture is unloaded and placed into final position without segregation or damage to or displacement of reinforcement, joints, and other appurtenances.

- For placement and finishing of the mixture:
    - Placement limits are clearly marked and both the Contractor and Inspector understand the markings.
    - Grade controls have been set.
    - Grade controls indicate a smooth grade line for the finished pavement.
    - Reinforcement size, grade, lap, ties, depth, spacing, and minimum clearance are as specified.
    - All reinforcing, joints, traffic signal detector loops, conduit, and other required appurtenances are placed, supported, and restrained as specified to prevent movement during placement and finishing of the concrete.
    - Self-supporting working platforms are located at each construction joint in continuously reinforced concrete pavement.
    - The procedure for ensuring that manholes and other devices are set in the proper location to the proper elevation and slope is effective.
    - Locations of all joints for jointed paving are clearly marked so that joints can be identified after concrete placement and are sawed in the proper location.

- o End forms and needed abutting work have been constructed to the proper grade and slope.
- o The spreader and finishing machine(s) has an effective means to control grade and cross-slope.
- o The Contractor has tested the vibrators to ensure that they operate in the specified manner or as recommended by the manufacturer.
- o The underlying surface is cleaned, smooth, compacted, and at proper grade and cross-slope.
- o The surface of subgrade or base in front of the paving operation is moistened.
- o Weather conditions are as specified for construction of concrete pavement.
- o If cold or wet weather is expected during the curing period, the Contractor has a process and devices on site to protect the concrete.
- o Quality of the concrete mixture is not affected by the placement and finishing operations.
- o Concrete that has not been placed within 1 hour of mixing, has begun to take an initial set, or has been retempered with water is rejected.
- o Defective material is not placed or is removed.
- o The Contractor ensures that the beginning section of the pavement is constructed, including consolidation and finishing, to provide a smooth surface that matches adjoining pavement.
- o Delivery of concrete mixture allows continuous operation of the spreader and finishing machines, except as allowed by specification.
- o A construction joint is constructed wherever there is an interruption of 20 minutes in concrete placement operations.
- o The finishing machine is operated as continuously as possible, with minimum stopping.
- o The concrete is placed to the specified thickness.
- o Hand work of the surfaces is minimized, including:
  - ▪ The surface is checked for irregularities and no hand finishing is done unless the check shows that it is needed.
  - ▪ No additional water is applied to the surface of the concrete mixture.
  - ▪ Hand work is only performed to correct irregularities or to seal the surface or sides of the pavement structure.
- o The surface is textured, as specified, after the mixture is adequately set, but before the texturing damages the surface.

- o The Contractor constructs the joint at the end of the day's work as specified, including consolidation, hand finishing, and assurance of smoothness and grade to produce a quality work and to match the adjoining surface.
- o The exposed surfaces of the concrete mixture are protected immediately after final floating, surface finishing and edging for at least 72 hours to prevent moisture loss either by:
  - Application of an approved curing membrane-forming compound is as specified.
  - Placement of other materials, as specified, to prevent loss of moisture from the concrete mixture and to prevent damage to the concrete surfaces.
- o **THE INSPECTOR MUST REMAIN ON-SITE UNTIL THE CURE IS COMPLETELY IN PLACE.**
- o Joints are sawed, or otherwise constructed, as soon as that work can be performed, but before shrinkage of the concrete starts. If required, joints are cleaned and filled with specified filler, as specified.
- o The concrete surfaces are protected from moisture loss, vehicle or equipment use, and other damage or use as long as specified.
- o The Contractor cleans up and disposes of unwanted material and repairs any damaged areas, as specified.

Smoothness Testing and Correction

- The Contractor tests the smoothness of the pavement surface as specified.
- No traffic is allowed on the concrete pavement until the Contractor corrects all required deficiencies.
- The Contractor corrects all deficiencies that are greater than allowed by grinding.

Measurement

Measure the work, or ensure that measurements are taken, to allow the quantity of work to be calculated.

Measurement for continuously reinforced and plain concrete pavement is by area, unless specified otherwise. Verify that material has been placed to the required depth. As work is performed, sketch and calculate the area of concrete pavement repair completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

Section 00758 – Concrete Pavement Repair

This work consists of saw cutting and removing existing concrete pavement and constructing new reinforced and continuously reinforced portland cement concrete pavement repairs as shown and specified.

Quality

Quality requirements are specified and in the Manual of Field Test Procedures, along with Non-Field Tested Materials Acceptance Guide.

Check that:

- The Contractor is aware of its responsibilities regarding material quality and has qualified technicians to perform sampling as required for production.
- The Contractor performs sampling, as specified, and submits the sample to ODOT for approval.
- ODOT performs verification sampling as specified
- The concrete mix design is a 1 ½ inch concrete mix as specified.

Gather and submit required quality documentation.

Preparation

Ensure that:

- Saw cuts are full depth through the concrete pavement before the contractor starts to remove the pavement. The depth of existing pavement is shown in the project plans.
- The saw cuts are in the locations shown on the plans or as marked by the Agency and not moved by the contractor for convenience.
- The contractor DOES NOT saw into the adjacent lane, and has the proper equipment listed in the specifications to prevent this from occurring.
- The Contractor removes existing reinforced concrete pavement full depth as shown or directed.
- Removal of concrete pavement is with equipment approved by the Engineer and does not damage remaining pavement.
- The Contractor removes the existing terminal expansion joint steel W-beam top flange and web as shown or as directed.

- The Contractor cuts the steel web so that no more than 1/4 inch remains above the existing sleeper slab.
- The Contractor repairs any damage to the existing pavement or sleeper slab due to the Contractor's operations.
- If the existing base requires removal, it is replaced it with materials conforming to the applicable parts of this Specification and to the depth shown. Note whether or not the repairs were greater or less than 2 inches deep since this affects payment.
- The Contractor places a non-woven geotextile or liquid curing compound as a bond breaker between the new plain concrete base and the new reinforced concrete pavement as shown or directed.
- If shown on the plans, the Contractor saw cuts the existing reinforced concrete pavement to a nominal depth of 2 inches.
- The Contractor removes existing concrete with jack hammers and chipping hammers that will not damage reinforced concrete pavement to remain in place or the underlying base as directed. Do not use jackhammers heavier than nominal 30 pounds class. Do not use chipping hammers heavier than nominal15 pounds class to remove concrete within 3/4 inch of reinforcing steel.
- The Contractor protects and keeps reinforcing steel clean of grease, oil, dirt, grout, or other contaminants at all times.
- Before placement of concrete, the repair area is blown clean with compressed air and a coat of epoxy grout or bonding agent is applied to all vertical surfaces.
- If full-depth saw cut and texturing with a bush hammer is shown on the plans, the contractor textures the full face of the cut as specified.

Placing Reinforcement

Ensure the Contractor:

- Places reinforcement as shown and specified.
- Laps splices according to Section 00530.
- Uses reinforcement that is straight, clean, and free of scale or other matter which would interfere with its bonding to the concrete.
- Places the reinforcement on support devices that maintains it in specified position during concrete placement.
- Ties or clips at every other transverse bar intersection, as a minimum, in a manner that does not allow for displacement.
- Ties or clips every lap splice as shown.
- Obtains approval of the proposed support devices before use.

- Places tie bars required for contact-type longitudinal joints by drilling the hardened concrete section and then inserting and grouting the tie bars into place.
- Does not damage the existing reinforcement when drilling the holes.
- Provides smooth, round dowel bars.
- Coats dowel bars with plastic, heavy oil, or other approved material that will not bond with or be harmful to the PCC.
- Places dowels in supporting framework or support devices that hold dowels parallel with each other, parallel with the surface of the pavement, and perpendicular to the joint.

Placing Concrete

Ensure the Contractor:

- Vibrates throughout the concrete until it is uniformly consolidated and does not segregate.
- Following the vibrating and strike-off operations, floats the concrete.
- Keeps the surface free from laitance, soupy mortar, marks or irregularities.
- Places the concrete in final position in one lift so a minimum of finishing will be necessary to provide a dense, homogenous pavement conforming to true grades and cross sections.

Curing Concrete

Ensure the Contractor:

- Immediately after the final floating, surface finishing and edging have been completed, and while the concrete surface is still moist, applies liquid membrane-forming compound uniformly to the concrete by pressure-spray methods at a rate of at least 1 gallon per 150 square feet so that the concrete is completely white like painting a wall.
- Uses other approved curing methods from the specifications if a curing compound is not used.

Measurement

Pavement repair will be measured on the area basis, and will be determined by measuring the width and length of each constructed panel of pavement. The width will be measured from edge-to-edge on the surface of the pavement, perpendicular to the centerline. The length will be measured from end-to-end of the pavement along the centerline, including the length of bar lap splices.

If depths are other than those specified then a proportionate volume ratio will be used for an equivalent number of square yards.

Bar lap areas will be measured on the unit basis. The reinforced bar lap area consists of an area of one 12 foot lane width and from 24 inches to 30 inches long. Where the bar lap areas consist of an area less than one lane width, the quantity of bar lap area will be adjusted by converting to a proportionate quantity based on a 12 foot lane width. A 6 foot wide pavement repair will be counted as one-half of a bar lap area.

Section 00759 – Miscellaneous Portland Cement Concrete Structures

This work consists of constructing commercial grade concrete curbs, islands, traffic separators, driveways, walks, monolithic curbs and sidewalks, miscellaneous surfaces, and stairs with metal handrail.

Quality

Quality requirements are specified and the Non-Field Tested Materials Acceptance Guide.

Check that the Contractor is aware of those requirements, performs required testing and provides copies of test results to the Inspector, and provides acceptable quality documentation before the material is incorporated.

Also check that ODOT performs required verification testing.

Inspect materials for damage. Do not allow concrete to be incorporated if it is improperly mixed or more than 90 minutes has elapsed since it was originally mixed.

Gather and submit required quality documentation.

Construction

Ensure that:

- Each structure location is accurately located and marked and both the Contractor and Inspector understand the markings.
- The underlying surface is cleaned, smooth, compacted, wetted, and at proper grade and cross-slope.
- Forms will result in a finished structure of the required dimensions and in the required locations.

- Reinforcement, dowels, joint materials, electrical conduit and devices, and other required appurtenances are placed as specified and anchored to prevent movement during placement and finishing of the concrete.
- The finished product will allow drainage of surface water.
- If extruding machines will be used to construct the structure:
  - The molds are of proper size.
  - Effective line and grade control has been established for the machine, including cross-slope if appropriate.
  - Vibrators operate properly and hydraulic or other leaks are repaired to prevent damage to the concrete or the environment.
- If cold or wet weather is expected during the curing period, the Contractor has a process and devices on site to protect the concrete.
- Concrete mixture is of quality and is placed and consolidated, as specified.
- Joints are constructed at the proper locations, as specified – contraction joints are at maximum 15-foot spacing, and ½″ thick preformed expansion joint filler is placed between new and existing concrete, unless specified otherwise.
- Finishing is performed in a timely manner.
- The surface is checked, using straightedge, string line, or other effective method, and deficiencies are corrected.
- Concrete is cured and protected as specified.
- **THE INSPECTOR MUST REMAIN ON-SITE UNTIL THE CURE IS COMPLETELY IN PLACE.**
- If forms were used during construction, the resulting surface is finished as specified after their removal.
- The Contractor cleans up and disposes of unwanted material.
- Affected areas are smoothed, restored, and finished as specified.

Measurement

Refer to the specifications for the method of measurement and payment. Measurement and payment will be by one of the following methods:

If measurement is by volume, measure each structure, and record those measurements. As work is performed sketch and calculate the volume of each structure placed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

If measurement is by area, verify that material has been placed to the required depth. As work is performed, sketch and calculate the area of structures completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

If measurement is by length, measure and record the length of structure. As work is performed sketch and total the length constructed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment

If measurement is by the unit (each) basis, count each location where the structure is constructed. Sketch and calculate the number of structures completed daily and submit that calculation with an Installation Sheet (form 734-2605) as a source document to justify payment.

INSERT TAB

Quantity Calculations

Quantity Calculations

Module 3

1

Quantity Calculations

- Specifications
- Post Bid Quantity Calculations
- Production Quantity Calculations
  - Checking Yield
  - Tracking Quantities
- Check Weights

2

Specifications

00190.10(c) Area Basis– Area will be square foot, square yard, or acre, unless otherwise specified in the Contract and will be determined by measuring the width and the length (or height) at least to the nearest 0.1 foot and computed at least to the nearest 0.1 square foot, nearest 0.1 square yard, or nearest 0.1 acre, as applicable, unless otherwise specified in the Contract.

ODOT MATERIALS & INSPECTION

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Specifications

Measurement

00620.80 Measurement – The quantities of cold plane pavement removal will be measured on the area basis, in place.

When the depth of pavement to be removed is variable, the depth as shown is an estimate and is approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

ODOT MATERIALS & INSPECTION

4

Specifications
Payment

00620.90 Payment – The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per square yard, for the item “Cold Plane Pavement Removal, ________ Deep”.

The depth will be inserted in the blank. If the depth is variable, the depth range will be inserted in the blank.

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Specifications

00190.10(d) Weight Basis – Weight will be pound or ton, unless otherwise specified in the Contract and will be determined as follows:

(2) Ton – Ton weight will be determined on Contractor-provided scales as required under 00190.20 unless otherwise allowed by the Specifications. Weight by ton will be measured at least to the nearest 0.01 ton unless otherwise specified in the Contract.

If bituminous materials, portland cement, lime, and similar bulk Materials are shipped by truck or rail, the supplier's shipping invoice with net scale weights, or volumes converted to weights, may be used for Pay Item quantity determination in place of weights determined on the Contractor-provided vehicle scales.

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Specifications

Measurement

00730.80 Measurement – The quantities of emulsified asphalt cement used as tack will be measured on the weight basis.

Payment

00730.90 Payment – The accepted quantities of emulsified asphalt cement used as tack coat will be paid for at the Contract unit price, per ton, for the item "Emulsified Asphalt for Tack Coat".

Payment will be payment in full for furnishing, mixing with water, and placing the materials, and for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for water added to dilute the Emulsified Asphalt used for tack coat after delivery from the asphalt supplier.

7

Specifications

00745.80 Measurement – The quantities of ACP will be measured on the weight basis, with separate measurement being made for the asphalt concrete mixture and the asphalt cement contained in the mixture. No deduction will be made for lime or any other additive used in the mixture.

8

Specifications

00745.90 Payment – The accepted quantities of ACP incorporated into the project, whether or not recycled materials are used, will be paid for at the Contract price, per unit of measurement, for the following items:

Pay Item

(a) Level (1,2,3,4), Size/type, admix, ACP, leveling and/or temporary ...ton

(b) grade Asphalt in type ACP … ton

9

Recalculate Quantities with Maximum Specific Gravity and Target Asphalt Content from JMF

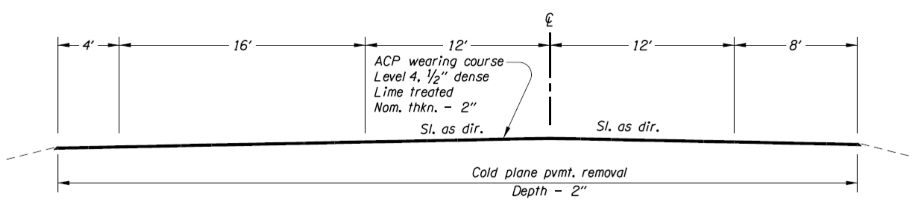
Conversion of Interest
1 Mile = 5280 ft

10

ACP Quantity Calculations Data Needs

- Surface Area (sq ft) for each lift from the plans
- Thickness (in) for each lift from the plans

11



MP 25.62 To MP 28.22

MP 25.62 to MP 28.22 = 2.6 miles

2.6 mi * 5,280 (ft/mi) = 13,728 feet

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ACP Quantity Calculations Data Needs

- Surface Area (sq ft) for each lift from the plans
- Thickness (in) for each lift from the plans
- Maximum Specific Gravity (Gmm) from the mix design

ODOT MATERIALS & INSPECTION QA

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OREGON DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
800 AIRPORT ROAD SE
SALEM, OR 97301-4798

503.986.3000
Fax: 503.986.3096

Contract No.: C14020 **EA:** CON02831 **F.A. No:** X-NH-S033(030) **Lab No.** 09-MD0052

Project Name:	US20: Newton Cr (Philomath) - OR99W (Corvallis)	**Amendment 1 Date:**	
Highway:	Corvallis-Lebanon Highway **County:** Benton	**Amendment 2 Date:**	
Begin MP:	51.31 **End MP:** 55.75	**Amendment 3 Date:**	
Contractor:	Morse Bros dba Knife River Ma		
Project Manager:	Cranston, Ray	**Use: Level** 3	1/2" Dense Mix **Lime** ☐

BITUMINOUS MIX DESIGN REVIEW

Lab Name:	Knife River	**Certified Mix Design Technician:**	Daniel Schnurbusch
Mix Producer:	Knife River Corp. - Corvallis	**Contractor Mix Design No.:**	5003-OCGM4T200B
Asphalt Supplier:	McCALL	**Transferred from Lab No.:**	08-MD0094
Asphalt Grade:	PG 70-22	**Antistrip Information:**	%
Gb (60°/60° F):	1.040		

This mix was originally designed with a PG 64-22 binder. Acceptable TSR's and a Rut Test were submitted with the PG 70-22 binder.

Stockpile Information

Stockpile Size	1/2" - #4	#4 - #8	#8 - 0	RAP			
Stockpile Source	22-001-2	22-001-2	22-001-2				
Stockpile Percentage	30.0	9.0	41.0	20.0	0.0	0.0	0.0
Bulk Specific Gravity (Gsb)	2.594	2.550	2.556	2.608	0.100	0.100	0.100

Job Mix Formula

Sieve	% Pass
3/4" (19mm)	100
1/2" (12.5mm)	98
3/8" (9.5mm)	85
1/4" (6.25mm)	65
No. 4 (4.75mm):	59
No. 8 (2.36mm):	41
No. 16 (1.18mm):	27
No. 30 (0.60mm):	17
No. 50 (0.30mm):	12
No. 100 (0.15mm):	9
No. 200 (0.075mm):	6.7

Paving Course	
Wearing	☑
Base	☑
Leveling	☑
Temporary	☐

% Asphalt by Wt. of Mixture (Pb): 6.1

Maximum Specific Gravity (Gmm): 2.417

VMA:	15.5	**VFA:**	74
Percent A/C in Rap:	5.4	**Combined Aggregate Gravity (Gsb):**	2.577
Number of Gyrations:	80	**Gmb Sample Weight:**	0
Void Target (Va):	4.0	**Mixing Temp Range:**	329-342 F
Tensile Strength Ratio:	104.7	**Placement Temp Range:**	306-315 F

Compliance Statement: Based on the information submitted for review, this mix design does comply with specifications.

Total Lab Charges: $0.00

Bruce M. Patterson P.E. 6-11-09

Reviewed by Signature **Date**

C: Files; FHWA; Project Manager; Dean Chess, Pavements; Bituminous; Region 2 QA Coor Morse Bros dba Knife River Ma
Materials Lab - Receiving; Larry Ilg, Pavements

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ACP Quantity Calculations

$$\text{Volume} = \text{Surface Area(sq ft)}\ x\ \text{Depth(ft)}$$

(Maximum Unit Weight)

$$\text{Mass (tons)} = \frac{(\text{Volume})(G_{mm})(62.4)}{2000}$$

Why would this tonnage be too high?

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ACP Quantity Calculations Data Needs

- Surface Area (sq ft) for each lift from the plans
- Thickness (ft) for each lift from the plans
- Maximum Specific Gravity (Gmm) from the mix design
- Minimum Compaction for each lift from the specifications

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ACP Quantity Calculations

$$\text{Estimated Quantity for a lift (tons)} =$$

$$\left(\frac{\%\ \text{Min Compaction} + 1\%}{100}\right)(\text{Mass})$$

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Example Quantity Calculation

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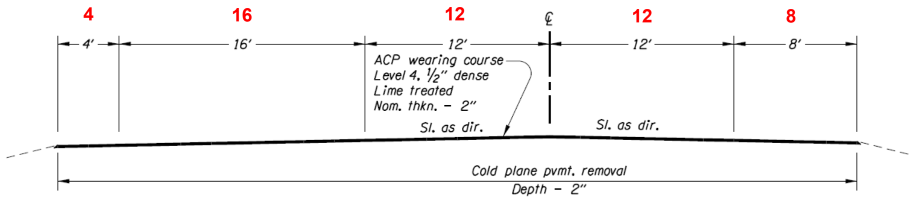

MP 25.62 To MP 28.22

MP 25.62 to MP 28.22 = 2.6 miles

2.6 mi * 5,280 (ft/mi) = 13,728 feet

4 + 16 + 12 + 12 + 8 = 52 feet

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Post Bid Volume Calculations

For the following calculations, use the cross section and mix design provided.

Length (miles) = **2.6** **W**idth (ft) **= 52**

Length (ft) = Length (miles) x 5280 ft/mile= **13,728**

Surface **A**rea (sq ft) **= L** x **W = 13,728 x 52.0 = 713,856**

Lift **T**hickness of ACP (in) **= 2.0**

Volume (cu ft) **= SA** x **T**/12 **= 713,856 x 2/12 = 118,976**

Full sheets are in the manual.

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Post Bid Mass Calculations

G_{mm} (Rice value) from JMF = 2.417

Min Compaction per Specification = 92%

Expected **C**ompaction = Min Compaction + 1% = 93%

Mix Unit **Wt.** (lbs/cu ft) = **Gmm** x 62.4 lbs/cu ft x Expected **C**ompaction/100 = 2.417 x 62.4 x 93/100 = 140.3

Est. Mix Quantity (tons) = **V** x **Mix Wt.**/2000 =

118,976 x 140.3/2000 = 8346.17

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ACP Quantity Calculations Data Needs

- Surface Area (sq ft) for each lift from the plans
- Thickness (ft) for each lift from the plans
- Maximum Specific Gravity (Gmm) from the mix design
- Minimum Compaction Spec for each lift
- Binder Content (%AC) from mix design

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OREGON DEPARTMENT OF TRANSPORTATION
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Tensile Strength Ratio:	104.7	**Placement Temp Range:**	306-315 F

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Total Lab Charges: $0.00

Bruce M. Patterson P.E. 6-11-09
Reviewed by Signature **Date**

C: Files; FHWA; Project Manager; Dean Chess, Pavements; Bituminous; Region 2 QA Coor Morse Bros dba Knife River Ma
Materials Lab - Receiving; Larry Ilg, Pavements

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Post Bid Asphalt Cement Calculations

% **A**sphalt **C**ement (from mix design) = 6.1

Total Estimated Mass of ACP(tons) = 8346.17

Tons of Asphalt Cement =**%AC**/100 x Mass of ACP=

6.1/100 X 8346.17 = 509.12 tons

ODOT MATERIALS & INSPECTION

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Quantity Calculations

Estimated Quantities

- Total Est. ACP Quantity = **8,346.17**
- Bid Tab Quantity for ACP = 8,550 tons

- Total Est. Asphalt Quantity = **509.12**
- Bid Tab Quantity for Binder = 480 tons

Est. ACP Quantity < Bid Tab Quantity — What now?

Est. Binder Quantity > Bid Tab Quantity — What now?

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Tracking Quantities and Yields During Production

- Weigh Memo Requirements
- Duties of Ticket Taker
  - **Must be safe**!!!!!!!!
  - Check quantities (yields) daily (minimum)
  - Required on all projects June 2012
  - Periodically during the day if safe
    - Early in the day is best

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ACP Yield Check

- Compare actual ACP placed versus expected ACP quantity from plans
- Obtain actual MAMD from Certified Density Technician (CDT)
- Calculate Moving Average Maximum Density (MAMD = Gmm x 62.4 lbs/cu ft)
- Obtain actual compaction (from CDT)

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Yield Check

$$\text{Expected Yield (tons)} = L \text{ x } W \text{ x } D \text{ x } MAMD \text{ x } \frac{C}{100} \text{ x } \frac{1}{2000}$$

Where:

- L = **L**ength (ft)   ➢ W = **W**idth (ft)
- D = **D**epth (ft)
- MAMD = **M**oving **A**verage **M**aximum **D**ensity (lb/cu ft)
- C = Actual Field **C**ompaction
- 100 = Conversion for %
- 2000 = Conversion factor from pounds to ton

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Oregon Department of Transportation

MATERIAL DELIVERY & YIELD CHECK SHEET

Page 1 of 4

PROJECT OR99W Repave — CONTRACT C99999

DATE 3/15/2021 — SOURCE ABC Paving

BID ITEM 700 — MATERIAL Level 4 - 1/2" ACP

MATERIAL DELIVERY

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS	(Width)
1	1002	26.15	91+65	7:21 PM	26.15	633	13'
2	1001	26.02	92+90	7:25 PM	52.17	634	
3	1003	29.93	94+15	7:30 PM	82.10	5114	
4	1004	25.42	95+70	7:44 PM	107.52	26	
5	1007	24.51	97+75	7:58 PM	132.03	631	13.5'
6	1008	26.04	99+00	8:05 PM	158.07	17	
7	1005	24.63	100+30	8:20 PM	182.70	2	
8	1009	24.69	101+80	8:48 PM	207.39	001	
9	1010	29.92	103+25	8:51 PM	237.31	4	
10	1011	25.44	104+30	8:59 PM	262.75	112	14'
	(A) Total	262.75					

10th Load placement ends at ~105+80

(B) THEORETICAL YIELD CALC: (Width x Length x (Depth/12) x (MAMD * %Comp./100) / 2000) = TONS

WIDTH (Ft)	LENGTH (Ft)	DEPTH (In)	MAMD	% COMPACTION	THEORETICAL TONS
13.5	1415	2	152.5	93.0%	*225.77*

(C) COMPARISON CALC: (A/B) X 100 **(D) % TOLERANCE CALC:** (100-C) (expected tolerance to be within +/- 10%)

Ten Load Yield (A)	262.75
Theoretical Tons (B)	*225.77*
Comparison (C)	**116.4%**
% Tolerance (D)	**-16.4%**

Does Not Meet Tolerance

*** Initial here if yield calculations are not applicable due to irregular areas or lack of consistent placement**

When +/- 10% tolerance is exceeded, verify Depth, Width, and Length, then MAMD and Compaction. Notify Contractor of unsatisfactory yield that needs adjustment. Continue checking yields.

DAILY THEORETICAL YIELD CALCULATION (expected tolerance to be within +/- 10%)
(Avg Width x Overall Length x (Depth/12) x (MAMD * Avg %Comp./100) / 2000) = TONS

WIDTH (Ft)	LENGTH (Ft)	DEPTH (In)	MAMD	% COMPACTION	THEORETICAL TONS	TOLERANCE
13.9	9880	2	152.5	93.0%	*1623.09*	*-13.7%*

Inspected by (Print Name) ____ Inspected by (Signature) ____ Date ____

OFFICE USE ONLY

Checked by (Print Name) ____ Checked by (Signature) ____ Date ____

Quantity This Note ____ Pay Unit ____ ☐ Quality Checked

Estimate Number ____ Note No. ____ ☐ Quantity Checked

734-2792 (06-2024)

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MATERIAL DELIVERY

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS	(Width)
1	1002	26.15	91+65	7:21 PM	26.15	633	13'
2	1001	26.02	92+90	7:25 PM	52.17	634	
3	1003	29.93	94+15	7:30 PM	82.10	5114	
4	1004	25.42	95+70	7:44 PM	107.52	26	
5	1007	24.51	97+75	7:58 PM	132.03	631	13.5'
6	1008	26.04	99+00	8:05 PM	158.07	17	
7	1005	24.63	100+30	8:20 PM	182.70	2	
8	1009	24.69	101+80	8:48 PM	207.39	001	
9	1010	29.92	103+25	8:51 PM	237.31	4	
10	1011	25.44	104+30	8:59 PM	262.75	112	14'
	(A) Total	262.75					

10th Load placement ends at ~105+80

(B) THEORETICAL YIELD CALC: (Width x Length x (Depth/12) x (MAMD * %Comp./100) / 2000) = TONS

WIDTH (Ft)	LENGTH (Ft)	DEPTH (In)	MAMD	% COMPACTION	THEORETICAL TONS
13.5	1415	2	152.5	93.0%	*225.77*

(C) COMPARISON CALC: (A/B) X 100 **(D) % TOLERANCE CALC:** (100-C) (expected tolerance to be within +/- 10%)

Ten Load Yield (A)	262.75
Theoretical Tons (B)	*225.77*
Comparison (C)	**116.4%**
% Tolerance (D)	**-16.4%**

Does Not Meet Tolerance

*** Initial here if yield calculations are not applicable due to irregular areas or lack of consistent placement**

When +/- 10% tolerance is exceeded, verify Depth, Width, and Length, then MAMD and Compaction. Notify Contractor of unsatisfactory yield that needs adjustment. Continue checking yields.

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(C) COMPARISON CALC: (A/B) X 100 (D) % TOLERANCE CALC: (100-C) (expected tolerance to be within +/- 10%)

Ten Load Yield (A)	262.75
Theoretical Tons (B)	225.77
Comparison (C)	116.4%
% Tolerance (D)	-16.4%

Does Not Meet Tolerance

* Initial here if yield calculations are not applicable due to irregular areas or lack of consistent placement

When +/- 10% tolerance is exceeded, verify Depth, Width, and Length, then MAMD and Compaction. Notify Contractor of unsatisfactory yield that needs adjustment. Continue checking yields.

DAILY THEORETICAL YIELD CALCULATION (expected tolerance to be within +/- 10%)

(Avg Width x Overall Length x (Depth/12) x (MAMD * Avg %Comp./100) / 2000) = TONS

WIDTH (Ft)	LENGTH (Ft)	DEPTH (In)	MAMD	% COMPACTION	THEORETICAL TONS	TOLERANCE
13.9	9880	2	152.5	93.0%	1623.09	-13.7%

Inspected by (Print Name) Inspected by (Signature) Date

OFFICE USE ONLY

Checked by (Print Name) Checked by (Signature) Date

Quantity This Note ______ Pay Unit ______ ☐ Quality Checked

Estimate Number ______ Note No. ______ ☐ Quantity Checked

734-2792 (06-2024)

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Oregon Department of Transportation

MATERIAL DELIVERY & YIELD CHECK SHEET

Page 2 of 4

PROJECT OR99W Repave CONTRACT C99999

DATE 3/15/2021 SOURCE ABC Paving

BID ITEM 700 MATERIAL Level 4 - 1/2" ACP

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS	(Width)
11	1012	26.08	105+80	9:03 PM	288.83	632	14'
12	1013	26.14	107+00	9:10 PM	314.97	633	
13	1014	26.12	108+52	9:13 PM	341.09	634	
14	1015	25.64	109+60	9:17 PM	366.73	625	
15	1017	25.45	110+90	9:25 PM	392.18	26	
16	1016	24.89	112+35	9:30 PM	417.07	626	
17	1018	29.32	113+50	9:35 PM	446.39	5114	14'
18	1019	23.17	115+00	9:44 PM	469.56	21	
19	1020	24.76	116+20	9:47 PM	494.32	631	
20	1021	26.11	117+19	9:52 PM	520.43	17	14'
	Subtotal	257.68		Running Total	520.43		

Yield	Width	Length	Depth	MAMD	% Comp	Theoretical Tons	Tolerance
10-Load	14	1280	2	152.5	93.0%	211.79	-21.67%
Running	13.75	2695	2	152.5	93.0%	437.96	-18.83%

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Check Weights

00190.20(f) Contractor-Provided Weigh Technician – The Contractor shall provide a technician to operate Contractor-provided vehicle weigh scales. The Agency may observe procedures and require check weighing according to the following:

(1) Scale with Automatic Printer – If the scales have an automatic weigh memo printer or an approved electronic weigh memo system that does not require manual entry of gross weight information, the Agency may periodically have a representative at the scales to observe the weighing procedures. In addition, the Engineer may periodically check the weight for a load of Materials by directing the haul vehicle to reweigh on a different scale that has been inspected and certified according to 00190.20(b) and 00190.20(d).

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Check Weights

00190.20(f) If a different scale is not available within a 30-mile round trip from the regular haul route, the Agency will allow check weighing on an approved alternate basis. Check weights within 0.4% of the Contractor-provided weight are acceptable.

The Engineer will resolve discrepancies found by check weighing. Agency employee costs will be paid by the Agency. The Contractor shall pay all other costs resulting from the check weighings, including, without limitation, the use of other scales.

When 2,000 tons or less of all types of Materials are received from a scale, check weighing will be at the discretion of the Engineer.

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Check Weights

The Contractor shall make at least one check weighing on projects where more than 2,000 Tons of all types of Materials are received from a scale. If more than 50 Tons per Day of all types of Materials are received from a scale, the Contractor shall make random check weighings at least once every ten Days on which more than 50 Tons is received or at each interval that 10,000 Tons has been weighed, whichever occurs first, or as directed by the Engineer. The check weighing frequency does not apply to total quantities less than 2,000 Tons of all types of Materials from a scale. The Contractor shall provide the Engineer with the results of the check weighing.

ODOT MATERIALS & INSPECTION

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Construction Manual Requirements for Weigh Memos and Receipt of Material on the Project

Located in Chapter 12-D of the Construction Manual

ODOT MATERIALS & INSPECTION

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Check Weights

Perform check weighing as required, and at the frequency specified, in Section 00190.20(f). Record the results of the check weighing and the comparison in the scale diary, as indicated in the example below.

Check Weighing Example

	Project or Contractor Scale	Check Scale
Gross	35.84	35.94

$$\frac{(35.84 - 35.94) \times 100}{35.84} = -0.3 \text{ percent difference}$$

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Check Weight Example

- Contractor Scale Gross Weight = 42.54
- Check Scale Gross Weight = 42.97

  % Difference = (42.54-42.97)/42.54 x 100

  % Difference = -1.0%

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Check Weight Example

- Action to be taken??
- Per Construction Manual:
  - Immediately order the scale operation to be corrected and
  - Determine which weigh memos were impacted by the incorrect scale and resolve that information

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Post Bid Volume Calculations

For the following calculations, use the cross section and mix design provided.

Length (miles) = __________ **W**idth (ft) **= ______________________**

Length (ft) = Length (miles) x 5280 ft/mile= **_____________________**

Surface **A**rea (sq ft) **= L** x **W = _____________________________________**

Lift **T**hickness of ACP (in) **= __________**

Volume (cu ft) **= SA** x **T/**12 **= ____________________________________**

Full sheets are in the manual.

ODOT MATERIALS & INSPECTION

Post Bid Mass Calculations

G$_{mm}$ (Rice value) from JMF = ________________________

Min Compaction per Specification = ____________________

Expected **C**ompaction = Min Compaction + 1% = _______

Mix Unit **Wt.** (lbs/cu ft) = **Gmm** x 62.4 lbs/cu ft x Expected **C**ompaction/100 = ____________________________

Est. Mix Quantity (tons) = **V** x **Mix Wt.**/2000 =

____

ODOT MATERIALS & INSPECTION

Post Bid Asphalt Cement Calculations

% **A**sphalt **C**ement (from mix design) = _____________

Total Estimated Mass of ACP(tons) = _____________

Tons of Asphalt Cement =**%AC**/100 x Mass of ACP=

____tons

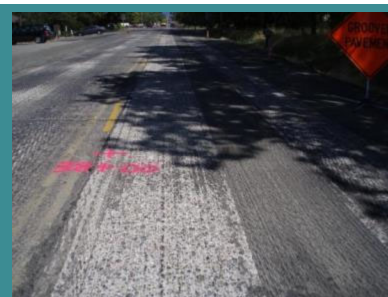
ODOT MATERIALS & INSPECTION

INSERT TAB

Surface Preparation

Surface Preparation

Module 4



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Surface Preparation

- Pre-overlay repairs
- Milling operations
- Leveling courses
- Tacking

2

Pre-Overlay Repairs

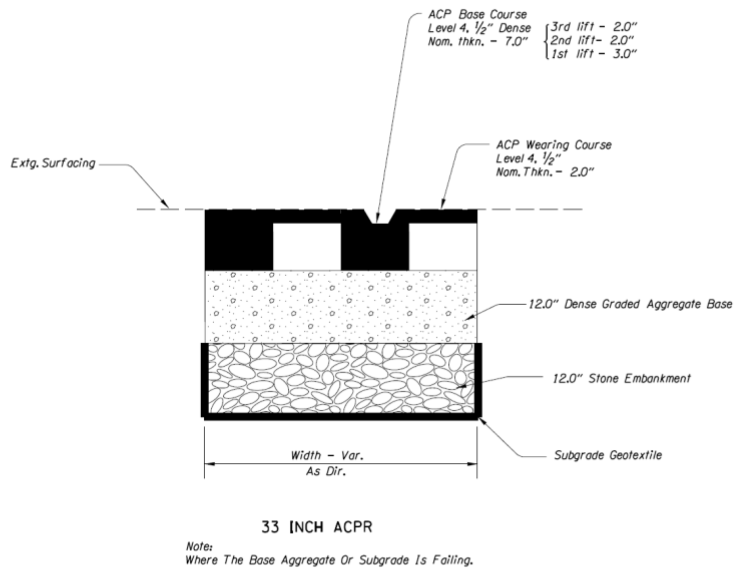
Asphalt Concrete Pavement Repair
Section 00748

- Necessary to repair failed areas of the pavement prior to overlay
- Get assistance from pavement designer to lay out areas

3

4

Full Depth Repairs



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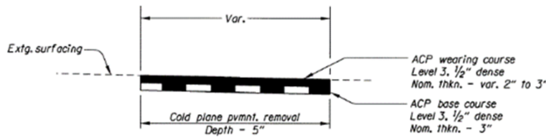
Partial Depth Repairs

STATION	LANE	LENGTH (FT)	WIDTH (FT)
174+60	EB TRUCK	150	12
196+80	EB TRUCK	225	12
201+00	EB TRUCK	50	12
302+40	WB TRUCK	100	12
314+50	EB TRUCK	100	12
342+00	WB TRUCK	200	12
345+70	WB TRUCK	100	12
354+10	WB TRUCK	150	12

Stations shown are approximate. Final repair locations, lengths, and widths will be determined in the field.



(Location as directed)

5″ ASPH. CONC. PAVEMENT REPAIR

7

Asphalt Concrete
Pavement Repair

- **00748.00 Scope** – This Work consists of excavating and removing existing asphalt concrete surfaces, Aggregate bases, and Aggregate Subbases and constructing new Subbases, bases, and asphalt concrete surfaces to the lines and grades shown or directed.
- **00748.16 Acceptance of Material** – All material will be accepted by visual inspection by the Engineer. The Engineer may perform tests to verify that the materials meet the appropriate Specifications.

ODOT MATERIALS & INSPECTION

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Asphalt Concrete
Pavement Repair

00748.80 Measurement – The quantities of asphalt concrete Pavement repair will be measured on the area basis, of surfacing area repaired to the full depth as shown. The Surfacing area will be determined by horizontal measurements. In areas where directed to repair to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

EAC and ACP will be measured according to 00735.80, 00744.80 or 00745.80 as applicable.

ODOT MATERIALS & INSPECTION

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Asphalt Concrete
Pavement Repair

ACP Compaction

00749.45 Compacting Asphalt Concrete – Compact asphalt concrete according to the following or as directed:

- Compaction to a specified density will not be required, regardless of thickness. Perform breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.

ODOT MATERIALS & INSPECTION

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Asphalt Concrete
Pavement Repair (continued)

ACP Compaction

00749.45 Compacting Asphalt Concrete – Compact asphalt concrete according to the following or as directed:

- Along curbs and walls, on walks, irregular areas, and other areas not practically accessible to rollers conforming to 00744.24 or 00745.24, compact the mixture with small, self-propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

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Asphalt Concrete Pavement Repair

How thick can we place ACP?

- 4" max in most cases
- 6" ok if 10 ton+ vibratory rollers can be used (set amplitude to high)

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Milling Operations

Purpose

- Eliminate cracking
- Eliminate ruts
- Eliminate poor quality materials
- Account for finish grade limitations
    - Curb exposure
    - Bridge clearances

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Milling Operations

00620.20 Equipment – Provide self-propelled planing machines or grinders:

- Capable of loosening Pavement material
- Capable of accurately establishing profile grades within a tolerance of 0.02 foot by reference from either the existing Pavement or from independent grade control
- With a positive means for controlling cross-slope elevations
- With a totally enclosed cutting drum with replaceable cutting teeth
- With an effective means of removing loosened material from the surface and preventing dust from escaping into the air
- Capable of providing a true cross-slope grade that will allow placement of overlay Pavement to a uniform thickness

ODOT MATERIALS & INSPECTION

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Milling Operations

- **00620.41 Surface Tolerance** – Test with a 12-foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.
- **00620.80 Measurement** – The quantities of cold plane Pavement removal will be measured on the area basis, in place. When the depth of Pavement to be removed is variable, the depth as shown is an estimate and is approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

ODOT MATERIALS & INSPECTION

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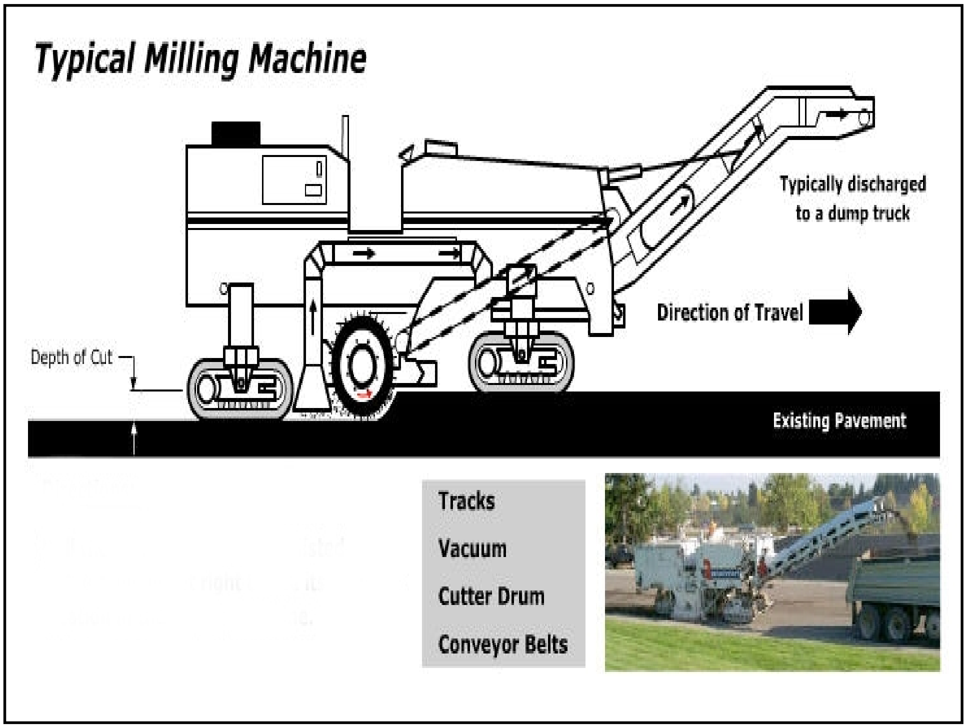
Typical Milling Machine
Typically discharged to a dump truck
Direction of Travel
Depth of Cut
Existing Pavement
Tracks
Vacuum
Cutter Drum
Conveyor Belts

25


040424

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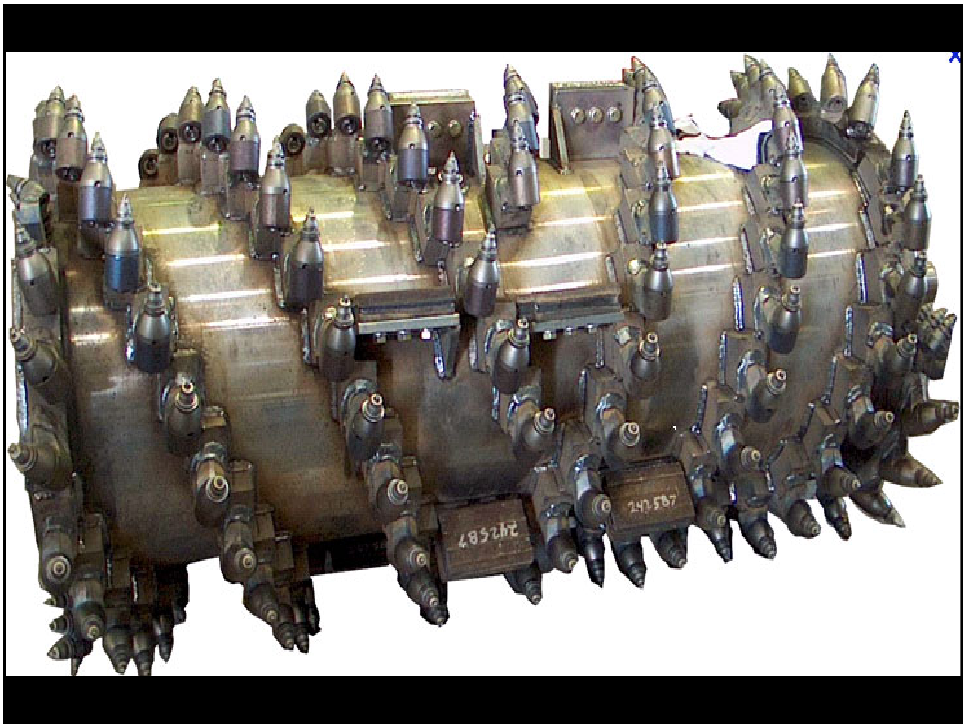

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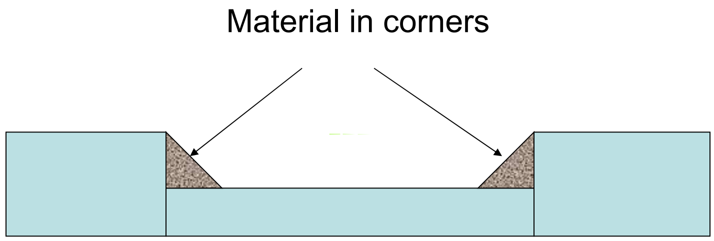
Milling Operations
Problem Area for Cleaning Inlays



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34

Milling Operations
Inspection Checks

- Proper location
- Proper depth (uniform across width?)
- Proper slope
- Properly cleaned
- Need to go deeper?
- Measure area
- Others?

ODOT MATERIALS & INSPECTION

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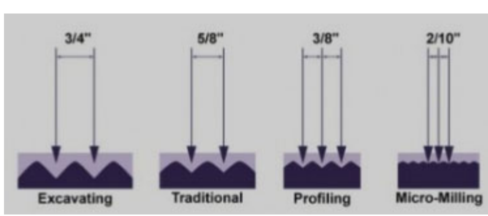
Fine Tooth Milling

What is fine tooth milling?

- Regular / standard spacing is 5/8″
- Fine milling (profiling) spacing at ODOT is 5/16″ down to micro milling.



ODOT MATERIALS & INSPECTION

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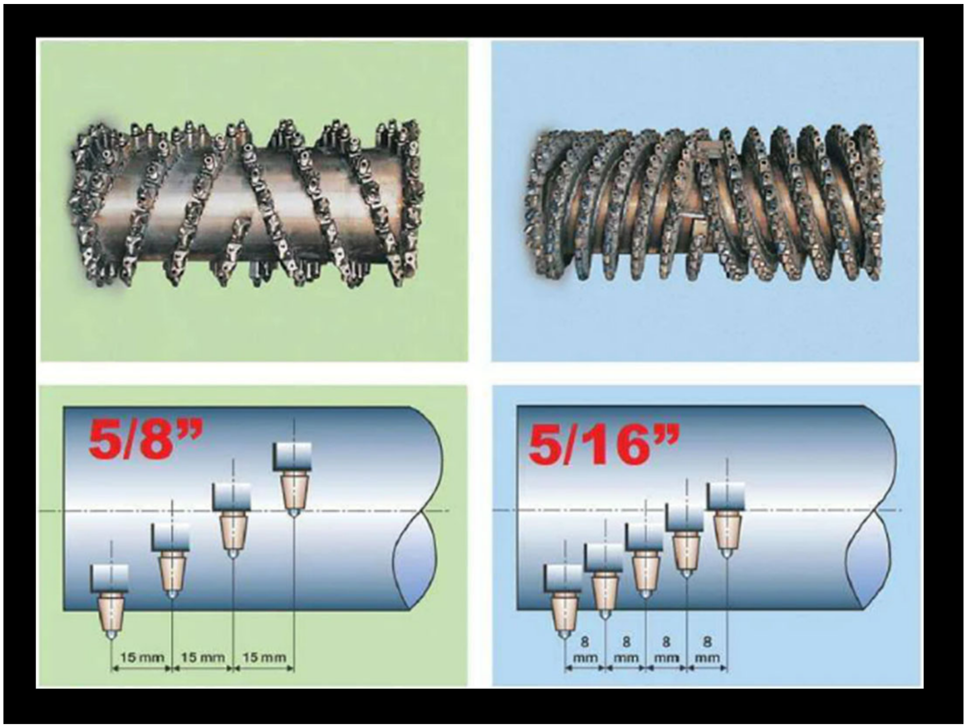

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Fine Tooth Milling

Some reasons for use of finer mills?

- Less damage to moisture sensitive AC base to remain in place (We/I think).
- For thin lift, paving the ridges is less likely to reflect into the surface.
- May promote a smoother surface (SLOW DOWN!).
- Promotes bonding of thin lift pavements.

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Fine Tooth Milling

Look for it in the Special Provisions under 620.20

00620.20 Equipment - Add the following bullet:

- For cold plane pavement removal between M.P. 9.65 and 13.03, provide a rotomill grinder using carbide cutting tools in a rotary drum with tooth spacing of not more than 5/16 inch, capable of leaving a smooth, uniform pattern of striations. Operate below a maximum forward speed of 60 feet per minute.

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General Cleaning for Overlays

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Leveling

Purpose

- Fill in ruts
- Restore proper x-slope
- Restore reasonable profile grade

ODOT MATERIALS & INSPECTION

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Leveling
Relevant 00745 Specs

00745.46(c) When Leveling irregular surfaces and raising low areas, do not exceed 2 inches actual compacted thickness of any one Lift, except the actual compacted thickness of intermittent areas of 1,000 square feet or less may exceed 2 inches, but not more than 4 inches. This may require portions of the mixture to be laid in two or more Lifts.

00745.49(c) Thin Pavement – Compaction to a specified density will not be required for Leveling, patches, or where the nominal compacted thickness of a Course of ACP will be less than 2 inches. Perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.

A pneumatic roller is recommended for leveling if there is enough thickness and length to keep too much material from being picked up.

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Tack

Purpose

- To ensure adequate bond between lifts of ACP
- Think of ACP as a laminated beam…if we don't glue the individual boards together, the pavement structure will not be as strong. (flat bottomed potholes)

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Tack

When is it ok not to Tack??

- ~~Second lift paved same day as first.~~
  ~~ok not to tack for second lift if no dirt tracked onto pavement by trucks~~
- All other circumstances – tack it!!!!!!!
- If in doubt…tack it!!!!!!!!!!

Section 00745.42 Preparation of Underlying Surfaces (4th ¶)
"Treat all paved surfaces on and against which ACP is to be placed with an asphalt tack coat, according to Section 00730."

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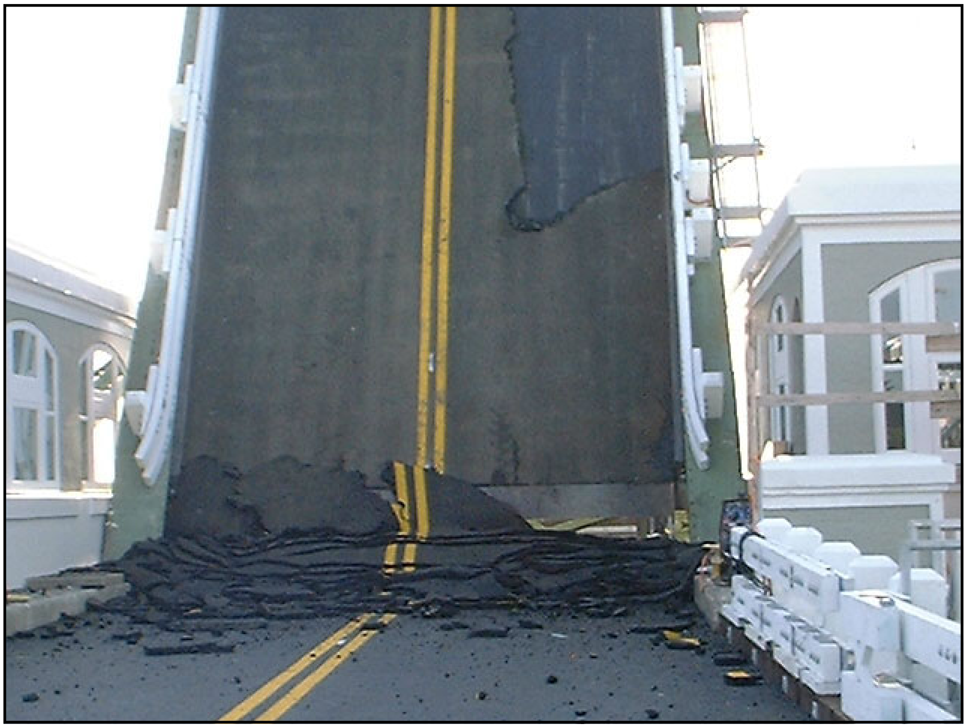

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Distributor Requirements

00730.22 Asphalt Distributor – Provide an asphalt distributor designed, equipped, maintained and operated so the Emulsified Asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. **Provide distributor Equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.**

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Distributor Requirements

Checking for Triple Lap Coverage

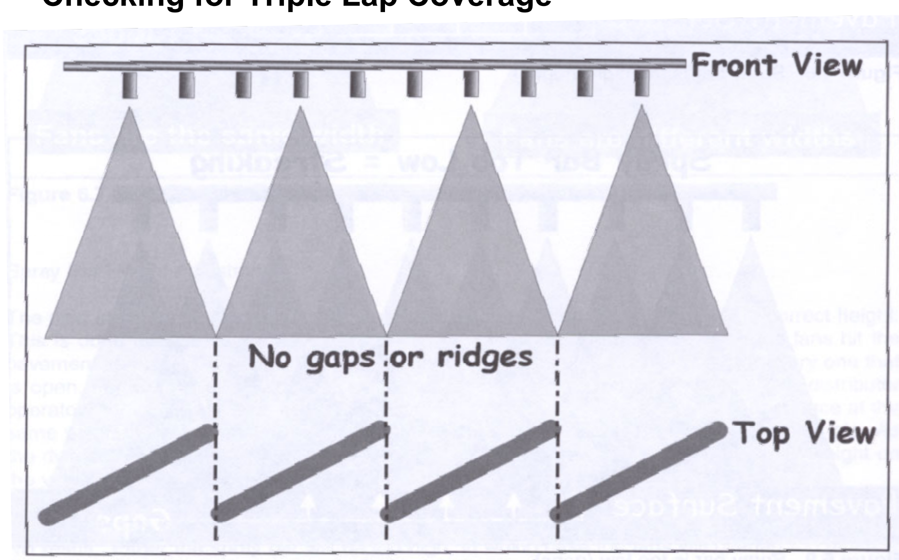

Figure 6.10. Spray bar height test for a triple lap seal

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Bar Height

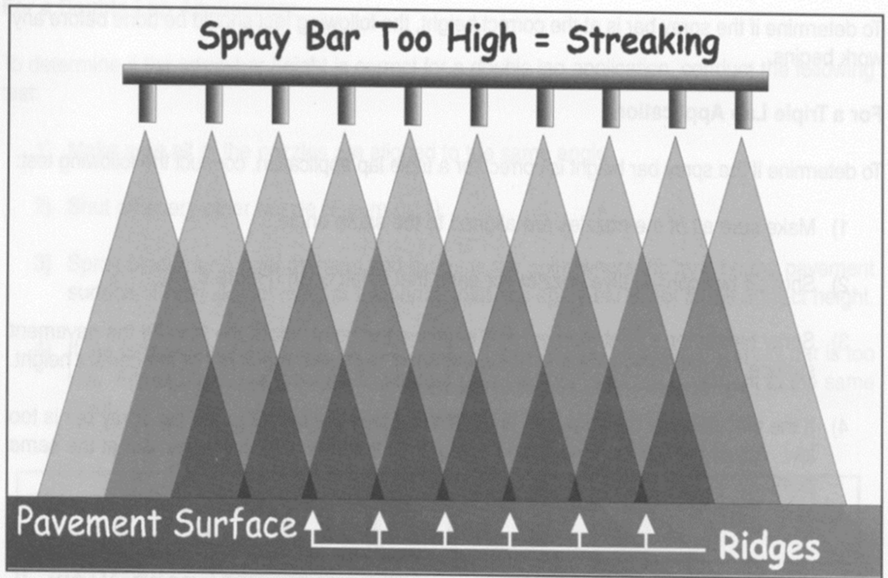

Figure 6.8. Spray bar is too high (ridges)

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Bar Height

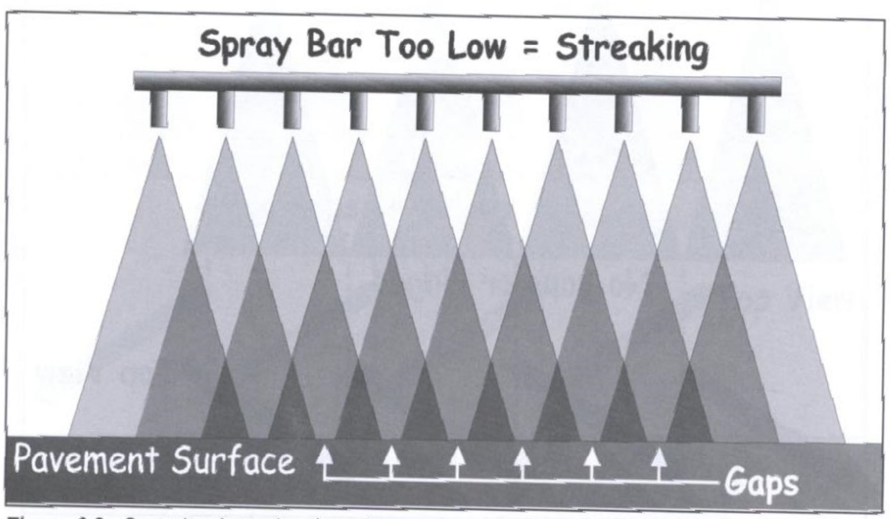

Figure 6.9. Spray bar is too low (gaps)

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Distributor Requirements
Typical Problems

- Emulsion too cold
- Plugged snivies
- Insufficient pump pressure
- Bar Height incorrect

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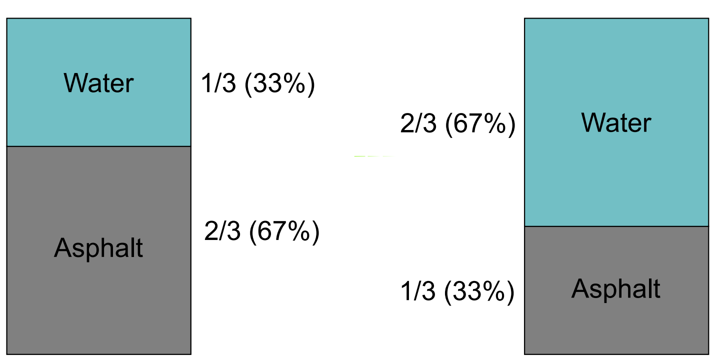
Tack
What is it??

As manufactured

Diluted 50/50



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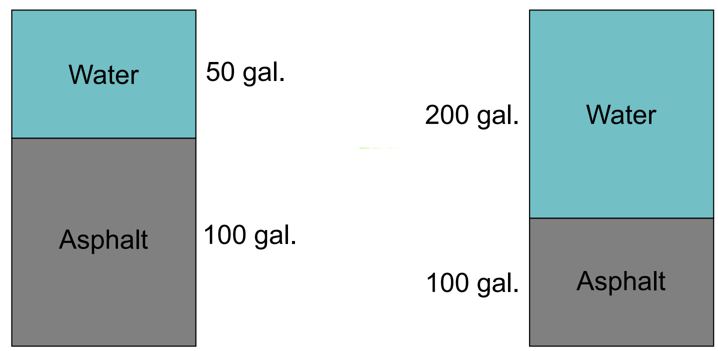
Tack
What is it??

As manufactured

Diluted 50/50



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Diluting Tack

Advantages
- More uniform spread for the small application rates for tacking
- Less plugged “snivies”

Disadvantages
- Pain to track quantity
- Longer to “break” (more water to evaporate)

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Tack
Spread Rates

- Need 0.04 to 0.06 gal/sq yd RESIDUAL asphalt for most surfaces
- May need up to 0.08 gal/sq yd RESIDUAL asphalt for milled or open/dry surfaces

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Tack
Spread Rate Problems

Given: Contractor is applying undiluted tack (i.e., 2/3 or 67% (.67) asphalt, 1/3 or 33% (.33) water)

What should the application rate be to wind up with a residual asphalt application of 0.04 gal/sq yd?

Residual rate = % asphalt x application rate

0.04/0.67 = **0.06**

Application rate = **0.06 gal/yd^2**

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Tack
Spread Rate Problems

Given: Contractor is applying 50/50 diluted tack (i.e., 1/3 or 33% (.33) asphalt, 2/3 or 67% (.67) water).

What should the application rate be to wind up with a residual asphalt application of 0.04 gal/sq yd?

Residual rate = % asphalt x application rate

0.04/0.33 = **0.12**

Application rate = **0.12 gal/yd^2**

ODOT MATERIALS & INSPECTION

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Tack
Calculating Spread Rate

- Calculate surface area covered (sq yds)
- (Distance(ft) x Width(ft)) / 9(sq ft/sq yd)
- Gallons used (from distributor readout)
- Spread Rate = Gallons Used / Surface Area

ODOT MATERIALS & INSPECTION

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Tack
Calculating Spread Rate Problem

Length(ft) = 8000 ft

Width(ft) = 12 ft

Gallons used = 514

Surface Area (sq yd) = (L x W)/9 =

= (8000’ x 12’)/9 = **$10{,}667\ yd^2$**

Spread Rate = Gallons/Surface Area =

= 514 gal. / 10,667 yd^2 = **$0.05\ gal/yd^2$**

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Tack
Determining Quantity for Payment

- Payment by ton for UNDILUTED tack
- Weigh distributor across certified platform scale at the start of the day and at the end of the day
- Weigh distributor across certified platform scale at the start of the project, add deliveries throughout project, and weigh again at the end of the project
- If the tack is diluted 50/50, divide the weight used by 2

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Tack
Acceptance Testing

- 1 sample per 50 tons used
- Contractor should take sample
- Sample must be undiluted otherwise it will fail
- Samples must be obtained in plastic jars (the emulsion will react with metal cans)
- Samples must be tested within 30 days of the date sampled

ODOT MATERIALS & INSPECTION

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Tack
Does it need to be broke?

- Tack is “broke” when its color turns from brown to black
- Prefer totally broken tack – excess moisture is always a consideration
- Europeans routinely pave over unbroken tack with no reported performance problems
- New Hot Mix Asphalt Handbook says it’s ok to pave on unbroken tack
- Probably ok if not pools of unbroken emulsion

ODOT MATERIALS & INSPECTION

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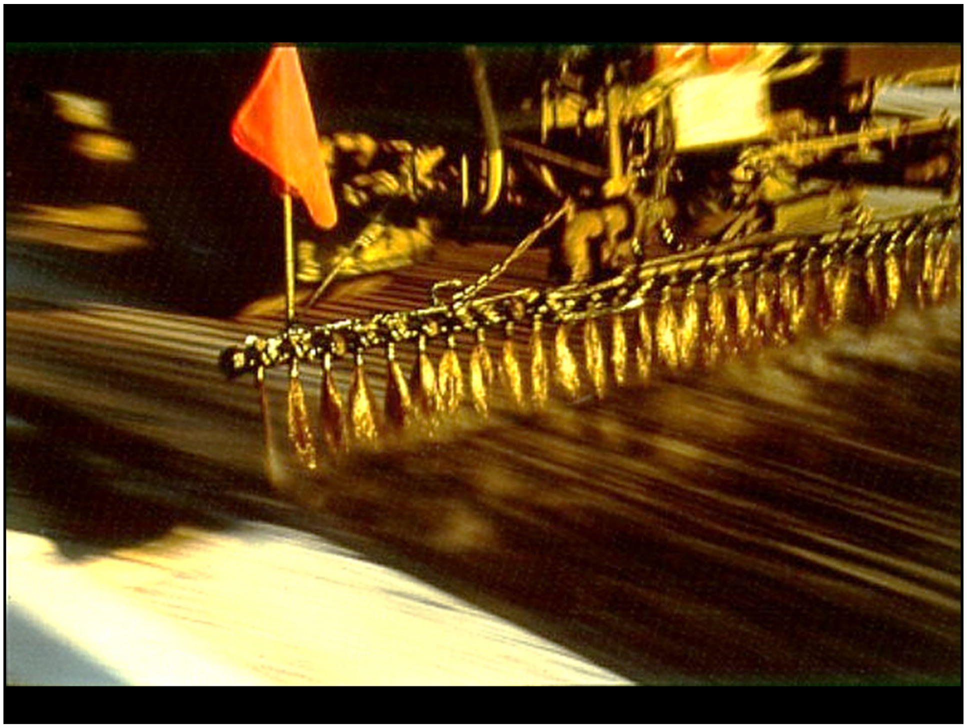

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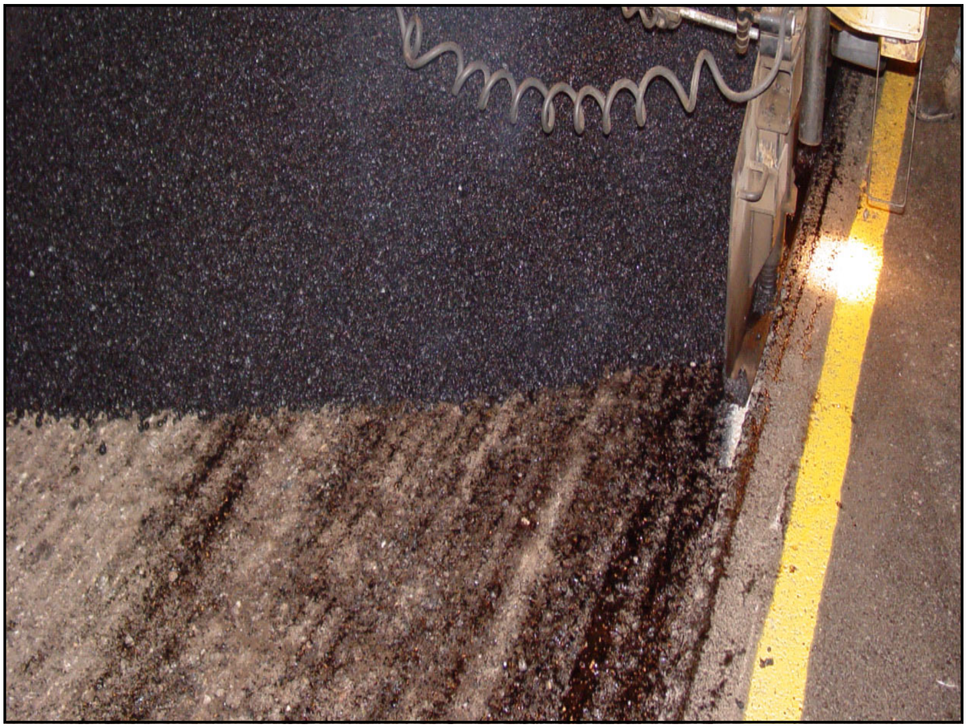

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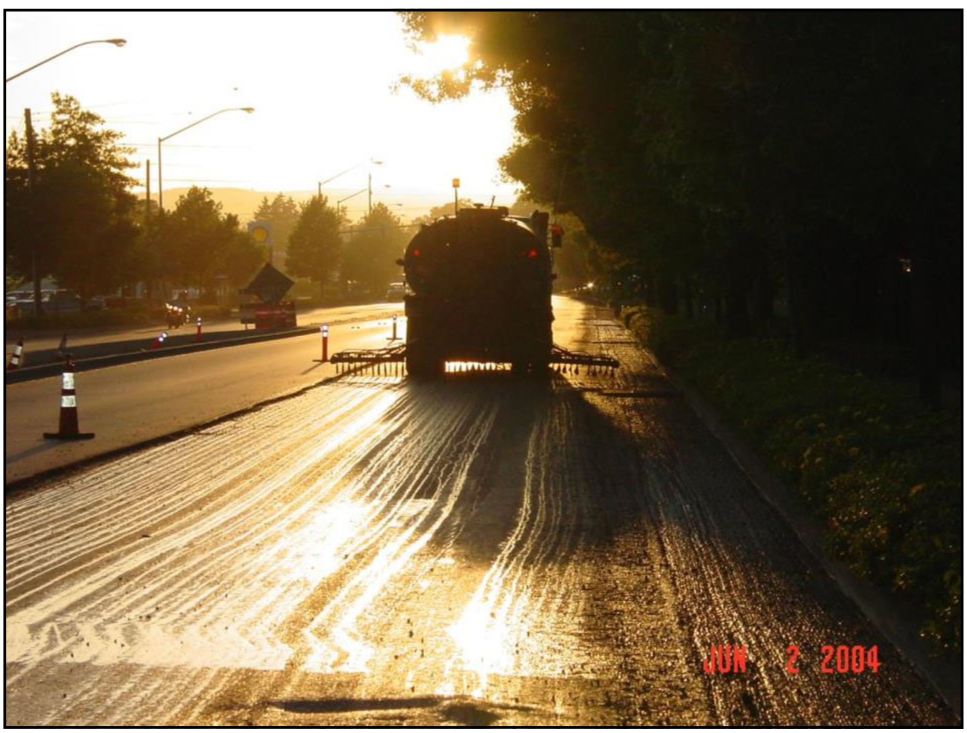

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Tack
Cold Weather Considerations

- See if supplier can provide warmer material
- Consider switching from CSS-1(h) to a CRS-1 or CRS-2. The latter are designed to break quicker and are allowed options in 00730.11.
- Consider paving grade “hot” tack
  - Difficult to shoot uniformly at very small application rates
  - Requires larger “snivies”

ODOT MATERIALS & INSPECTION

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ODOT MATERIALS & INSPECTION

Spec Notes
& Best Practices

June 2015 Number 4

00730 Emulsified Asphalt Tack Coat

Tack Bonding

Ultimate Goal – To produce uniform, complete, and adequate tack coverage to bond asphalt pavements to better resist shear stresses.

Section 00730.11 – Dilution of tack coat material (adding additional water) may be allowed up to a maximum 1:1 ratio with Engineer approval.

Bonded Demonstration

Poorly Bonded Asphalt Pavements
- Reduce fatigue life
- 10% bond loss = approximate 50% less fatigue life
- No bond = approximate 60 to 75% loss of pavement life
- Increase slippage and shoving
- Can be difficult to compact

Resources
- 2015 Oregon Standard Specifications for Construction
- ODOT HMAC Inspector Certification Manual http://www.oregon.gov/ODOT/HWY/
- Best Practices for Emulsion Tack Coats, NAPA 2013

Technical Contact
Larry Ilg, Pavement Quality & Materials Engineer
503-986-3072
larry.d.ilg@odot.state.or.us

Recommended Application Rates Using Asphalt Emulsions (gallons/square yard)			
Condition of Existing Surface	Undiluted Residual Rate (asphalt only in tack)	Undiluted Shot Rate (asphalt and water in tack)	1:1 Diluted Shot Rate (additional water)
New Asphalt (Multilayer)*	0.03 to 0.04	0.04 to 0.06	0.09 to 0.12
Old Asphalt (Overlay)	0.04 to 0.06	0.06 to 0.09	0.12 to 0.18
Milled Asphalt (Inlay)	0.04 to 0.08	0.06 to 0.12	0.12 to 0.18
Portland cement concrete	0.04 to 0.06	0.06 to 0.09	0.12 to 0.18

*If tack coat is applied to newly paved ACP surface the residual rate may be reduced to 0.02 gallons/square yard.

Application Rate Multiplication Factors**	
Type of Tack Coat Material	Multiplier Factor (to maintain residual asphalt)
Asphalt Binder (Hot Tack)	1.0
Undiluted Asphalt Emulsion	1.5
1:1 Diluted Asphalt Emulsion	3.0

** The application rate for diluted asphalt emulsions needs to be adjusted to maintain the same residual rate of tack

Tack Dilution Advantages and Disadvantages

Advantage
- Easier to provide a uniform coverage
- Less Likely to plug nozzles
- Diluted tack may track less

Disadvantages
- May take longer for tack to break (water and asphalt separate)
- May be prone to run-off
- Difficult to measure and confirm rate
  - May need ODOT lab test for dilution rate
- Difficult to calculate undiluted asphalt emulsion for payment

Distributor Checklist
- Adequate distributor pressure for even tack flow
- Application rate (calculate for proper residual rate)
- Temperature of emulsion
  - Asphalt emulsions typically 130° to 160° F
  - PG type asphalt binder typically 350° to 400° F
- Bar height (ensure triple coverage)
- Correctly sized nozzle clean and free-flowing
- Nozzle angle setting 15 to 30 degrees

Continued on back

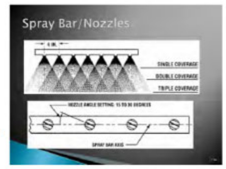
Controls to Minimize Tracking of Emulsified Tack
- Minimize construction vehicle traffic especially when tack is breaking
- Prior to tack application, make sure all surfaces are clean especially with grinding operations
- Apply evenly across surface
- Dilute asphalt emulsions
- Use alternate approved asphalt emulsion (CSS-1H)
- Contact the asphalt emulsion supplier for other methods

Asphalt Emulsion (Tack) Breaking and Setting
- Look for the color to change: brown to black
- Supplier can adjust tack formulation to increase/decrease set time if needed
- Variables that may affect break time
  - Weather (damp weather will delay set time)
  - Uniformity of tack coat (pooled tack will set slower)
  - Type of tack (softer tacks will set slower)
  - Initial temperature of tack (lower tack temperature will delay set time)
  - Ambient temperature (cooler temperatures will delay set time)

Sampling and Handling of Asphalt Emulsions
- Sample **undiluted** asphalt emulsions
- Use non-metallic containers for the sample storage
- Keep sample out of direct sunlight
- Do not excessively jostle or disturb sample
- Deliver to the ODOT materials laboratory as soon as possible
- Material should be tested within 30 days of sampling

Spec Notes are prepared for inspectors by the Construction Quality Assurance Unit to provide background information around design elements and specifications. For additional Spec Notes, visit us at http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/Pages/QAIndex.aspx.

If you have an idea for a Spec Notes topic, please e-mail us at ODOTConstructionTraining@odot.state.or.us or contact us at 503.986.5453.



Construction vehicle traffic on tack
- Minimize construction vehicle traffic as much as possible.
- Stagger vehicle traffic to minimize tack pick up
- Best to allow tack to set completely (all water evaporated) before allowing construction vehicle traffic on tack
- May allow construction vehicle traffic on fresh non-breaking tack coat though equipment may have slippage or traction issues
- Avoid all traffic while tack is breaking or in a flocculant state where the water is evaporating away from the asphalt

Tack Yield Calculations
Multiply shot rate (gals/yd^2) by binder ratio (typically 2/3 or 1/3) to get residual rate

Mass Method (recommended for full load applications)
Length X Width (feet) of area covered = Area
Net weight of tack used X Gallon conversion[1] = Gallons
Gallons ÷ Area ÷ 9 (convert to square yards) = gals/yd^2

[1]*gallon conversion on tack bill of lading*

Volume Method
Length X Width (feet) of area covered = Area
Gallons of tack applied X 60° F conversion Factor[2] = Gallons
Gallons ÷ Area ÷ 9 (convert to square yards) = gals/yd^2

[2]*see attached temperature volume correction chart for multiplier*

Temperature Volume Correction for Emulsified Asphalt[3]

125	0.98375	130	0.98125
135	0.98125	140	0.98000
145	0.97875	150	0.97750
155	0.97625	160	0.97500
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175	0.97125	180	0.97100
185	0.96875		

[3]*Interpolate correction values for temperatures not shown*

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ODOT MATERIALS & INSPECTION

Spec Notes
& Best Practices

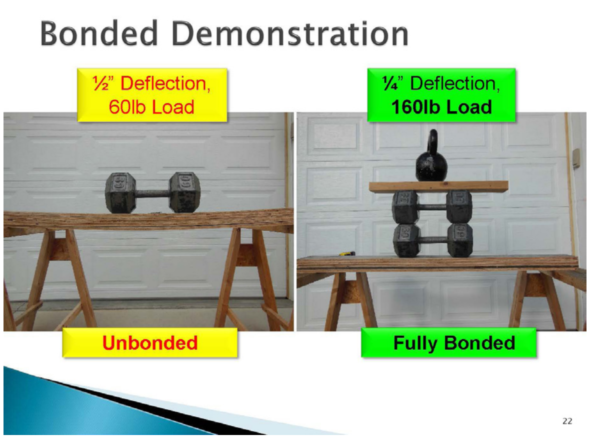
February 1, 2024 Number 4

00730 Emulsified Asphalt Tack Coat

Tack Bonding

Ultimate Goal – To produce uniform, complete, and adequate tack coverage to bond asphalt pavements to better resist shear stresses.

Section 00730.11 – Dilution of tack coat material (adding additional water) may be allowed up to a maximum 1:1 ratio with Engineer approval.



Poorly Bonded Asphalt Pavements

- Reduce fatigue life
- 10% bond loss = approximate 50% less fatigue life
- No bond = approximate 60 to 75% loss of pavement life
- Increase slippage and shoving
- Can be difficult to compact

Resources

- 2024 Oregon Standard Specifications for Construction
- ODOT HMAC Inspector Certification Manual http://www.oregon.gov/ODOT/HWY/
- Best Practices for Emulsion Tack Coats, NAPA 2013

Technical Contact

Chris Duman Pavement Quality & Materials Engineer 503-559-4994
christopher.l.duman@odot.oregon.gov

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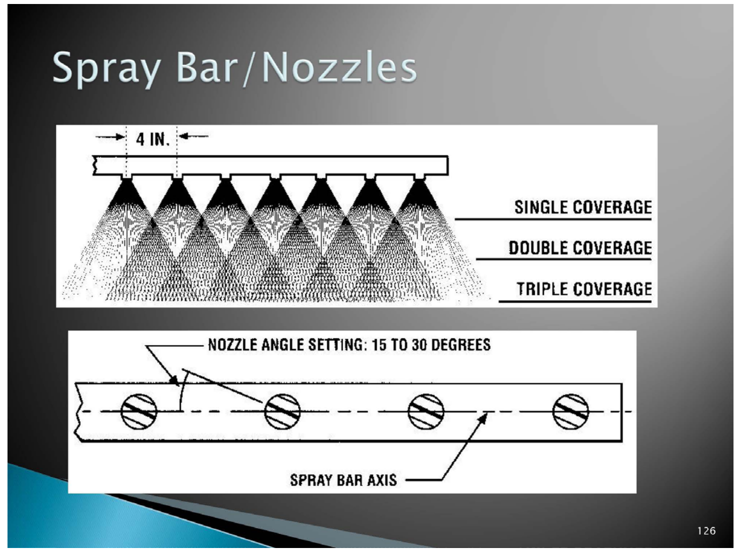

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ODOT MATERIALS & INSPECTION
SPEC Notes
February 1, 2024 Volume 1, Number 2

Milling Operations
Inspection Checks

- ✓ Proper Location
- ✓ Proper Depth (uniform across width?)
- ✓ Proper Slope
- ✓ Properly Cleaned
- ✓ Need to go Deeper?
- ✓ Measure Area

Resources

- 2024 Oregon Standard Specifications for Construction Sec. 00620, 00730, 00745
- ODOT Pavement Design Guide: *http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/Pages/PSIndex.aspx*
- ODOT HMAC Inspector Certification Manual http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/pages/hmac_inspection_manual.aspx

Contact Us

Jim Gunter, QA Specialist
Phone: 503-910-7836
james.c.gunter@odot.oregon.gov

Spec Notes are prepared by the Construction Section QA Unit for inspectors to provide background information around design elements and specifications to help with making field decisions.

If you have a topic you would like to see addressed in this format, please contact us.

Cold plane pavement removal is used for a variety of treatments including repairing localized failures and removing long segments of highways in preparation for new pavement. Like any construction, a bit of judgment is required to create a good quality milled pavement that comes in on budget and results in a good quality finished pavement. Here are some questions and answers around the intent of the grinding and the associated specifications.

Q -- Why grind?

A – Grinding is specified for a variety of reasons including:

- to remove all or part of the cracked surface to help control reflective cracking;
- to remove poorly bonded (delaminated) layers which can slide creating pot holes;
- to remove poor quality/unstable asphalt pavement;
- to remove an open graded wearing surface thereby removing a potential water-retaining layer;
- to restore the pavement surface without changing the pavement grade.

Q – Section 00620.43 in the Special Provisions sometimes states that *Traffic will not be allowed to travel on cold planed surfaces*. Why not?

A – The design reason is that traffic could damage a thin layer of pavement left in place that otherwise would be good enough to pave on. We don't want to delaminate or crack up a good base. Also, there may be safety issues including flying rock and friction.

Q – What happens if we grind deeper than the design?

A – Grinding deeper may result in leaving a thin section of pavement that could become dislodged and delaminate. In some areas, like shoulders, aggregate base may be encountered. Going deeper can result in significant pavement quantity overruns. If an extra ½” of mix is required for 500 feet for a 14-foot wide section, the added mix is more than 20 tons. It adds up!

Q – So then, how deep is deep enough?

A – For most situations, the design section should be adequate. For delaminated pavements, once the grinding starts, it is the inspector’s duty to verify that adequate preparation has been made. Check for loose chunks or slabs of material that are left after the pavement has been swept. Can you kick off pieces around the edges? Can you dislodge large sections easily either with your boot or shovel?

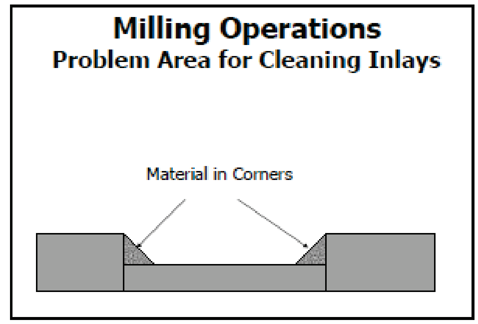
Loose and delaminated sections need to be removed which should be readily accomplished with a shovel. When in doubt, check with your PM! The photo below shows a pavement ready for an inlay that was partially delaminated. The loose slabs have been removed and the pavement swept. While it might not look perfect, all broken edges are gone and the remaining section adheres well to the layer below it. Once prepared, try to minimize the truck traffic on the pavement to reduce the potential for dislodging more material.

Q – What happens if we are overrunning our quantities and decide to grind a thinner section?

A – Grinding thinner can increase the potential for reflective cracking or increase the potential to leave delaminated pavement sections in place that will lead to shoving and pot holes. With an open graded wearing surface, we typically don’t want to leave an open graded layer under a dense graded pavement because it can trap water and lead to future problems. Also, depending on the pavement design, a thinner pavement could compromise the pavement life as the design may require new HMAC thickness to accommodate future traffic.

Q – We are done with the grinding, what should we look for during sweeping?

A – Per the specifications (00730.42 and 00745.42), prior to applying tack, *remove all material, loose or otherwise, that will reduce adhesion of the tack by brooming, flushing with water, or other approved methods*. Dust behind a fast-moving vehicle driving on the milled surface is an indicator of inadequate preparation. The areas to pay close attention to are the corners as shown in the graphic.



Q – The sweeping is done, can we start paving?

A – Maybe. If traffic has been running on the cold planed surface, Section 00620.43 states that …*Before beginning paving operations, make repairs to the existing cold planed surface as directed.* The intent of the specification is to locate any areas that have cracked or delaminated under traffic. Also, Section 00745.42 requires *Preparation of Underlying Surfaces* which refers to Section 00610 *Reconditioning Existing Roadway* which requires removal of unstable material. Now, back to the boilerplate for Section 00620.43, *Payment for the repairs will be made according to Section 00196.* Bottom line, repair the failed sections caused by traffic and pay for it as Extra Work.

Q – What’s important about applying tack?

A –After the pavement is swept, per 00745.42 all surfaces that will be next to new HMAC, should be tack coated. This includes the edges of the trench; many joint failures have been attributed to missing tack. Be sure that enough tack is placed and that the trucks are not picking it up during paving. The goal is to glue the pavement layers together for long term performance.

INSERT TAB

Delivery

Delivery

Module 5

1

Delivery

- End dump operations
- Belly dump operations
- Determining number of required trucks

2

Trucks

00745.22 Hauling Equipment – Provide hauling vehicles in good operating condition with tight, clean, smooth beds. Coat the beds with a minimum amount of an approved material to keep the ACP from sticking to the beds. Do not use diesel oil. Drain excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.

ODOT MATERIALS & INSPECTION

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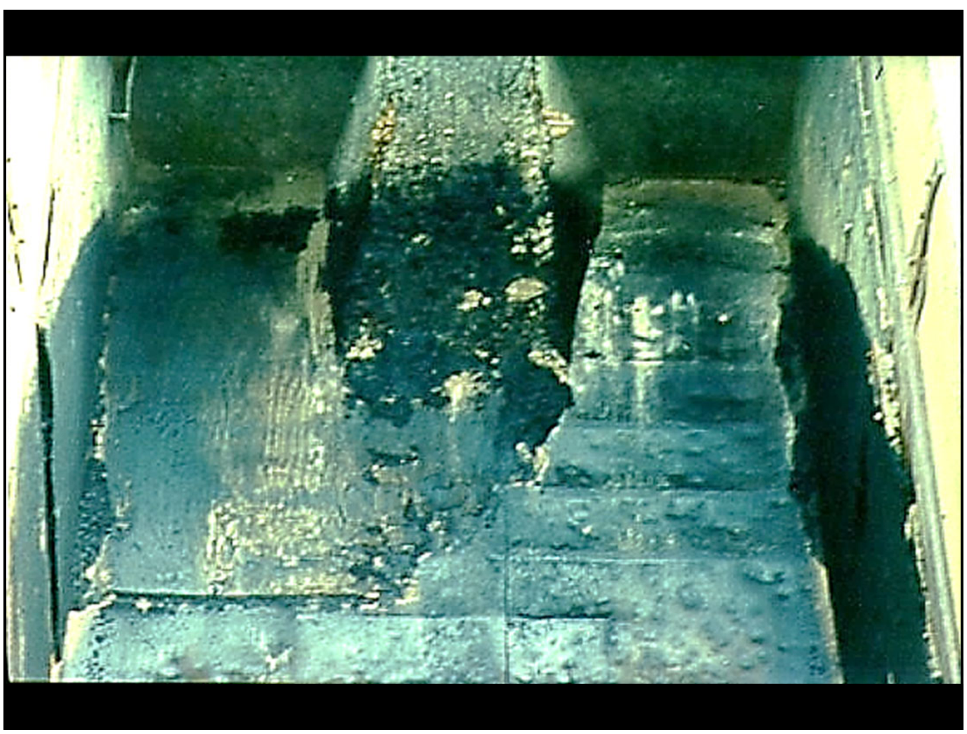

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OREGON DEPARTMENT OF TRANSPORTATION
CONSTRUCTION SECTION

QUALIFIED PRODUCTS LIST

PUBLISHING DATE: JULY 2020

Oregon Department of Transportation

The Qualified Products List is updated every six months.

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ODOT CONSTRUCTION / MATERIALS SECTION
QUALIFIED PRODUCTS LIST
APPROVED LIST - NO SAMPLES OR TESTS REQUIRED*
QUALIFIED LIST - ADDITIONAL REQUIREMENTS**
JULY 2020

STANDARD SPEC #	CATEGORY	PRODUCT NAME	LOCAL REPRESENTATIVE AND/OR MANUFACTURER	EFFECTIVE DATE	PRODUCT NUMBER	LIST	REMARKS
00745.22	ASPHALT RELEASE AGENT	BMF	COMPOUND TECHNOLOGIES, INC. 678/721-4101	09/20/16	4978	A	NTPEP LISTED
00745.22	ASPHALT RELEASE AGENT	CLEARRELEASE	KT CHEMICALS,INC 855/932-2228	06/26/15	4888	A	NTPEP LISTED

00745.22 ASPHALT RELEASE AGENT CLEARRELEASE

KT CHEMICALS,INC 06/26/15 4888 A NTPEP LISTED
855/932-2228

00745.22	ASPHALT RELEASE AGENT	MAXI-KREME	GLOBAL CHEM-SOURCE 866/391-1126 OR 503/391-1126	08/11/11	4336	A	10:1 DILUTION RATIO TESTED.

*LIST 'A' = APPROVED. MAY BE USED WITHOUT SAMPLES, TESTING, OR QUALITY COMPLIANCE CERTIFICATIONS. MAY NEED A FIELD INSPECTION REPORT.
**LIST 'Q' = QUALIFIED. USE WITH SAMPLING, TESTING, &/OR QUALITY COMPLIANCE CERTIFICATIONS AS NEEDED. NEEDS A FIELD INSPECTIONS REPORT. CHECK SPECS AND NFTMAG.
LIST PUBLISHED BY: ODOT MATERIALS LAB; 800 AIRPORT RD SE; SALEM, OR 97301-4798; (503) 986-3059. PLEASE REPORT ANY PROBLEMS USING THESE PRODUCTS.

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Loadout Techniques

Minimize Segregation

ODOT MATERIALS & INSPECTION

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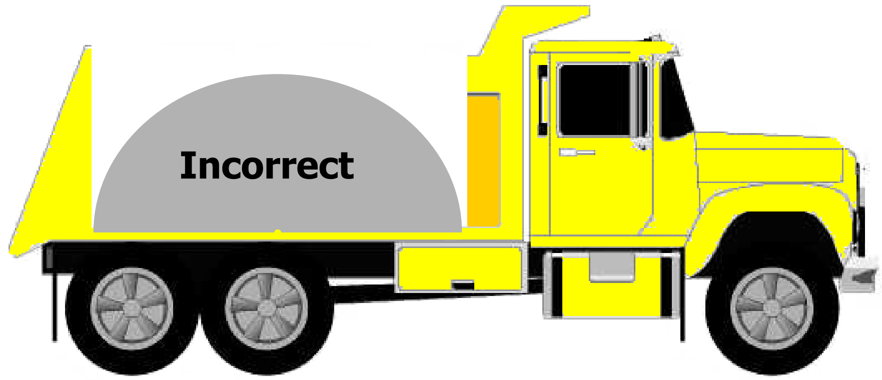

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Not recommended for segregation prone mixes

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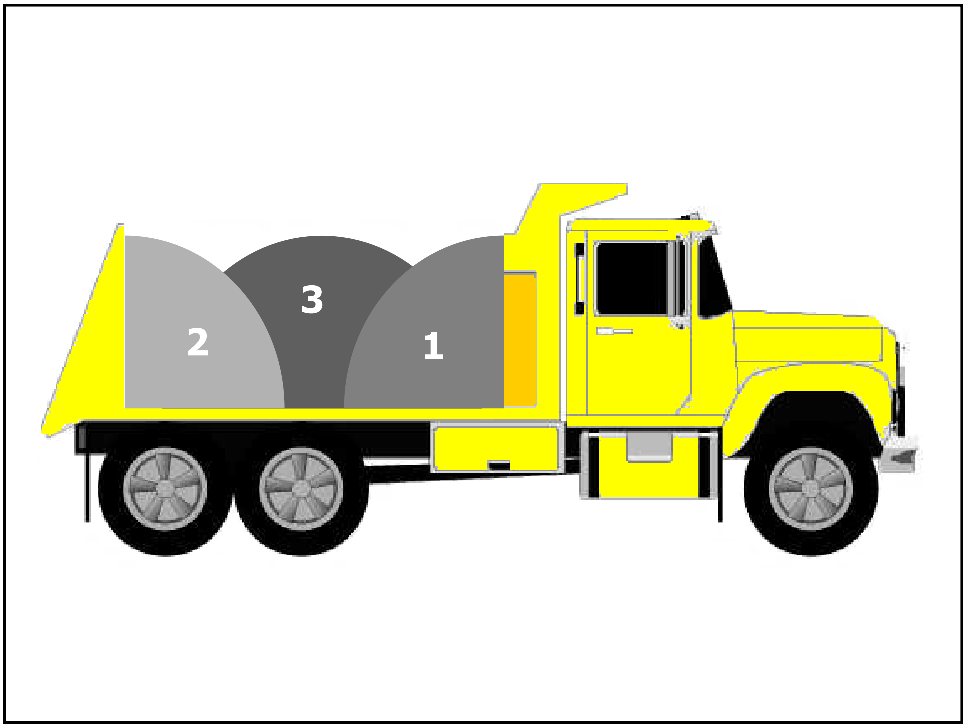

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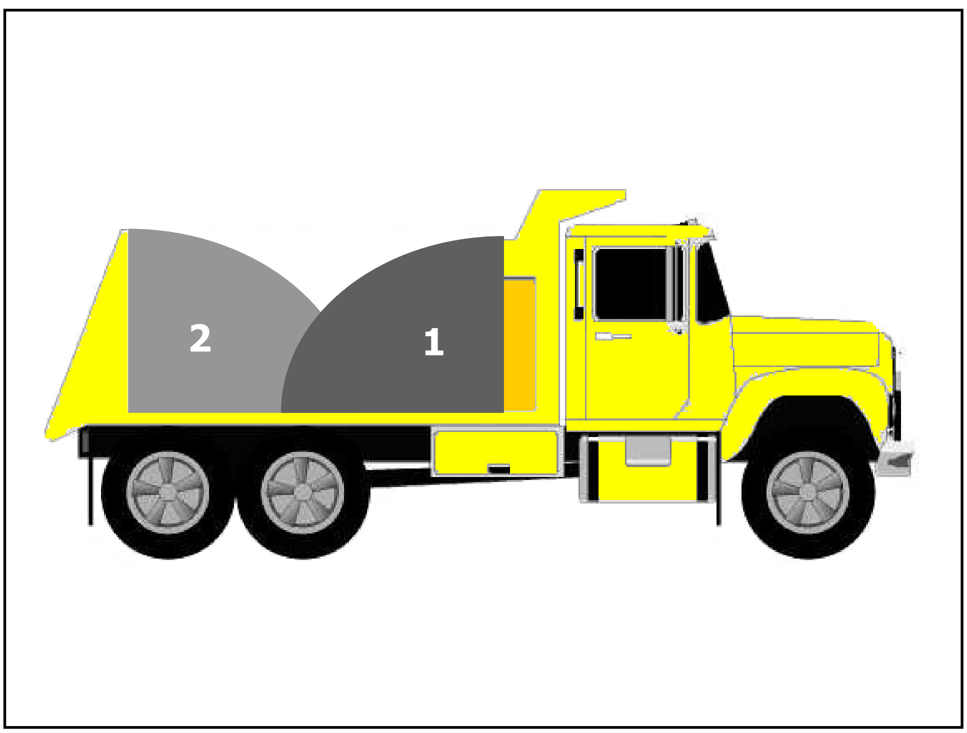

18

Proper Truck Exchange

00745.46(b) Depositing – Deposit ACP from the hauling vehicles so segregation is prevented.

19

Proper Truck Exchange

- Windrow pickup machine or end-dump transfer machine required on some projects
- For projects with dense graded wearing surface and paving is primary intent of contract.
- Watch for it in 00745.46(b) of special provisions

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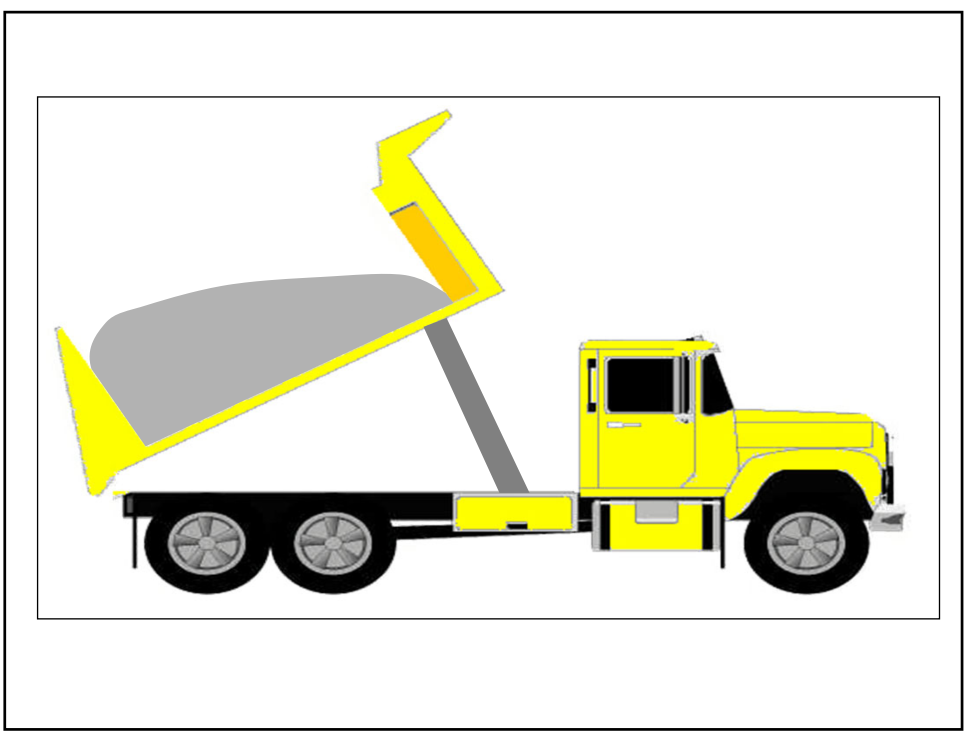

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Breaking the Load

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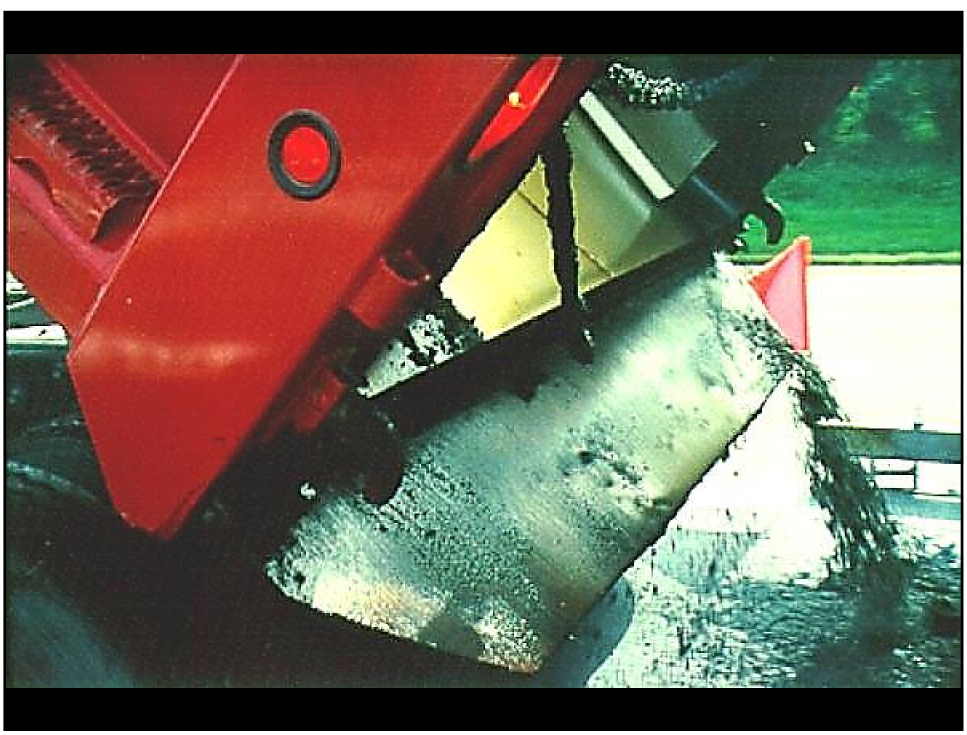

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Truck Exchange – Release Truck

The paver operator followed a four-step routine during the truck exchanges on day one of the test. This is a routine that helps ensure that the hopper is not run low on mix.

Step one is releasing the truck as soon as the truck bed is empty. The operator signals the truck driver to begin lowering the bed and preparing to exit from the front of the paver. The paver continues to lay down mix at the same speed paving speed.

Truck Exchange – Continue Paving

As the empty truck pulls away, the paver operator continues to pave at the same speed and checks the level of material in the hopper. Assuming that the hopper is full, the operator paves until the level has gone down to the point where the hopper can be cycled without spilling mix out of the front of the hopper.

At this point the next truck should be getting ready to position in front of the paver.

36

Truck Exchange – Cycle Hopper

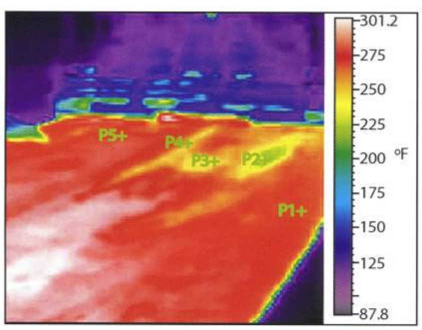
Next, the operator brings both hopper wings up all the way. This action creates a funnel and mix that has accumulated at the sides of the hopper is pinched in with the rest of the mix in the hopper. The paver is still laying down mix at the same paving speed. When the level of mix in the hopper is just below the top of the flashing at the front of the hopper, the operator should begin to lower the hopper wings.

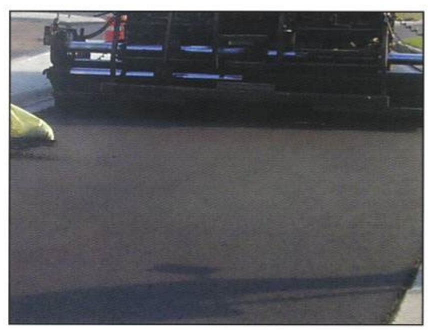
Truck Exchange – Stop Paver

As soon as the hopper wings are all the way down, the operator stops the paver quickly but smoothly. The level of mix in the hopper should be even and still covering the deck and tunnels completely. The mix left in the hopper will be covered by fresh hot mix as soon as the next truck is in position to raise its bed and dump into the hopper.

37

Poor Truck Exchange





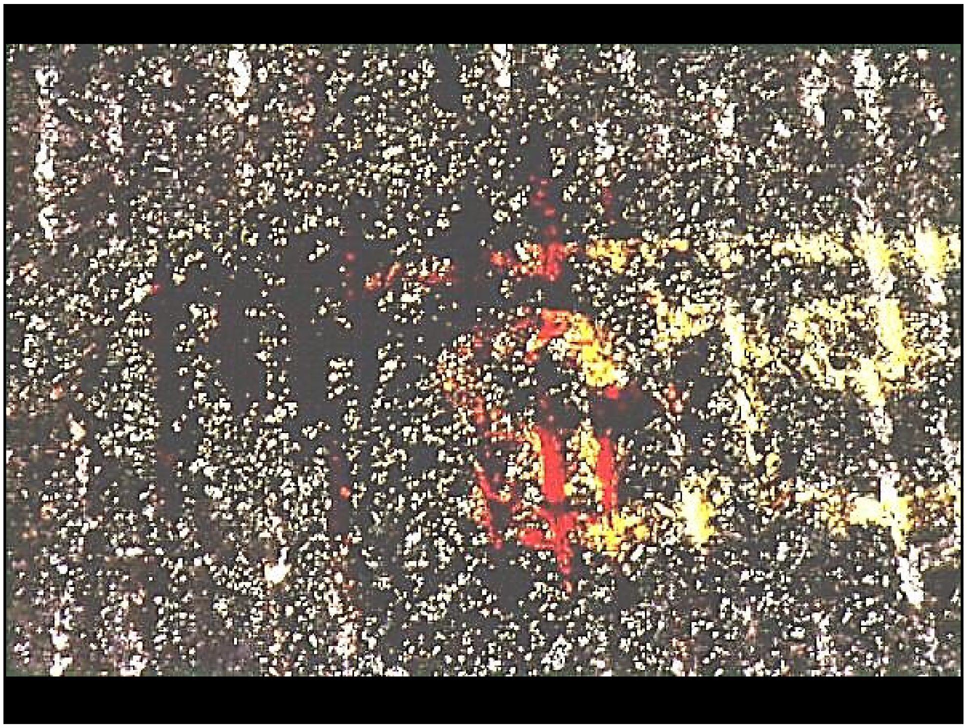
Point	Temperature
P1	261°F
P2	213°F
P3	223°F
P4	243°F
P5	278°F

If the operator continues to pave until the hopper is nearly empty and the hopper wings are cycled too late, cold mix from the sides of the hopper will be dropped on exposed conveyors. Cold spots are likely to show up in the mat. This example was taken from a different project where proper truck exchange practices were not followed.

This degree of temperature variation is likely to result in variations in density. The cold mix will not compact at the same rate as the hotter mix. Rideability will be affected as well as density.

This problem can be, and should be, cured with proper operator training.

38



39

40

End Dump Operations

Don't Dos

41

Direct Discharge

Hauling unit discharges material directly into the paver hopper

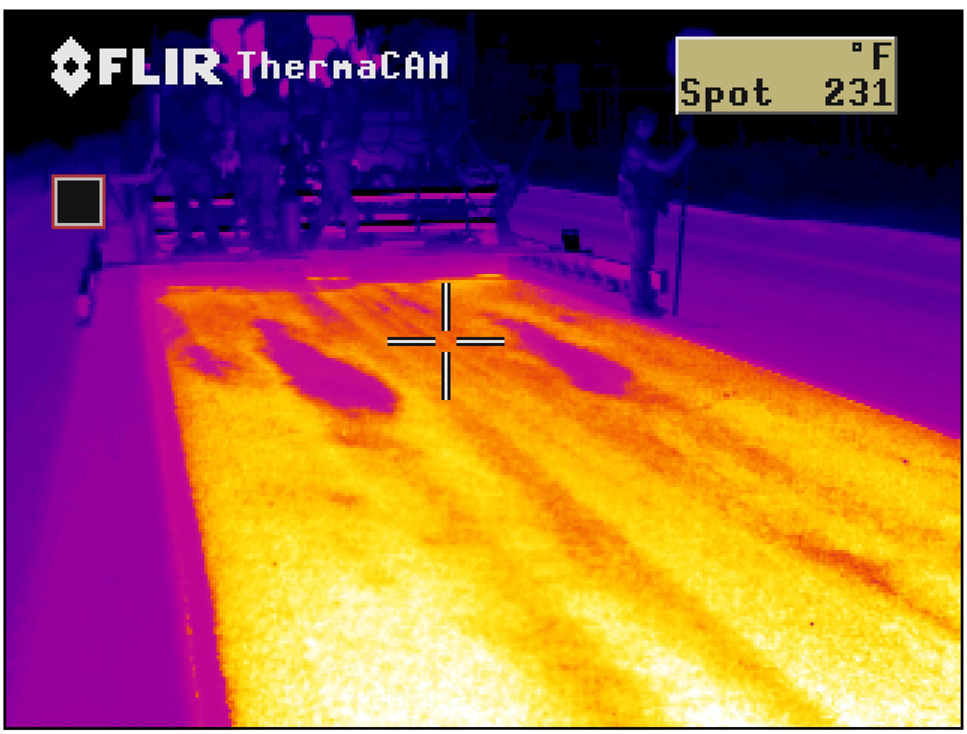
Areas of concern

- Don't run the hopper empty between loads
- Don't hold the truck in the hopper too long
- Don't allow ACP to dribble when raising bed
- Don't bump the paver
- Don't hold the truck brakes too tightly
- Don't disturb the paver steering
- Don't clean and leave piles of ACP on grade

42

Don’t run the hopper empty!

43



44

45

46


Don’t hold the truck
in the hopper too long!

47


Don’t allow HMA
to dribble when raising the bed!
Segregation

48

49

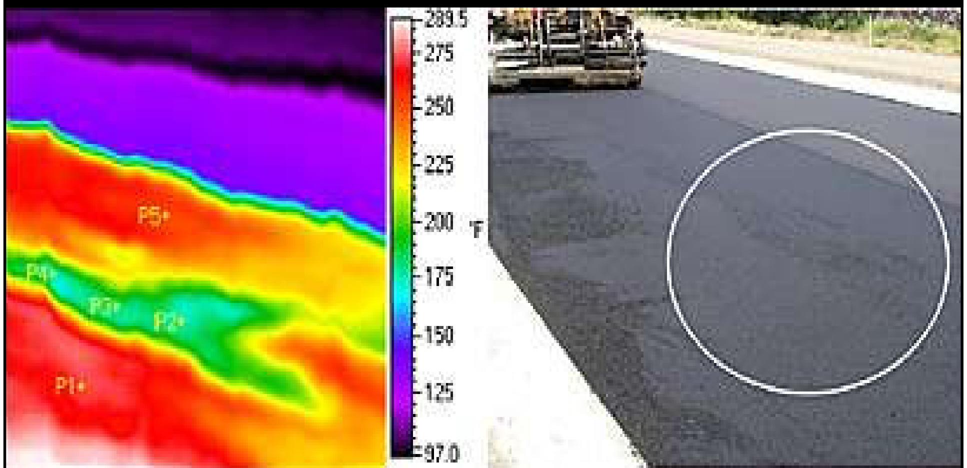
50

<u>Don't</u> hold the brakes too tightly!

51

Don't clean and leave piles of HMA on the grade!

52



53

Belly Dump Operations

54

Windrow Operations
Specs

00745.46(b) When ACP is windrowed, the pick-up equipment shall:

- Pick up substantially all of the ACP deposited on the roadway
- Be self-supporting, not exerting any vertical load on the paving machine, nor causing vibrations or other motions which could have a harmful effect on the riding quality of the completed pavement

55

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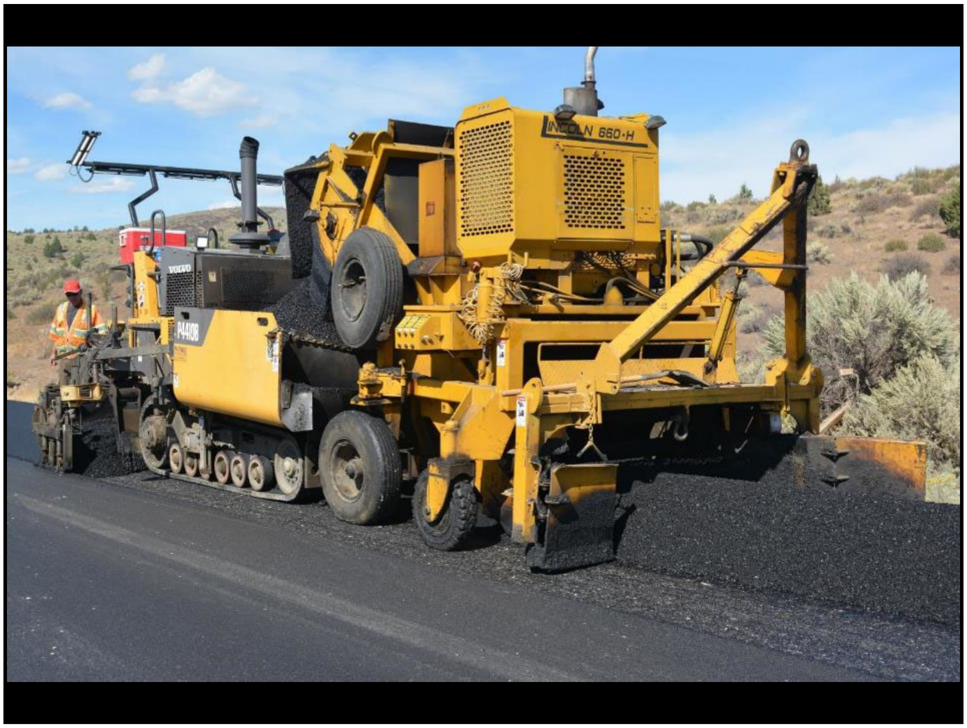
LINCOLN 660-H

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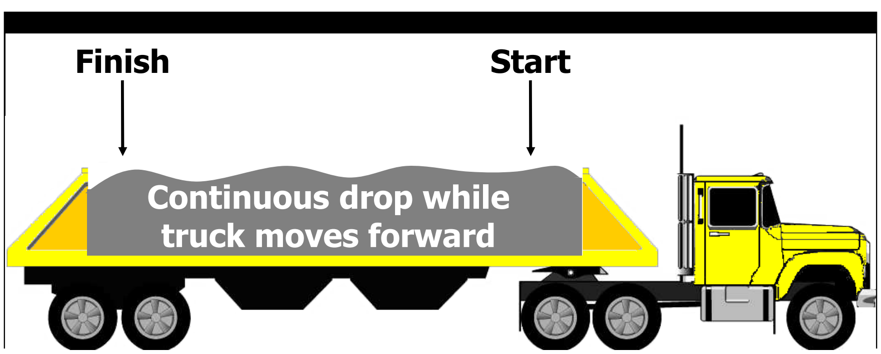

Finish
Start
Continuous drop while
truck moves forward

58

Windrow Paving
Mission Statement

"Receive ACP at the paving site. Place it in a windrow sized to match capacity of paving width and depth. Try to pave non-stop with the correct amount of ACP in the hopper at all times without inducing rock or thermal segregation."

ODOT MATERIALS & INSPECTION

59

Windrow Paving
Dump Person's Responsibilities

- Sizing the windrow
- Alignment of windrow
- Pick the windrow up cleanly
- Monitor the hopper level

Make sure pick up machine doesn't vibrate the paver or affect the smooth forward paving speed.

ODOT MATERIALS & INSPECTION

60

Windrow Paving Operation
Sizing the Windrow

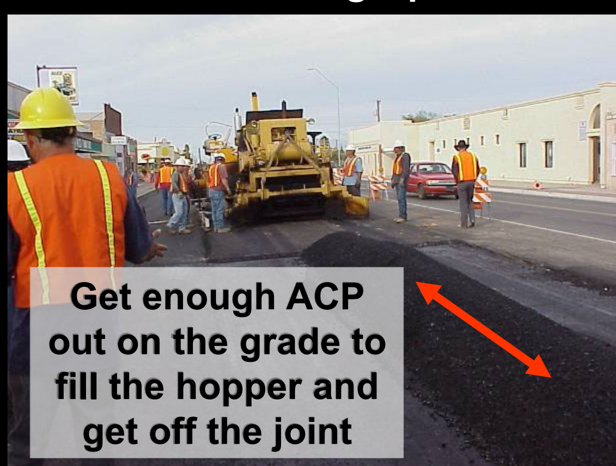
Most critical of all operational procedures:

- Calculate ACP volume required (Length x Width x Depth) Match the volume required with the volume size of windrow.
- If end of load segregated or cooler ACP appears try over lapping the ending and beginning of the windrow.

ODOT MATERIALS & INSPECTION

61

Start Up Procedures
"Windrow Paving Operation"



Best to use third or fourth truck loaded
Mix less likely to be cold or non-uniform

62

"Too little or too much!"

63

"Too little or too much!"

64


"Too little or too much!"
What's wrong?

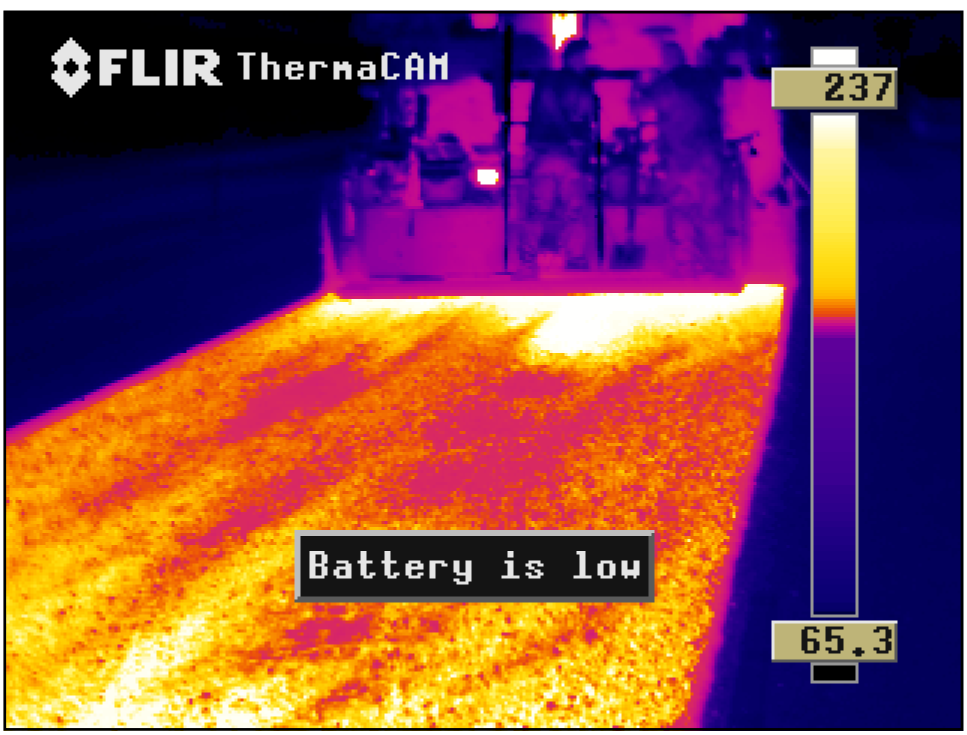
65


Solution?
Contractor should have a backhoe on-site for mishaps

66


"Windrow Paving Operation"
Don't run the hopper empty
Rocks + Rocks = Segregation

67


FLIR ThermaCAM
237
Battery is low
65.3

68

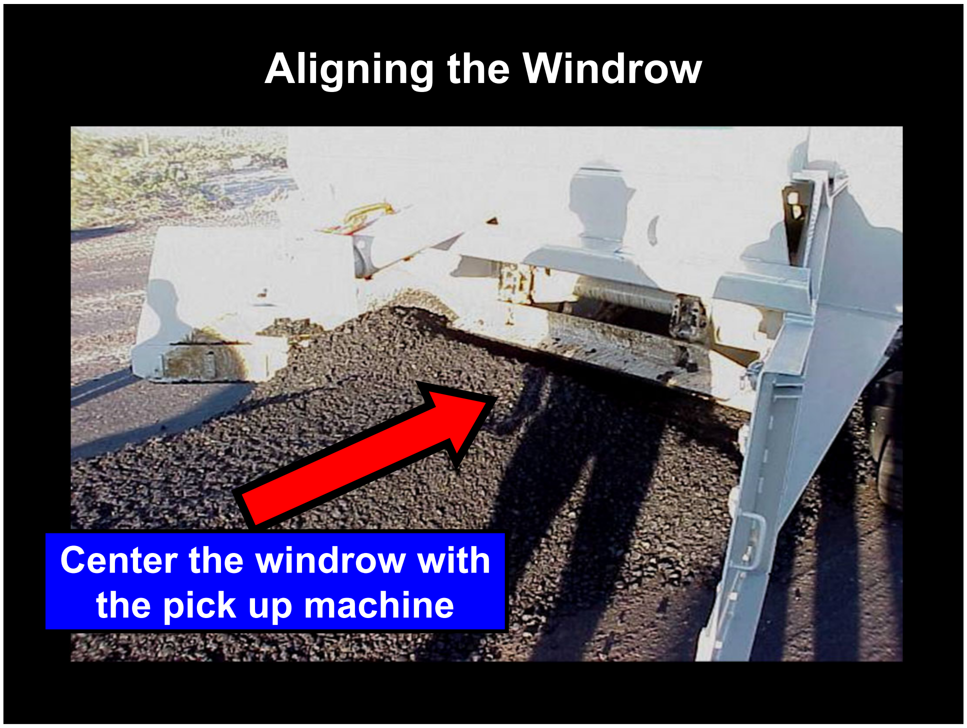
69

Alignment of the Windrow

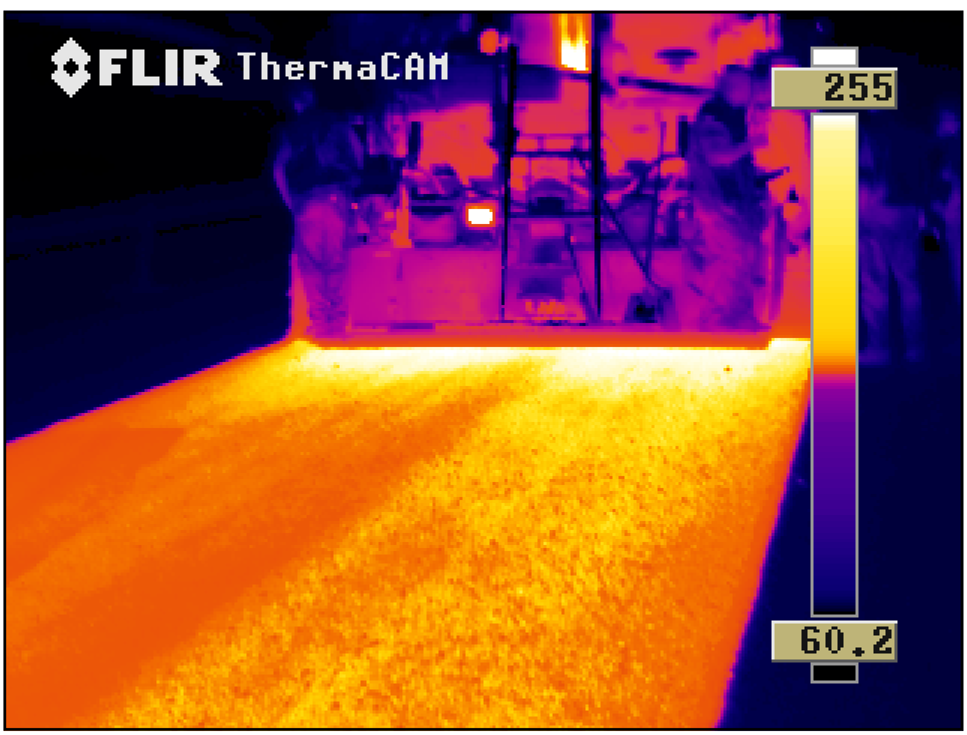
- Align the windrow so it matches the pick up machine right in the center.
- Watch the wings that they don't pick up any foreign materials.

ODOT MATERIALS & INSPECTION

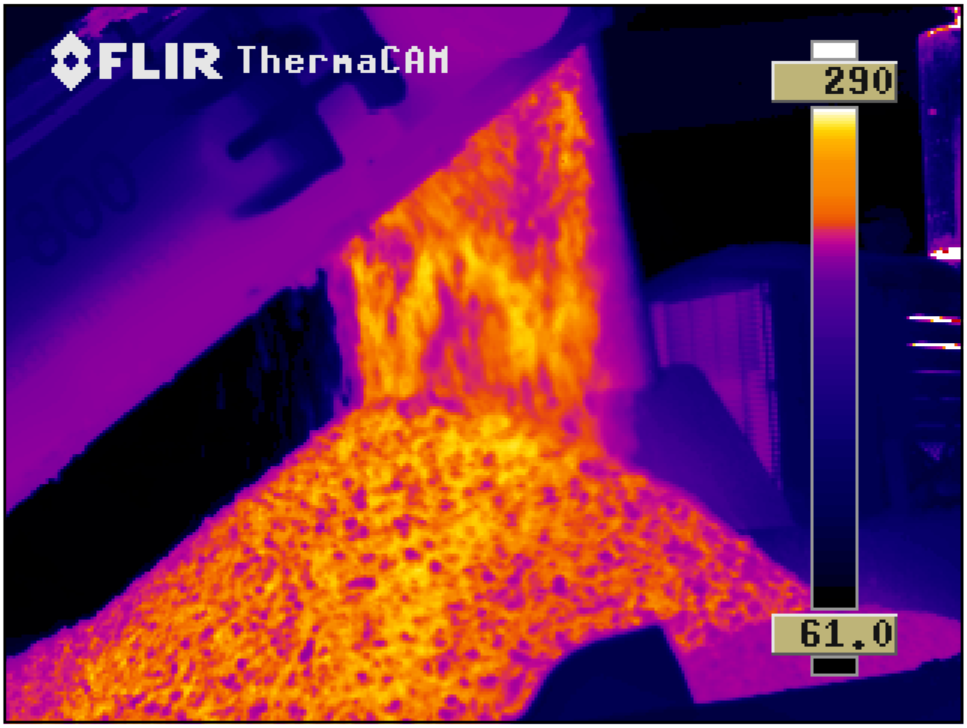
70


Aligning the Windrow
Center the windrow with the pick up machine

71


FLIR ThermaCAM
255
60.2

72



73

Pick Up the Windrow Cleanly

- Adjust the height of the scraper to pick up the windrow cleanly.
- Watch that the scraper doesn't catch on some raised obstruction.

ODOT MATERIALS & INSPECTION

74

Pick Up the Windrow Cleanly

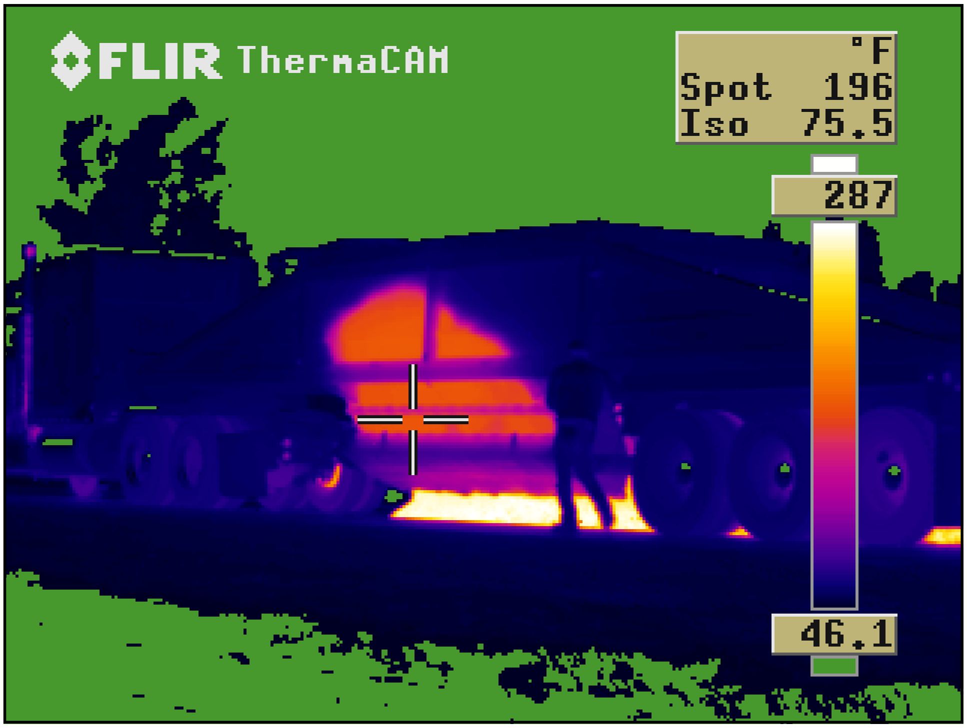
75

Watch for Segregation!

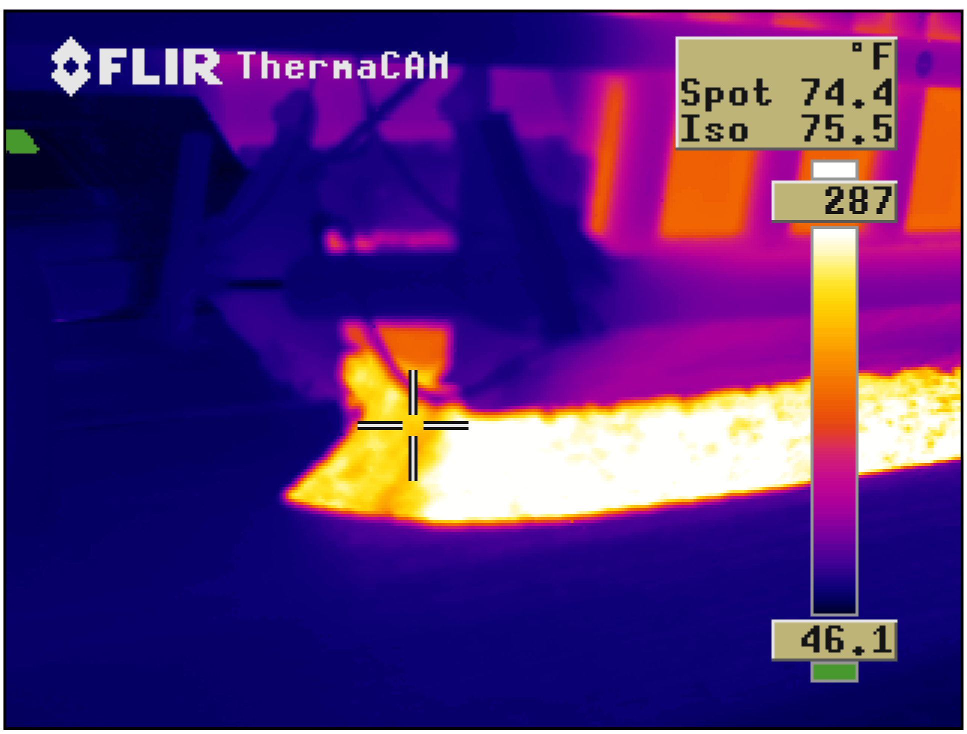
Rock and Thermal:

- At the windrow (the ACP “breaks & runs” down the outsides of windrow and accumulates along the edges).
- In the corners of the pick up head as the ACP is being elevated up into the hopper.
- In the hopper where ACP is allowed to “break & run” forming segregation in the corners and pockets. (Add plates to minimize segregation.)

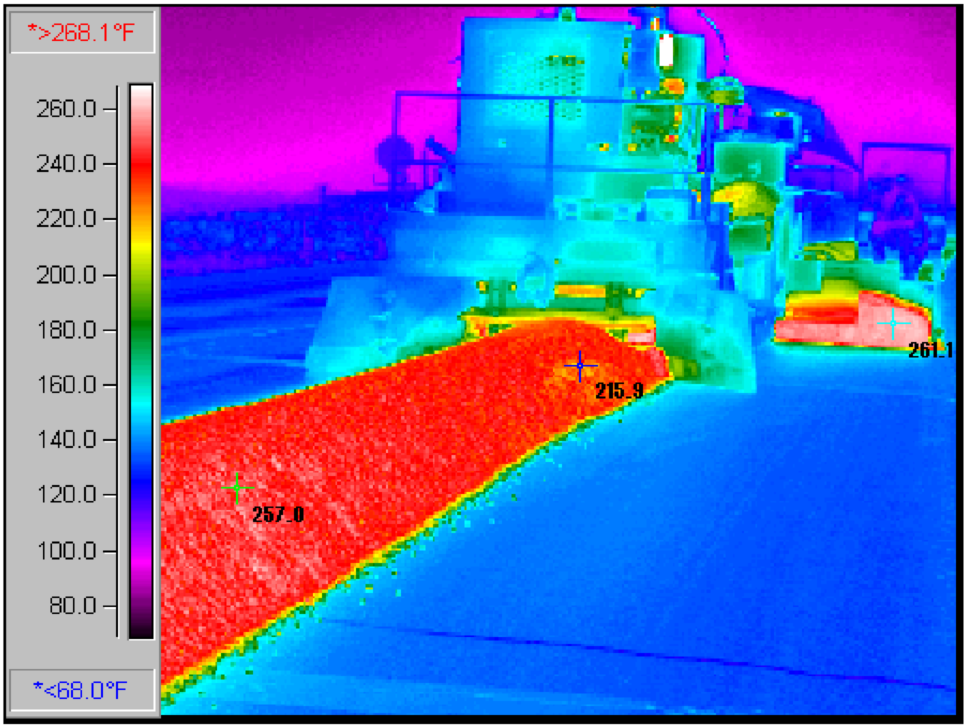
76


FLIR ThermaCAM
°F
Spot 196
Iso 75.5
287
46.1

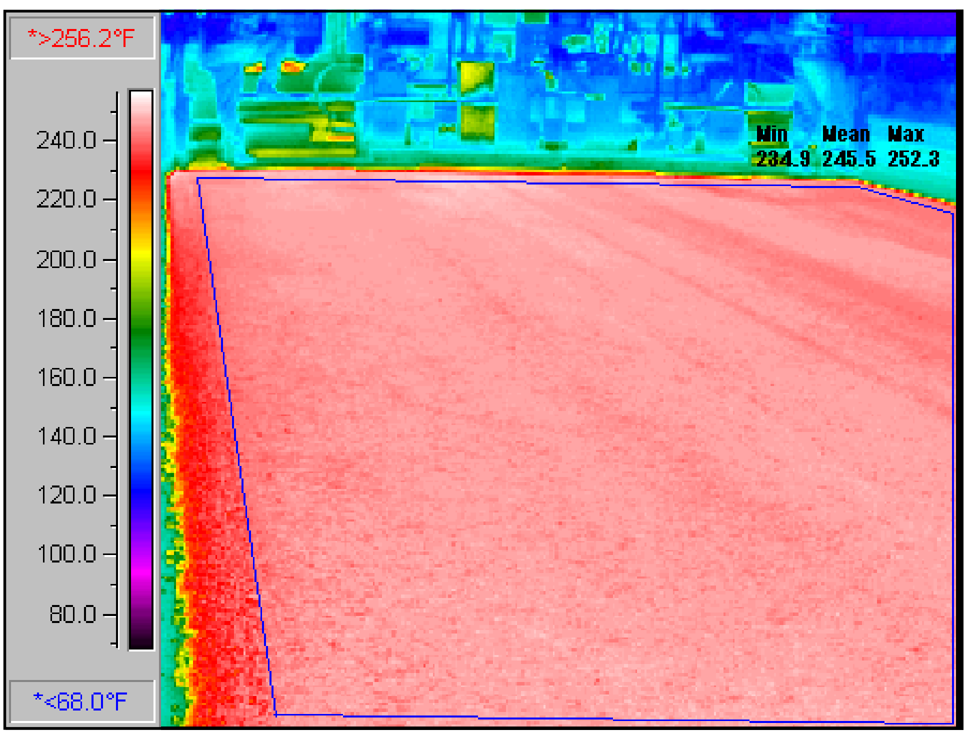
77


FLIR ThermaCAM
°F
Spot 74.4
Iso 75.5
287
46.1

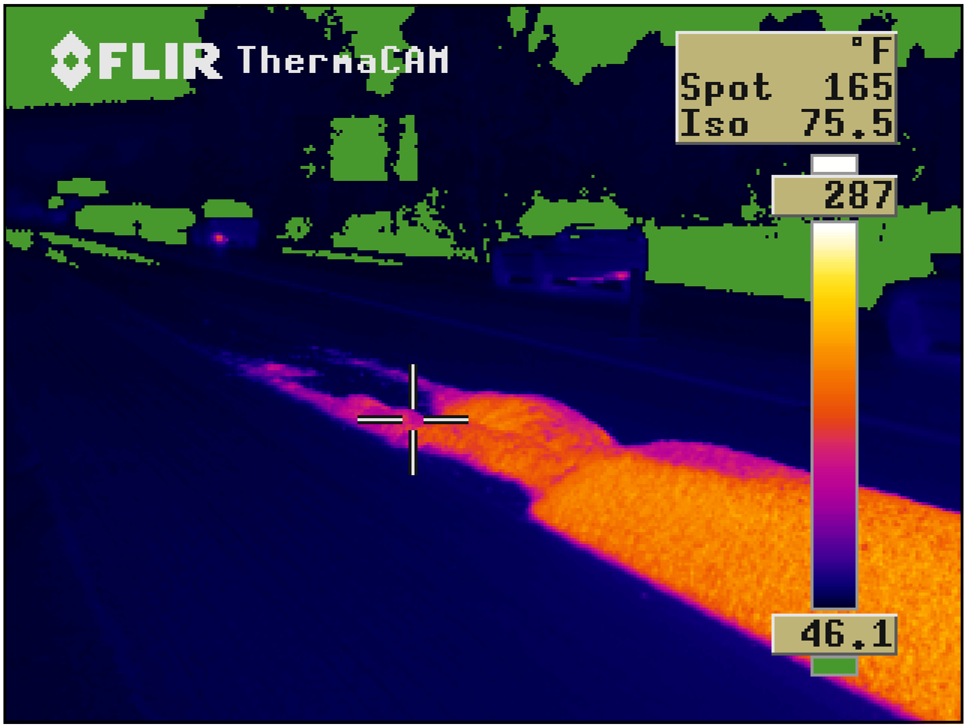
78


*>268.1°F
260.0
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
*<68.0°F
261.1
215.9
257.0

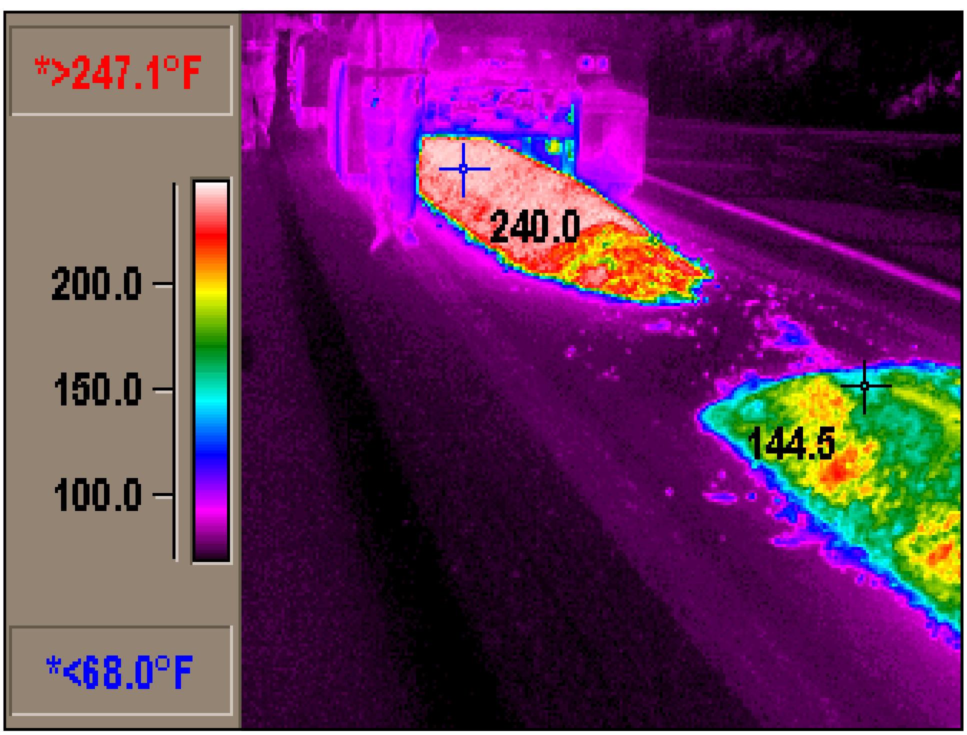
79


*>256.2°F
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
*<68.0°F
Min Mean Max
234.9 245.5 252.3

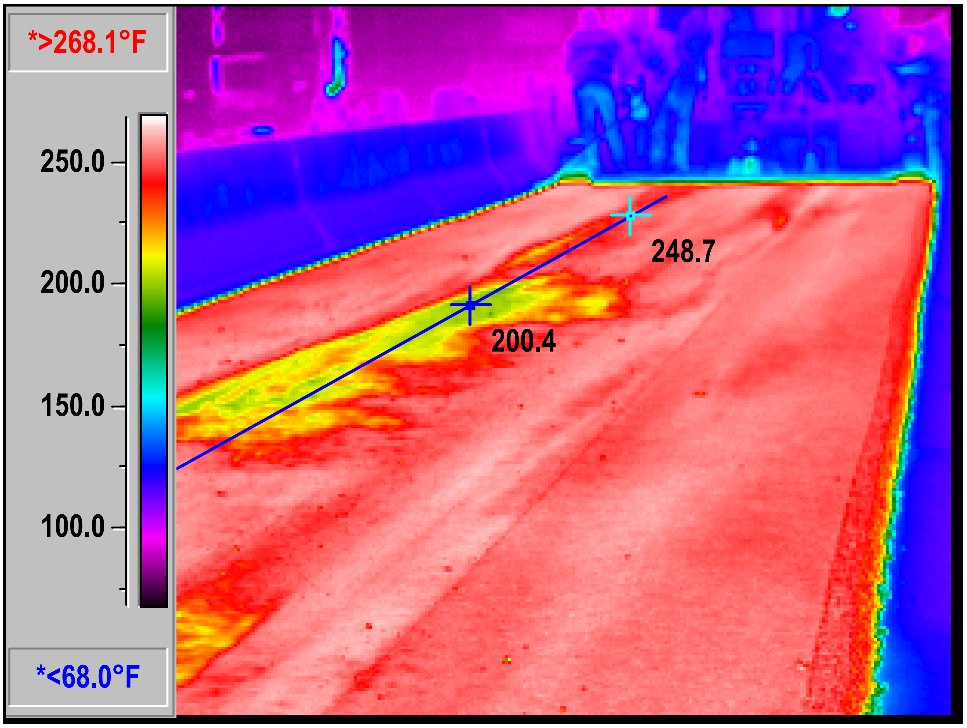
80


FLIR ThermaCAM
°F
Spot 165
Iso 75.5
287
46.1

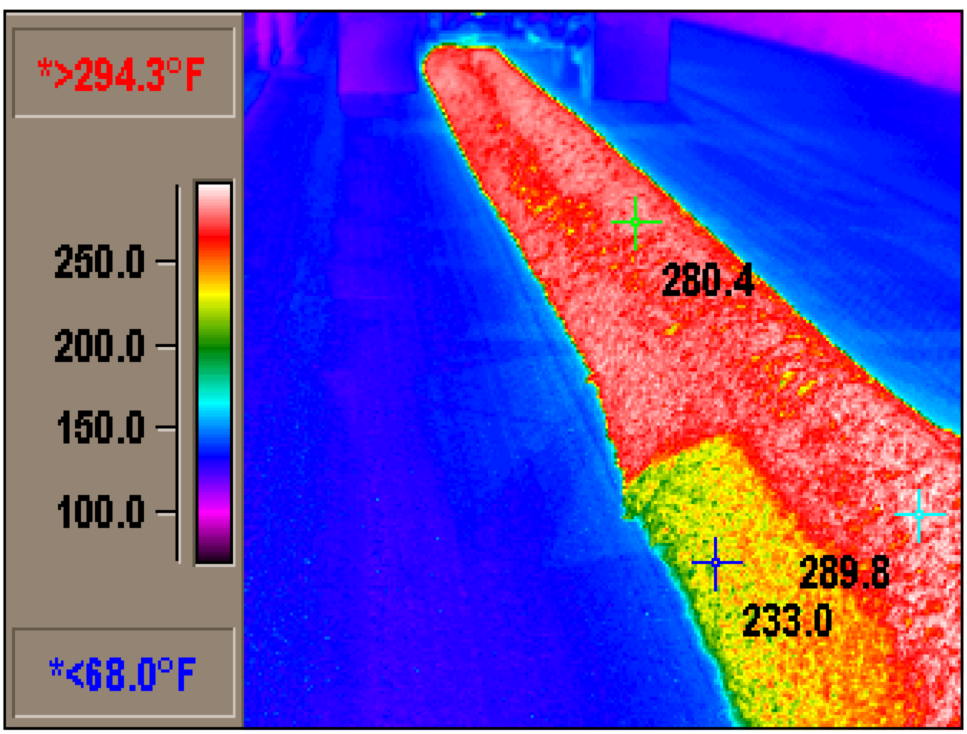
81


*>247.1°F
200.0
150.0
100.0
240.0
144.5
*<68.0°F

82

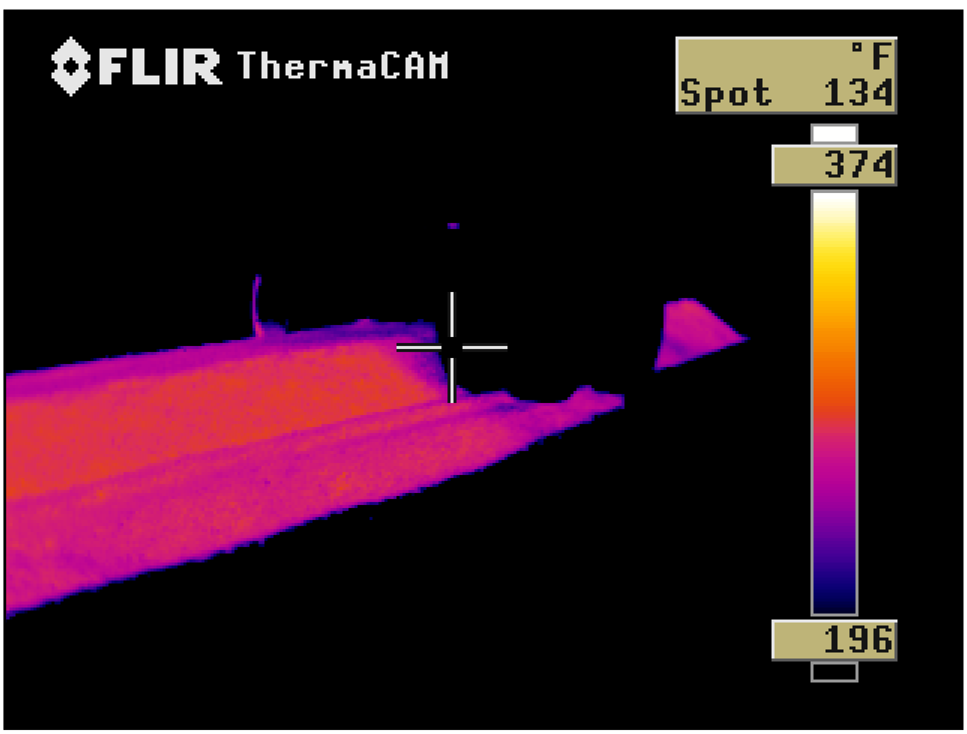

*>268.1°F
250.0
200.0
150.0
100.0
*<68.0°F
248.7
200.4

83


*>294.3°F
250.0
200.0
150.0
100.0
*<68.0°F
280.4
289.8
233.0

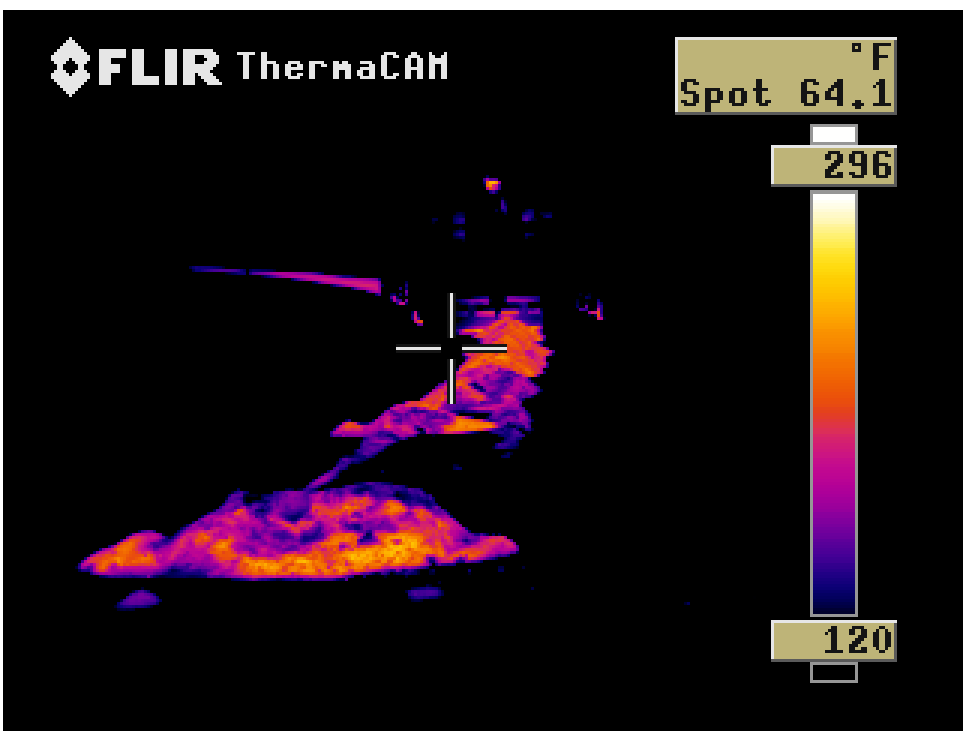
84

85

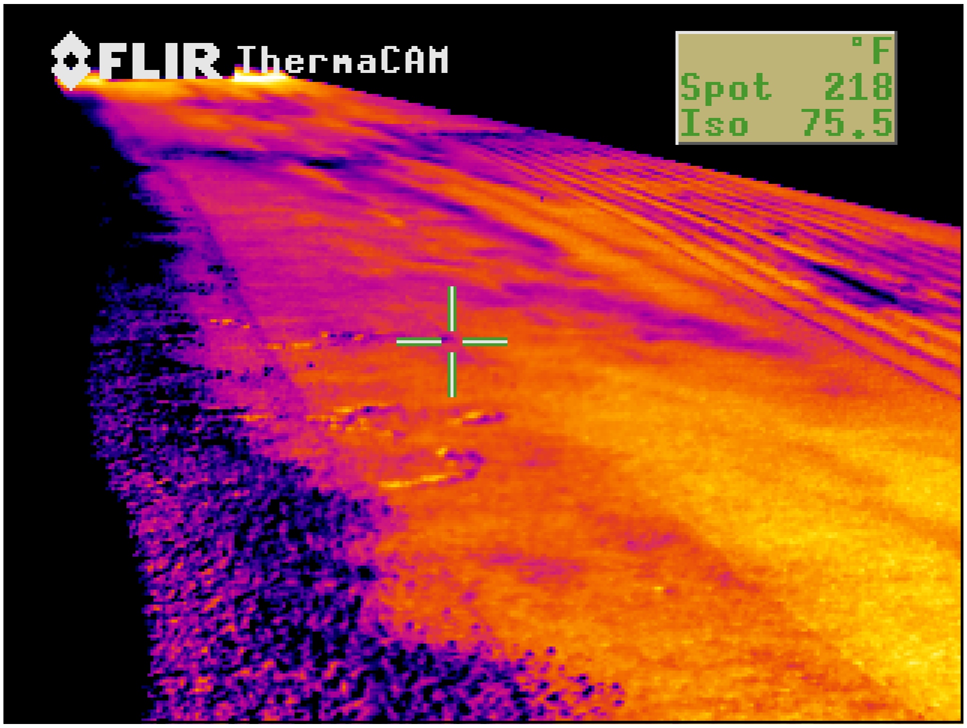


86

87

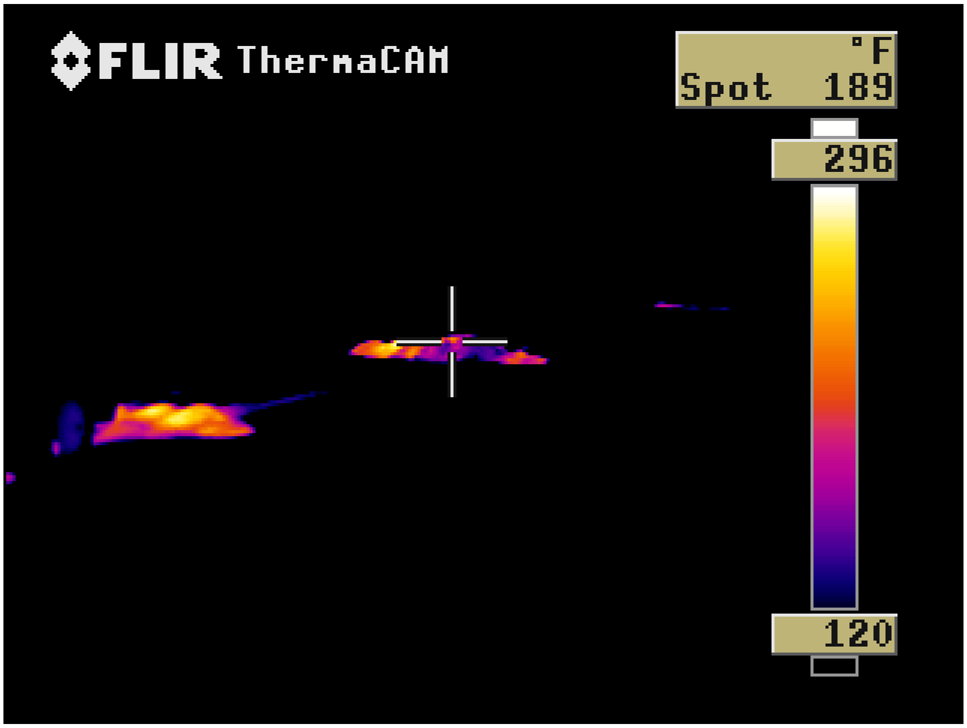


88



89

90



91

Tarping

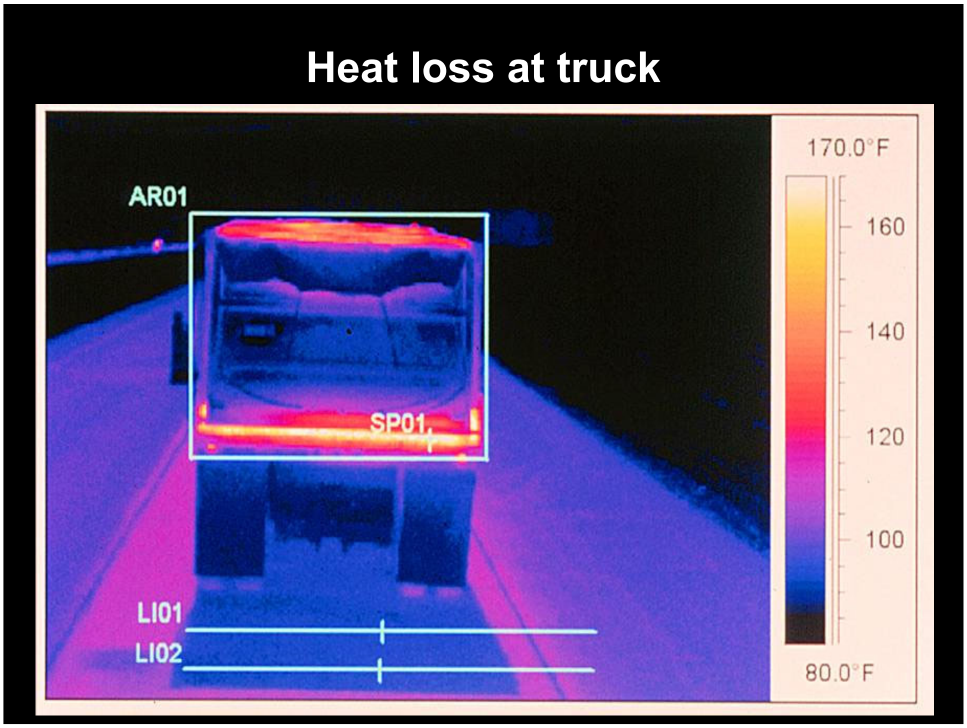
00745.46(a) Hauling – Cover ACP if rain or cold air temperatures are encountered any time between loading and placement.

ACP will be rejected before placing if one or more of the following occurs:

- Below temperature limit specified in 00745.43
- Slumping or separating
- Solidifying

Dispose of rejected loads at no additional cost to the Agency.

92

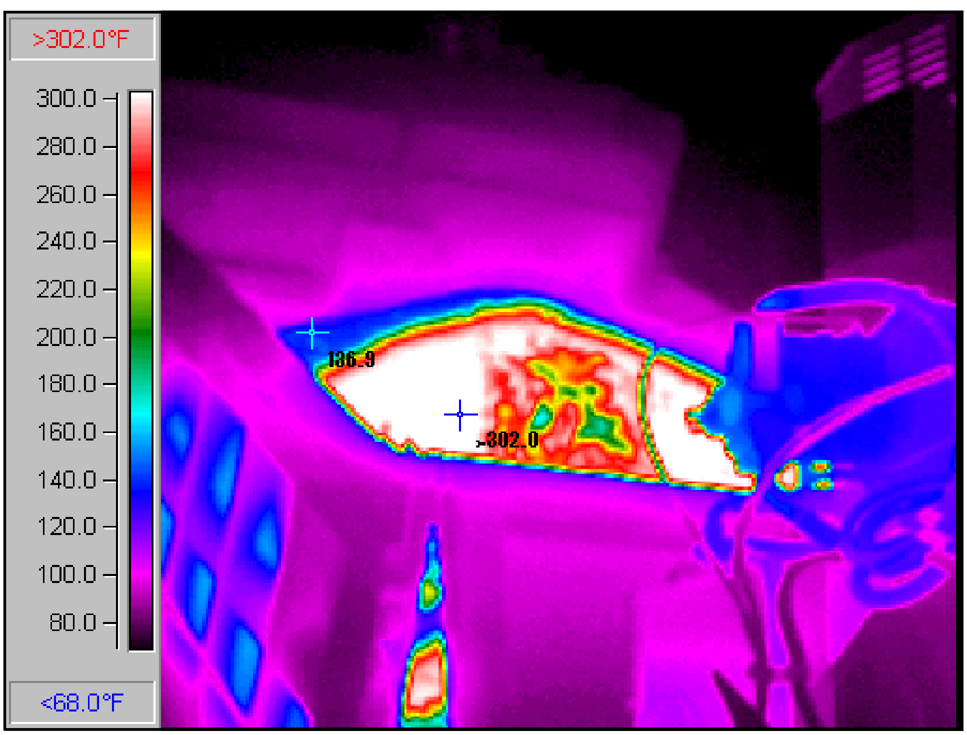

Heat loss at truck
AR01
SP01
LI01
LI02
170.0°F
160
140
120
100
80.0°F

93

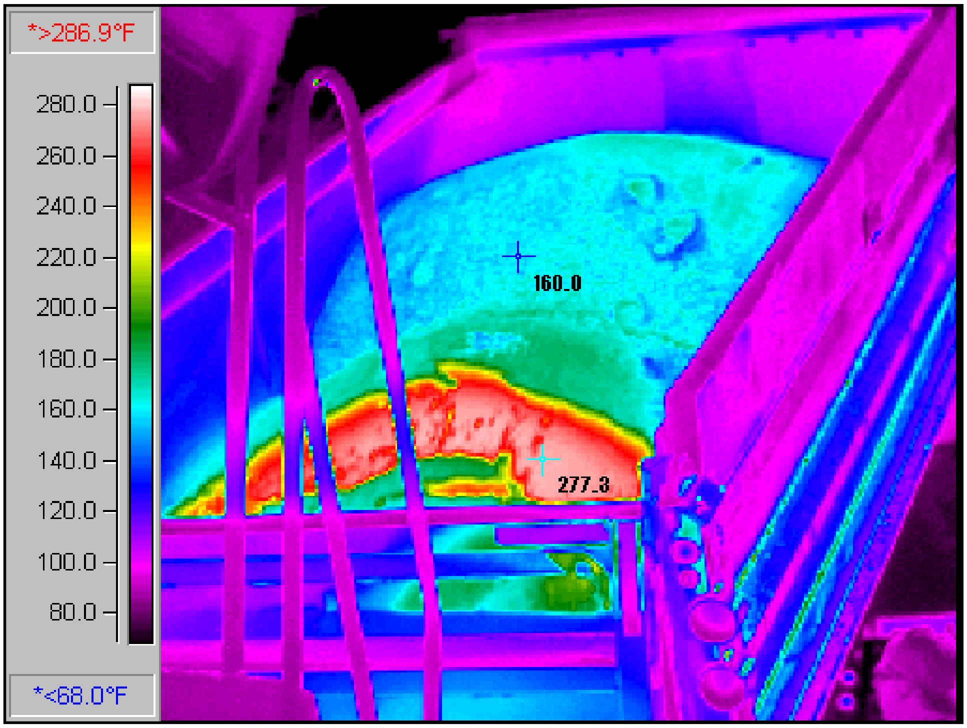
94


DACCO
41

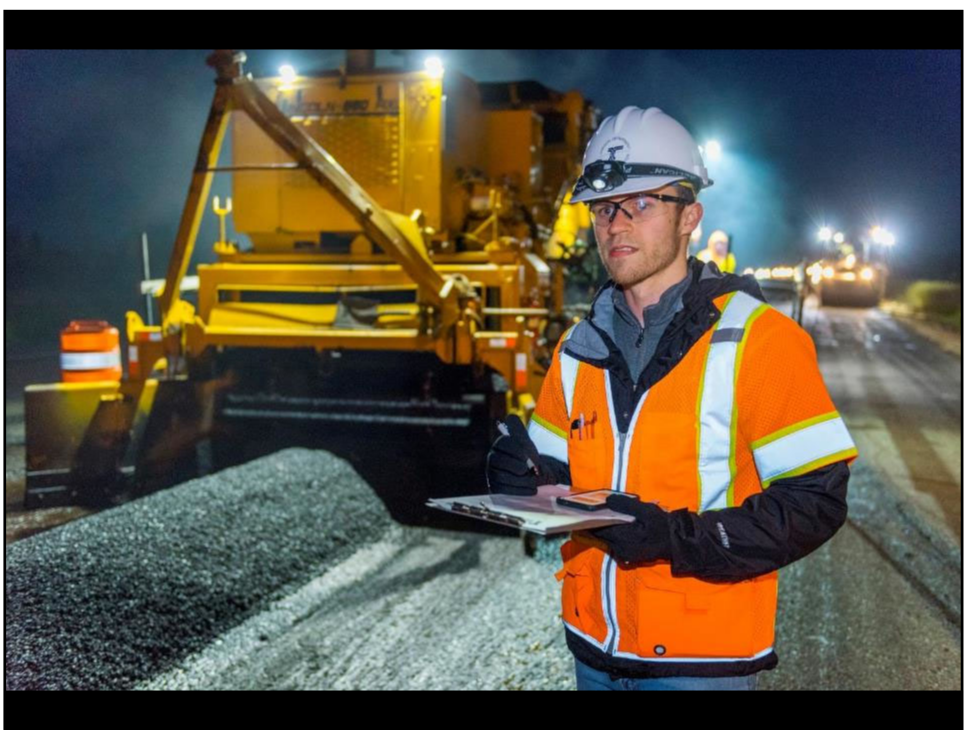
95


>302.0°F
300.0
280.0
260.0
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
<68.0°F
136.9
>302.0

96


*>286.9°F
280.0
260.0
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
*<68.0°F
160.0
277.3

97



98

Ticket Takers Duties
(if you have them)

- **Be safe!!!!!!!!!!!!!!!!!!!**
- Check for overloads
- Proper mix for the project?
- Monitor temperature
- Track yields
- Identify Blind Random Density test regions or stations
- Other???
- **Be safe!!!!!!!!!!!!!!!!!!!**

ODOT MATERIALS & INSPECTION

99

Continuous Paving

Are there enough trucks?

ODOT MATERIALS & INSPECTION

100

Continuous Paving
Specs

00745.46(a) – Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

101

Enforcement of Continuous Paving?

00745.43(b)
Minimum Temperature Behind Paver

HMAC = 240° F
WMAC = 215° F

Tough to get compaction below these temperatures.

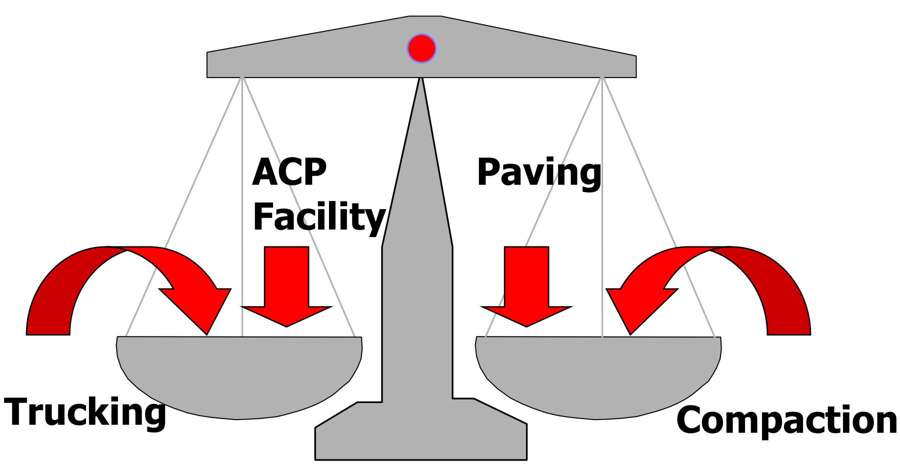
May need to make a transverse joint and start over.

102

Estimating the Required Number of Trucks

103

Balancing Production



104

MIX DELIVERY PRODUCTION CALCULATION FORM

DATE:	6/22/22	Contract #	99999	
Project:	Here - There			
Tons Scheduled to be placed **(MIX)**			1600	Tons
Hours of paving scheduled **(TIME)**			8	Hours
Rate of mix delivered to jobsite**(H-RATE)**		**MIX / TIME**	200	Tons/hr
Rate of mix available from plant **(F-RATE)**			200	Tons/hr
STOP: Is the H-RATE equal to or greater than F-RATE?				
Average Truck Capacity **(SIZE)**			20	Tons
Total truck trips needed **(TRIPS)**		**MIX / SIZE**	80.0	Trips
Truck Cycle **(minutes)**				
Delay at Plant:	10			
Load Time:	3			
Ticket & Tarp Time:	5			
Haul to Job:	15			
Delay on site:	2			
Dump & Clean up:	10			
Return Haul:	15			
Total Cycle in minutes =	60	60 min/hr		
		Truck Cycle (Cycle) =	1.0	Hours/Trip
Number of trips per truck **(LOADS)**		TIME/CYCLE	8.0	
		round down	8	Loads/trk
Number of trucks needed **(TRUCKS)**		TRIPS/LOADS	10	
		round up	**10**	**Trucks**

105

MIX DELIVERY PRODUCTION CALCULATION FORM

DATE:	6/22/22	Contract #	99999	
Project:	Here - There			
Tons Scheduled to be placed **(MIX)**			1600	Tons
Hours of paving scheduled **(TIME)**			8	Hours
Rate of mix delivered to jobsite**(H-RATE)**		**MIX / TIME**	200	Tons/hr
Rate of mix available from plant **(F-RATE)**			200	Tons/hr
STOP: Is the H-RATE equal to or greater than F-RATE?				
Average Truck Capacity **(SIZE)**			20	Tons
Total truck trips needed **(TRIPS)**		**MIX / SIZE**	80.0	Trips
Truck Cycle **(minutes)**				
Delay at Plant:	10			
Load Time:	3			
Ticket & Tarp Time:	5			
Haul to Job:	60			
Delay on site:	2			
Dump & Clean up:	10			
Return Haul:	60			
Total Cycle in minutes =	150	60 min/hr		
		Truck Cycle (Cycle) =	2.5	Hours/Trip
Number of trips per truck **(LOADS)**		TIME/CYCLE	3.2	
		round down	3	Loads/trk
Number of trucks needed **(TRUCKS)**		TRIPS/LOADS	26.7	
		round up	**27**	**Trucks**

106

MIX DELIVERY PRODUCTION CALCULATION FORM

DATE:	6/22/22	Contract #	99999	
Project:	Here - There			
Tons Scheduled to be placed **(MIX)**			5400	Tons
Hours of paving scheduled **(TIME)**			12	Hours
Rate of mix delivered to jobsite**(H-RATE)**		**MIX / TIME**	450	Tons/hr
Rate of mix available from plant **(F-RATE)**			450	Tons/hr
STOP: Is the H-RATE equal to or greater than F-RATE?				
Average Truck Capacity **(SIZE)**			20	Tons
Total truck trips needed **(TRIPS)**		**MIX / SIZE**	270.0	Trips
Truck Cycle **(minutes)**				
Delay at Plant:	10			
Load Time:	3			
Ticket & Tarp Time:	5			
Haul to Job:	60			
Delay on site:	2			
Dump & Clean up:	10			
Return Haul:	60			
Total Cycle in minutes =	150	60 min/hr		
		Truck Cycle (Cycle) =	2.5	Hours/Trip
Number of trips per truck **(LOADS)**		TIME/CYCLE	4.8	
		round down	4	Loads/trk
Number of trucks needed **(TRUCKS)**		TRIPS/LOADS	67.5	
		round up	**68**	**Trucks**

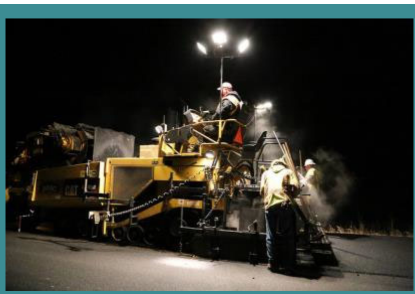
107

INSERT TAB

Pavers & Mix Laydown

Pavers & Mix Laydown

Module 6

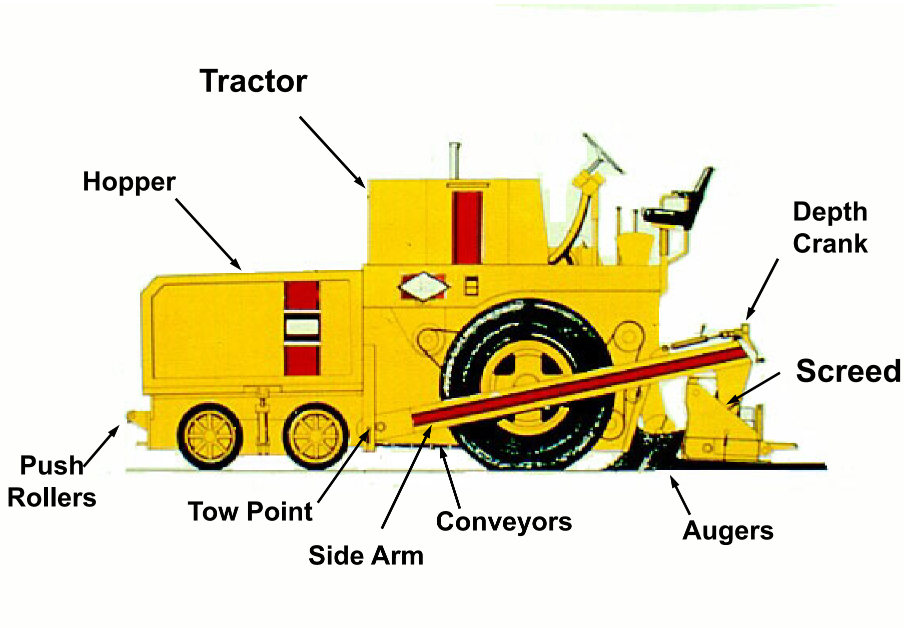


1

Pavers & Mix Laydown

- Review paver components
  - Tractor
  - Screed
  - Grade and slope control
- Operational principles of screed
- Take-offs
- Mat problems
- Determining paver speed

2



3

Paver Specifications
Tractor Unit

00745.23 Power and Support – Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.

4

Tractor Unit

- Push rollers and truck hitches
- Hopper
- Slat conveyer
- Conveyer flow gates
- Augers
- Materials feed system
- Tow points

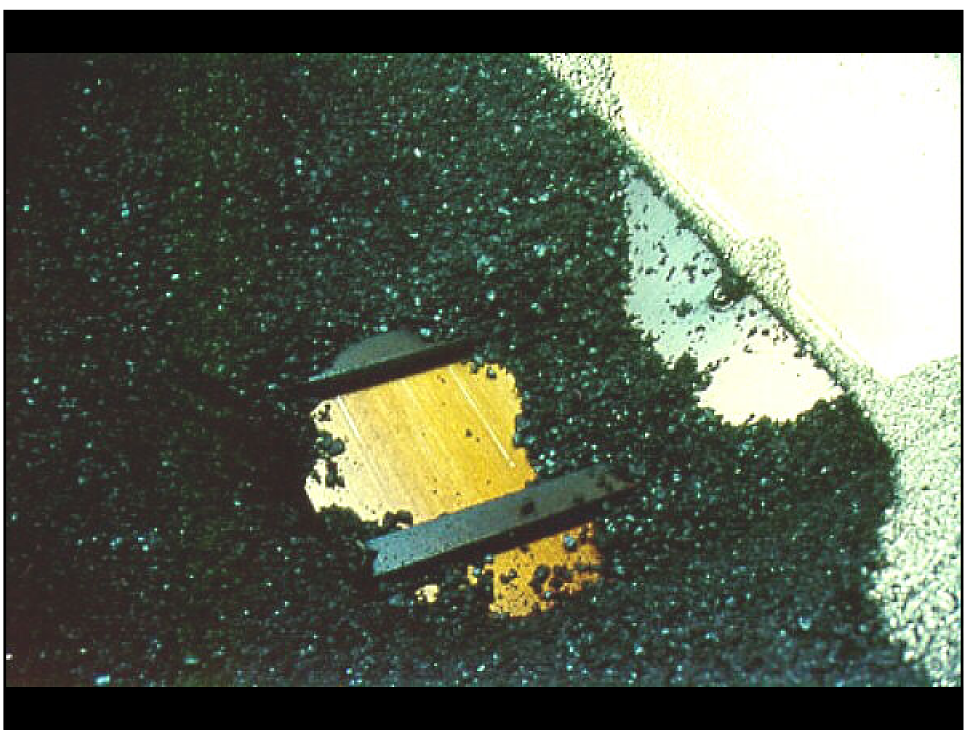
5

6

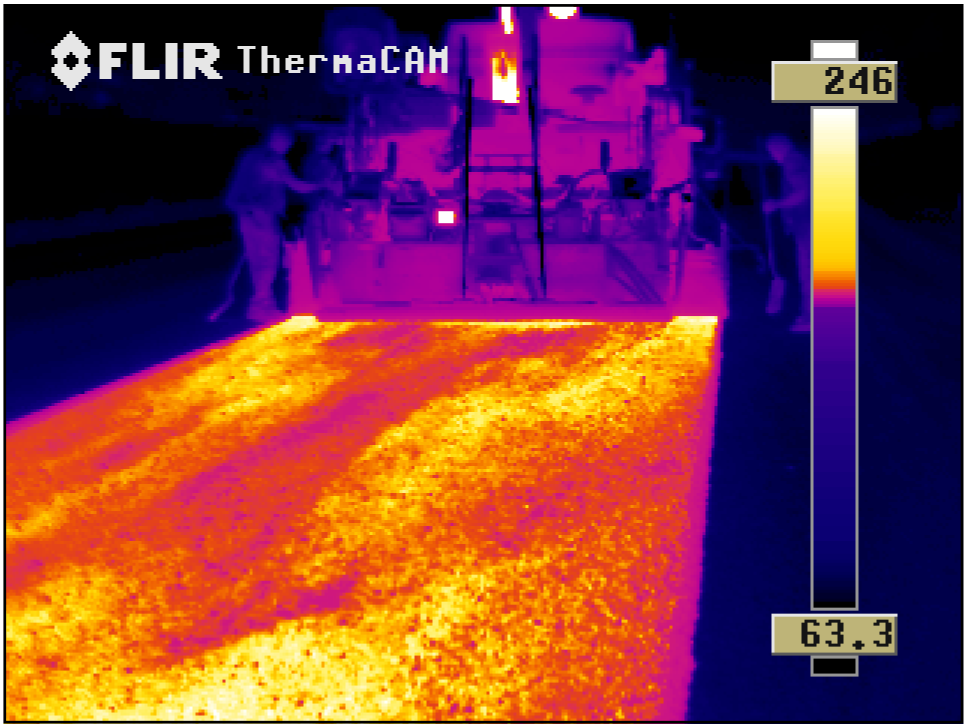
7

8

9



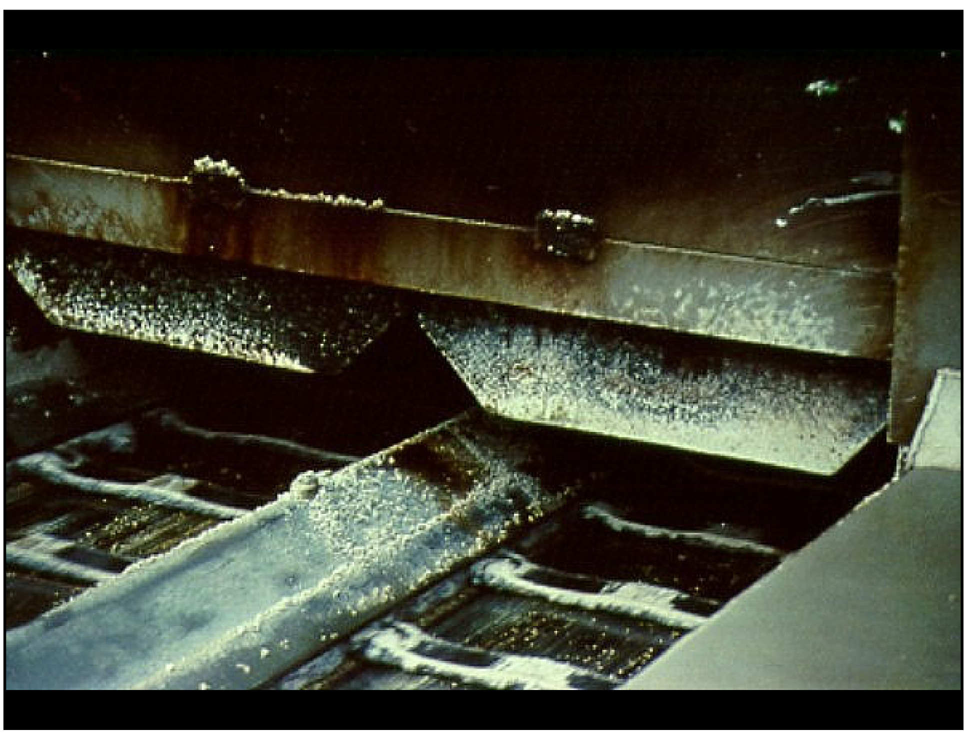
10



11

12

13



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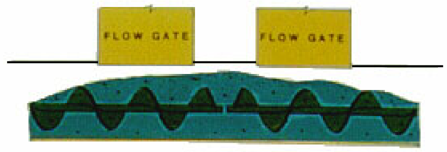
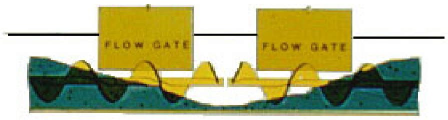
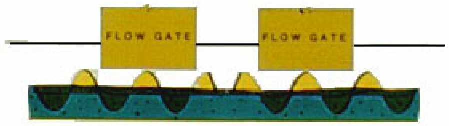


Gates too HIGH – augers overloaded



Gates too LOW – insufficient material supply

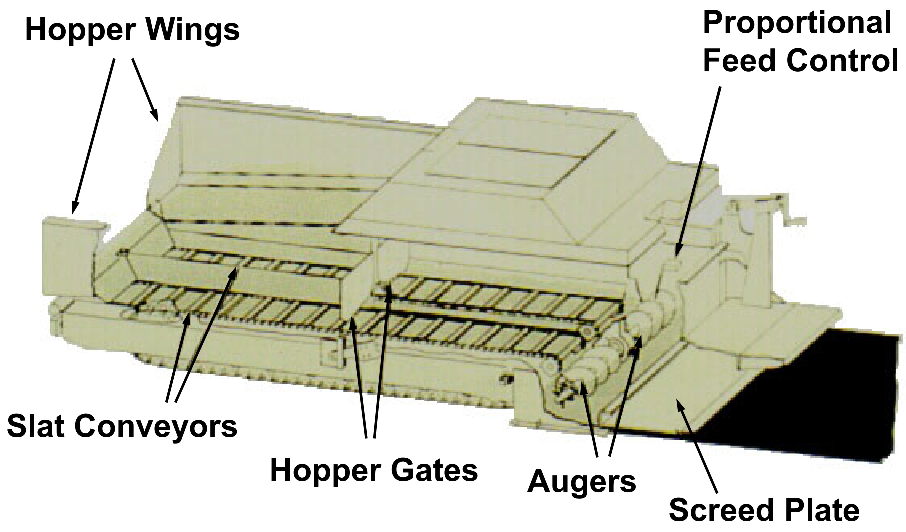


Correct adjustment – uniform material volume/flow

15

16

Material Flow



17

Paver Specifications
Auger & Screed

00745.23 Pavers– Equipped with augers and a screed or strike-off assembly, heated if necessary, which:

- Can spread and finish the ACP to a uniform texture, in the specified widths, thicknesses, lines, grades and cross sections
- Will not segregate, tear, shove or gouge the ACP

When are auger extensions beneficial?

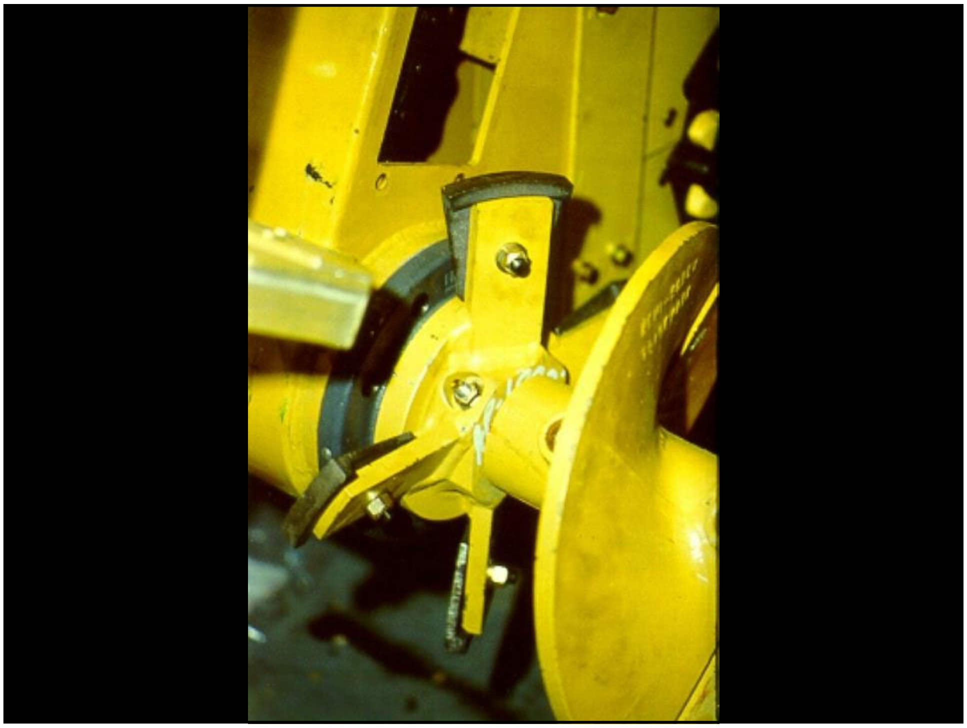
- *If a consistent width is being paved*
- *When non-uniform surface texture occurs in the area outside the auger locations*

ODOT MATERIALS & INSPECTION

18

19

20



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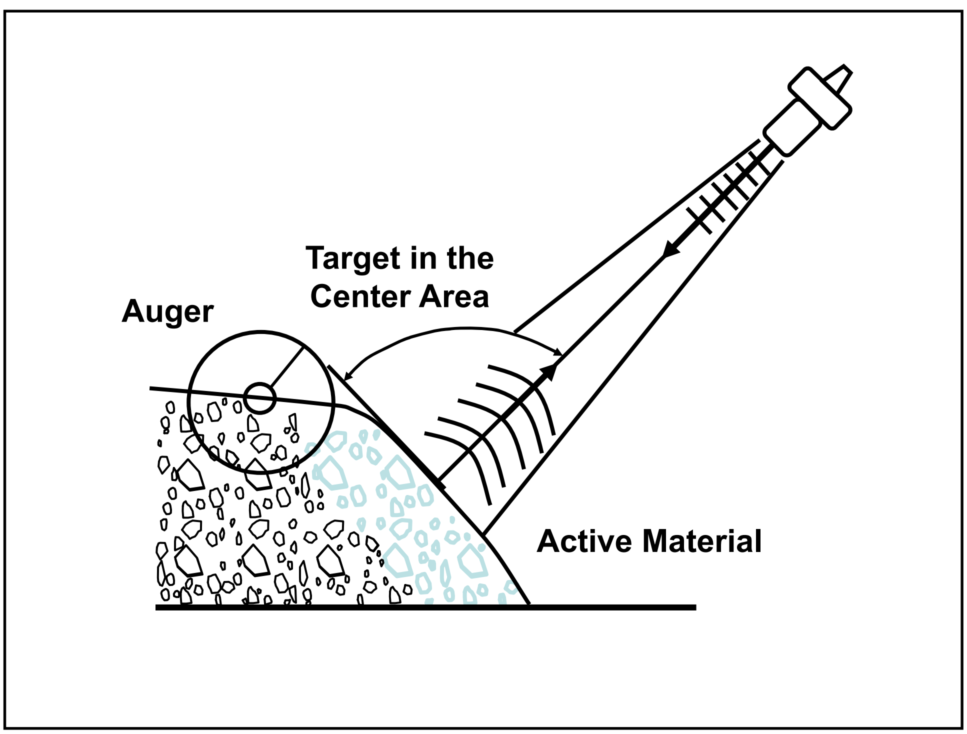

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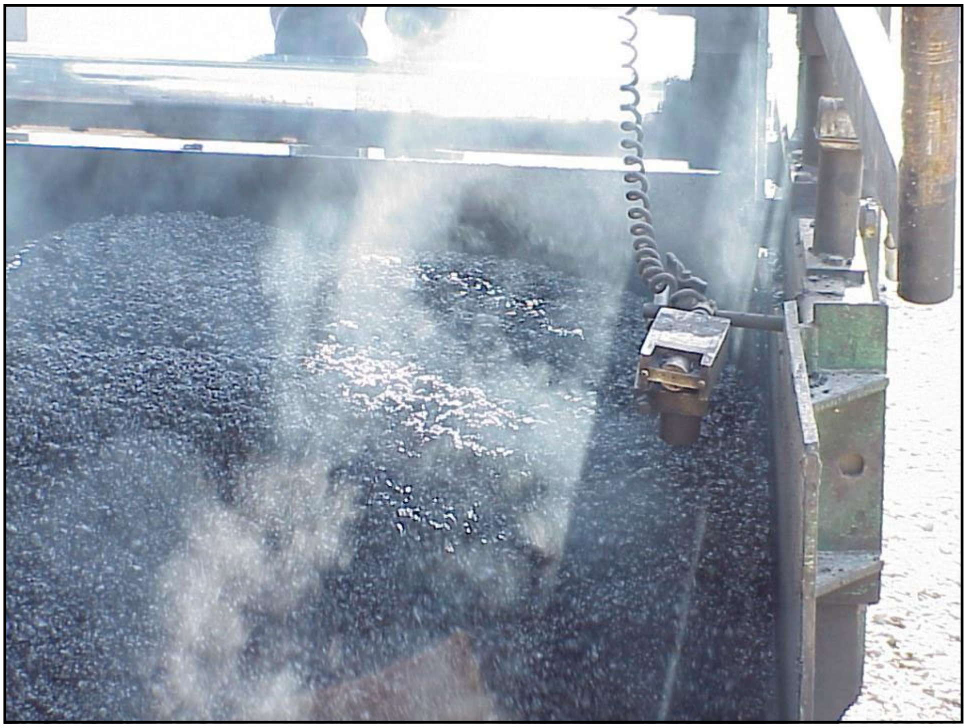
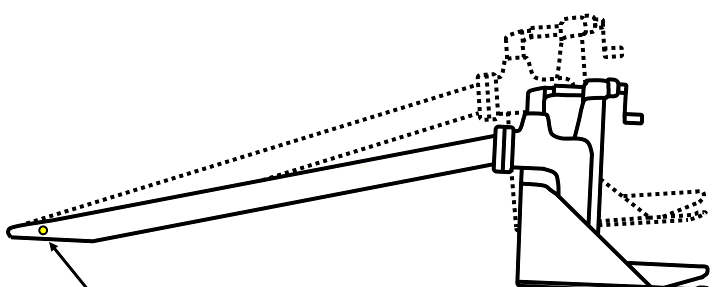


23



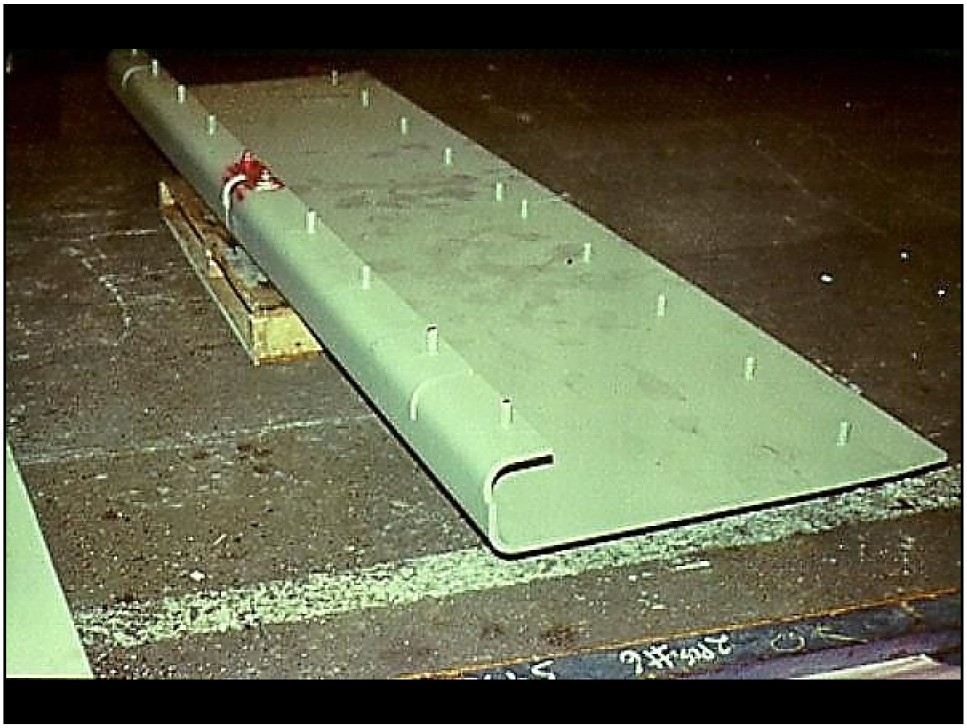
24

25

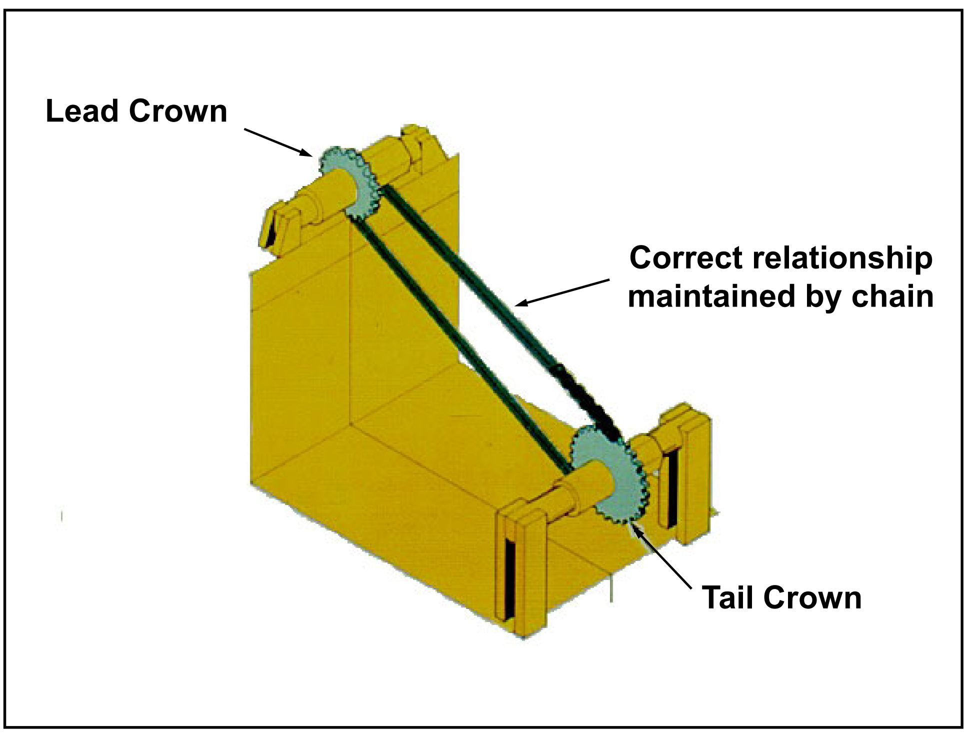
Screed Unit

- Screed plate
- Strike-off
- Crown control
- Extensions & end plates
- Thickness control screws
- Screed arm
- Pre-compaction system
- Heating systems

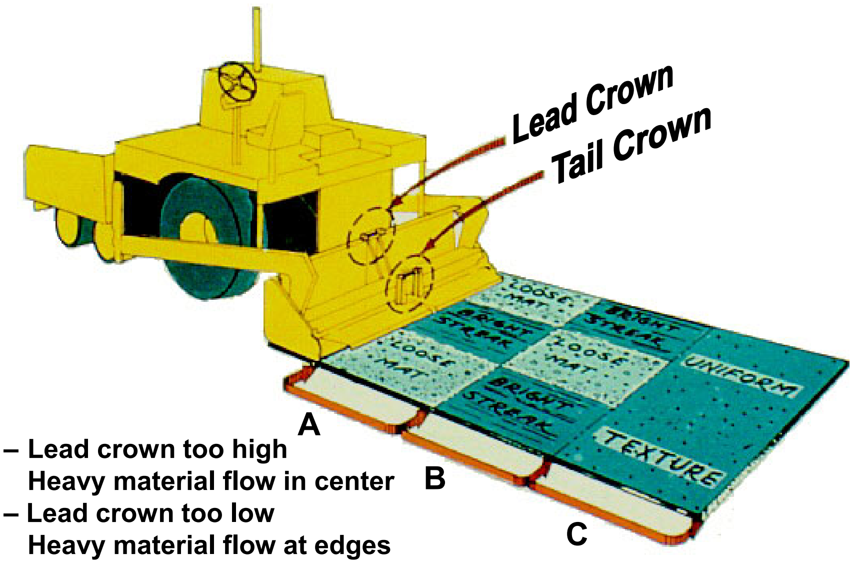
26



27


Lead Crown
Correct relationship maintained by chain
Tail Crown

28



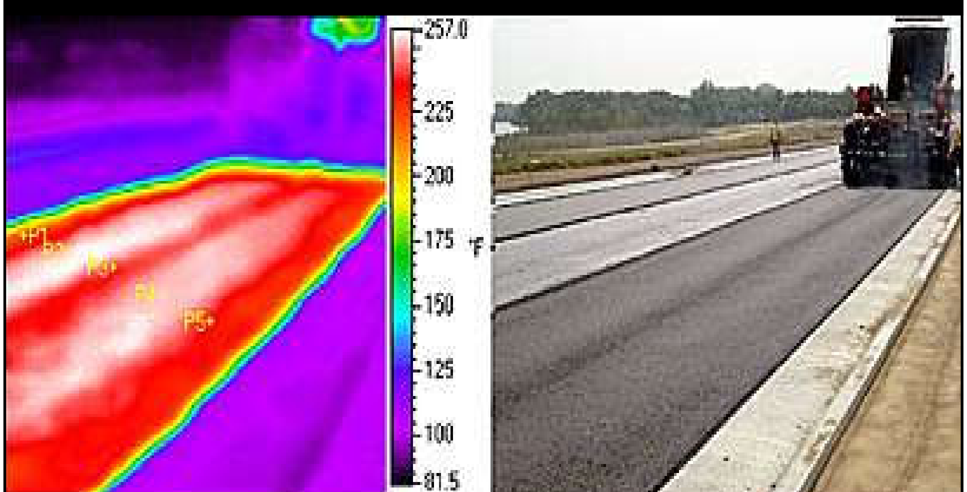
A – Lead crown too high
Heavy material flow in center

B – Lead crown too low
Heavy material flow at edges

C – Uniform mat texture and material flow from correct crown adjustment

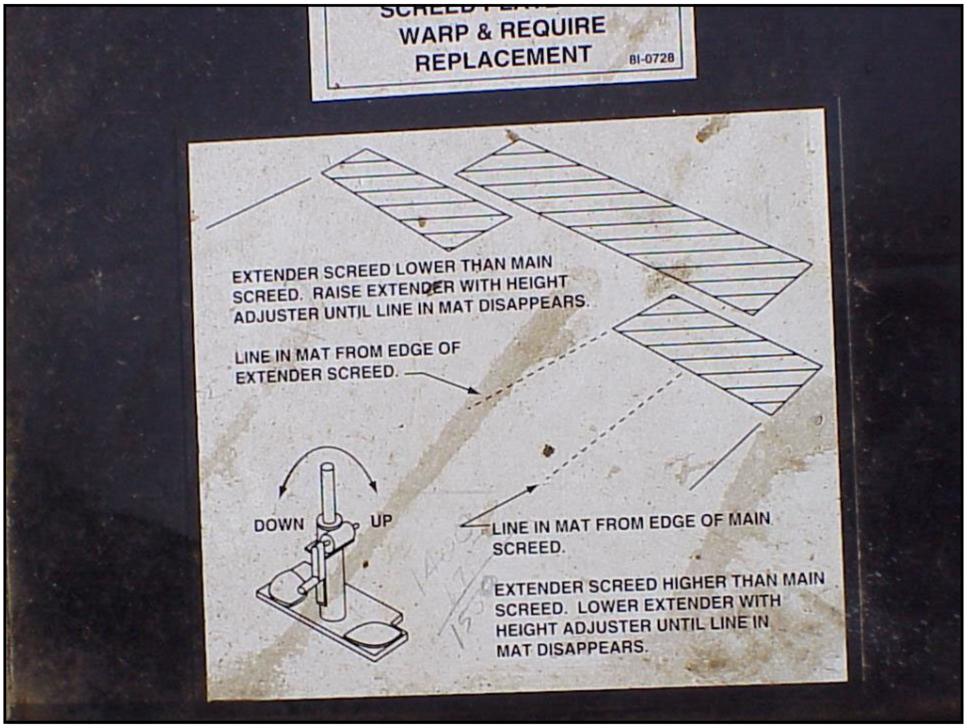
29

Lead Crown Too Low



Worn kicker paddles or reverse augers will also look like this.

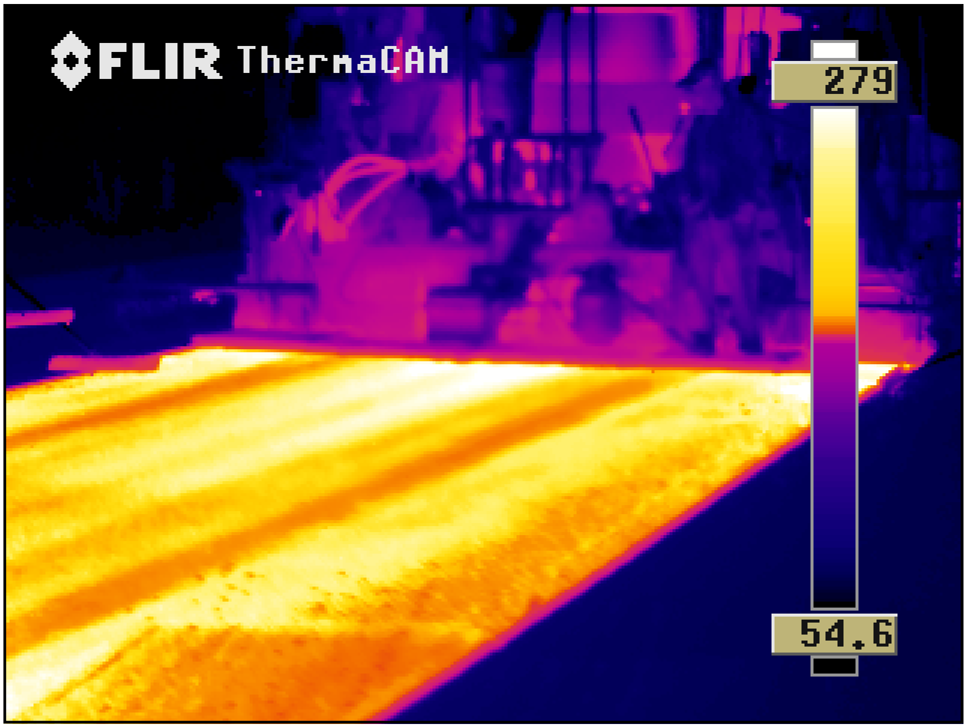
30


WARP & REQUIRE
REPLACEMENT
BI-0728
EXTENDER SCREED LOWER THAN MAIN SCREED. RAISE EXTENDER WITH HEIGHT ADJUSTER UNTIL LINE IN MAT DISAPPEARS.
LINE IN MAT FROM EDGE OF EXTENDER SCREED.
DOWN
UP
LINE IN MAT FROM EDGE OF MAIN SCREED.
EXTENDER SCREED HIGHER THAN MAIN SCREED. LOWER EXTENDER WITH HEIGHT ADJUSTER UNTIL LINE IN MAT DISAPPEARS.

31

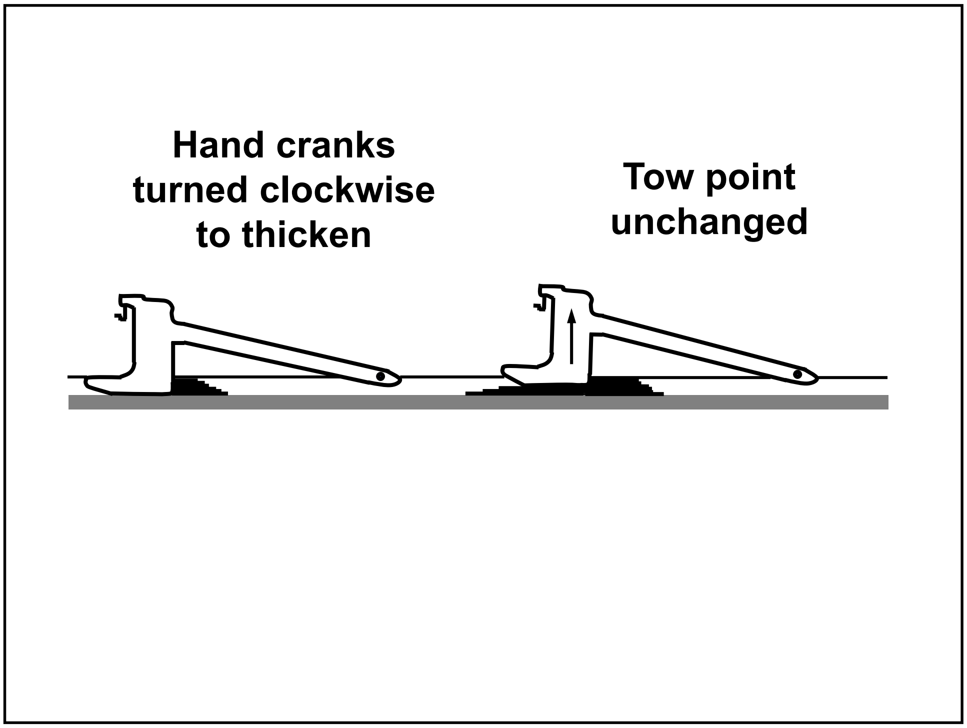

2002 9 23

32

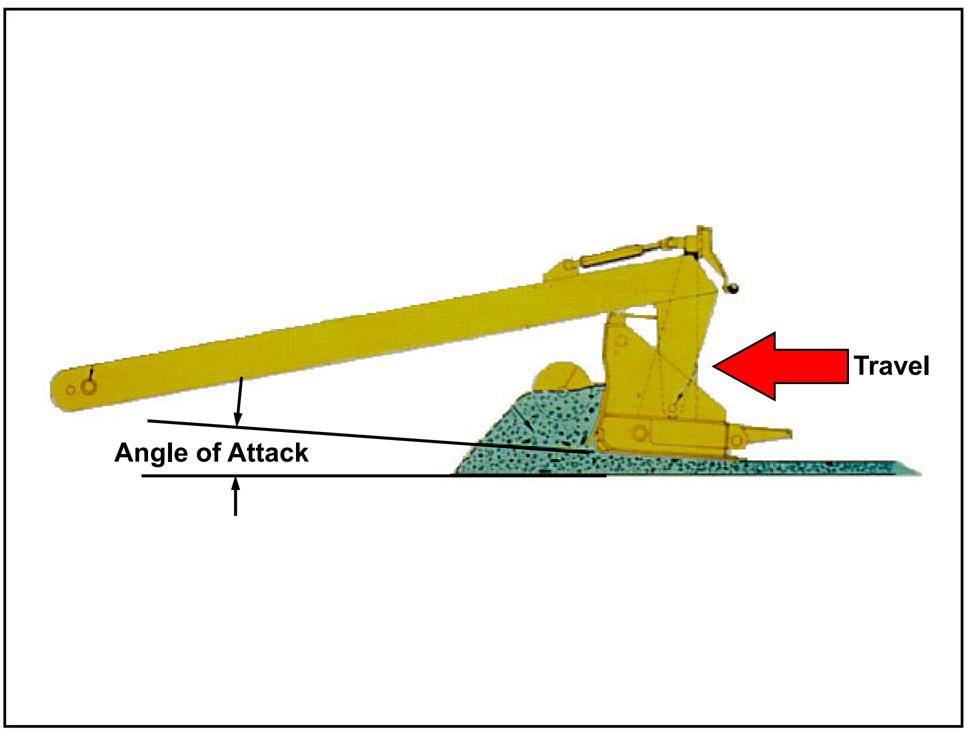


33

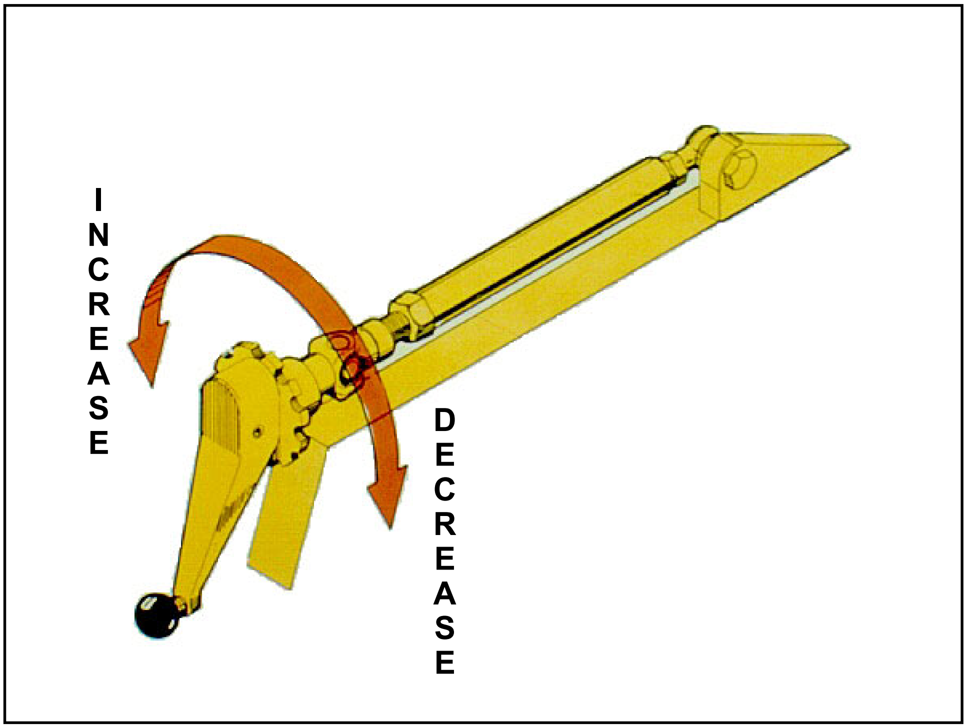
34


Hand cranks
turned clockwise
to thicken
Tow point
unchanged

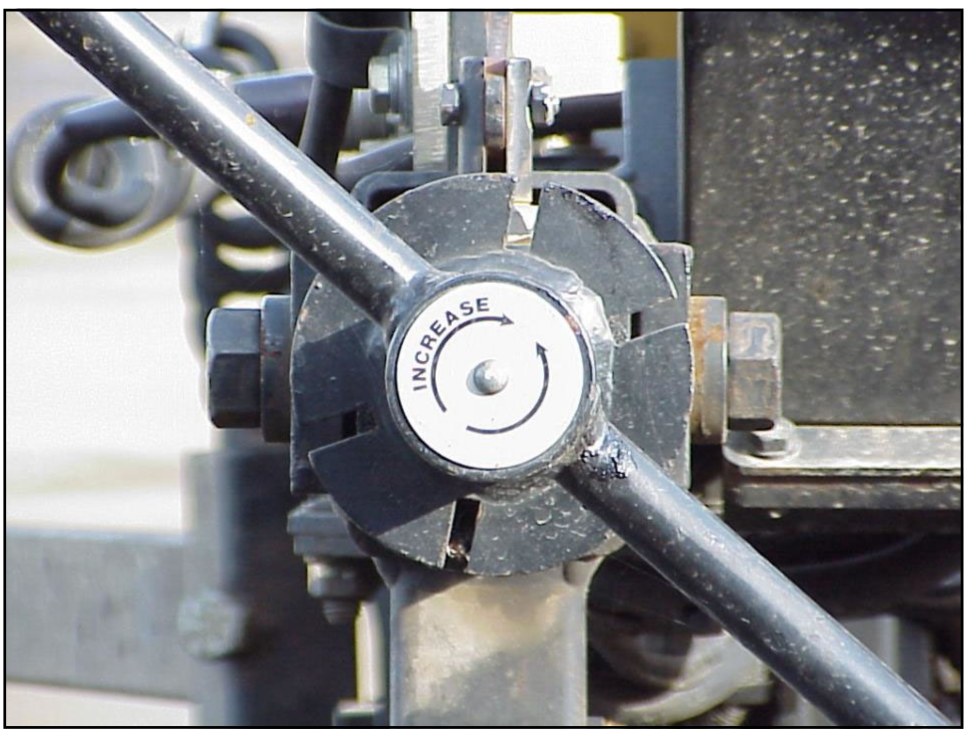
35


Travel
Angle of Attack

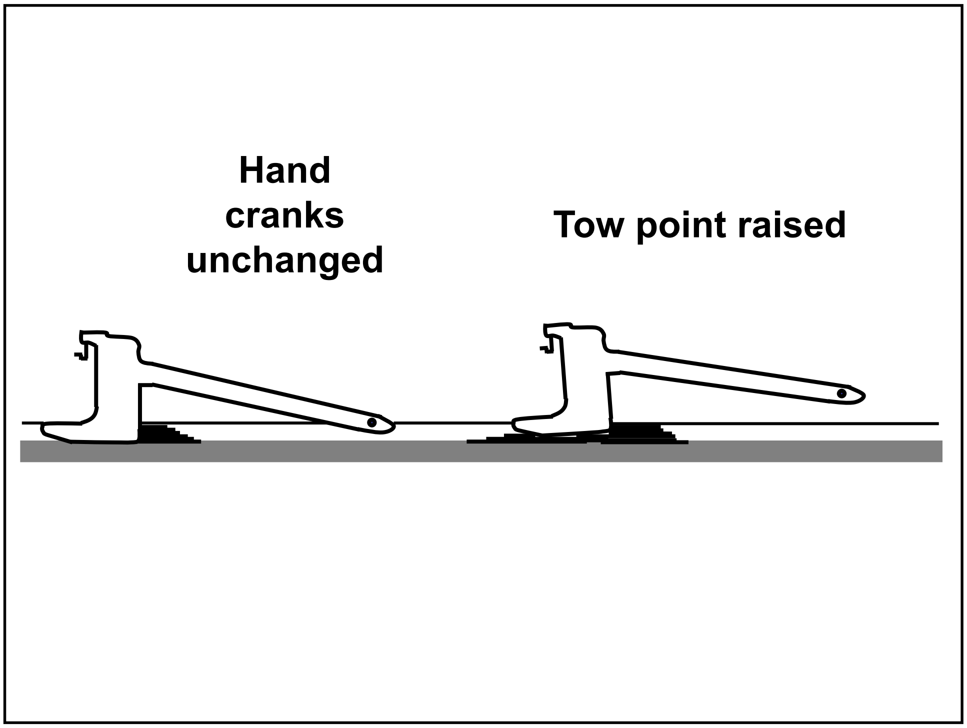
36



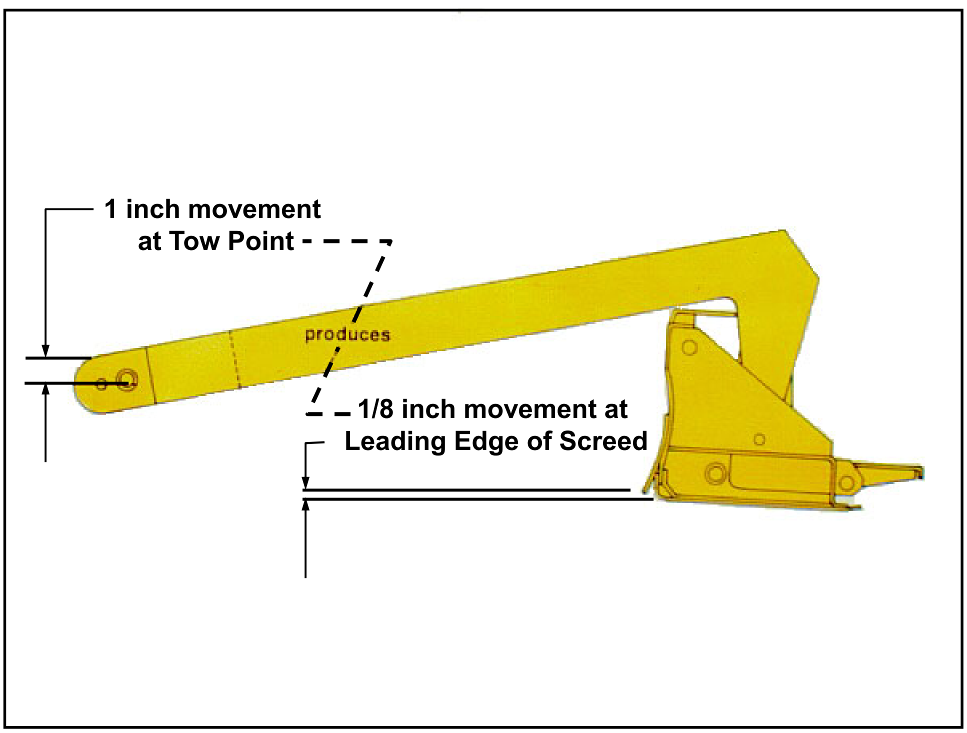
37



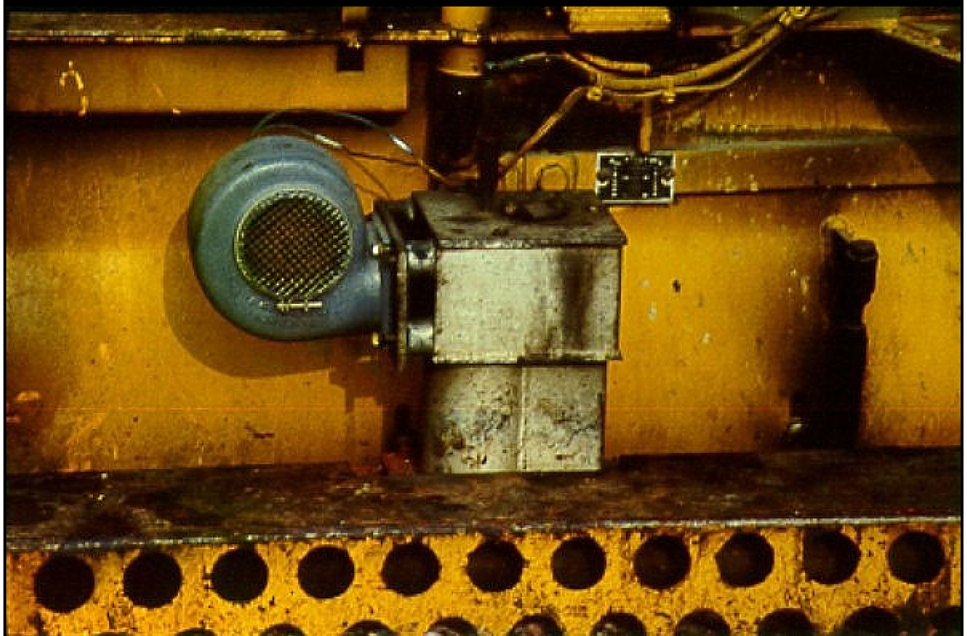
38


Hand
cranks
unchanged
Tow point raised

39

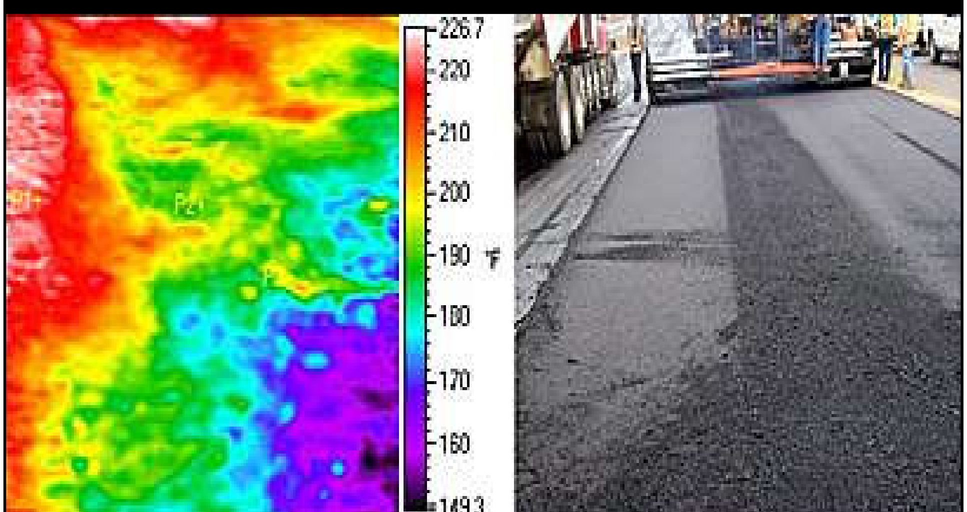

1 inch movement
at Tow Point
produces
1/8 inch movement at
Leading Edge of Screed

40



41

Cold Screed



42

43

Grade and Slope Control

00745.23 Control System – Equipped with a paver control system which:

- Controls the ACP placement to specified slope and grade
- Maintains the paver screed in proper position
- Provides the specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references

00745.45 Control of Line and Grade – Use a floating beam device of adequate length and sensitivity to control the grade of the paver. Where this method is impractical, manual control of grade will be allowed when approved.

ODOT MATERIALS & INSPECTION

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Types of Grade Reference

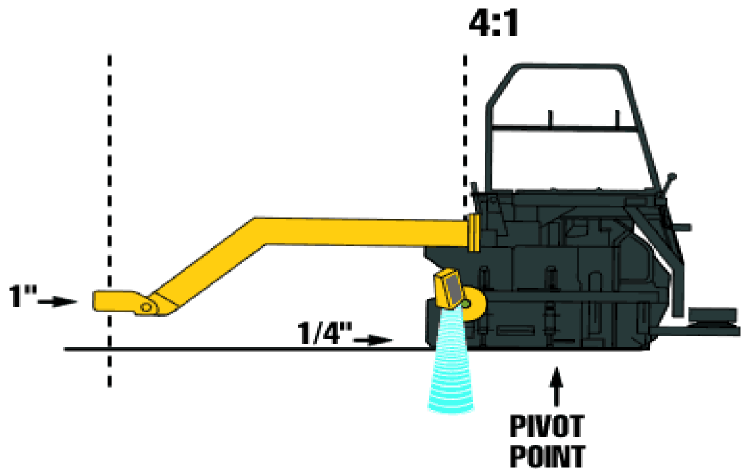
- Stringline
- Mobile reference
- Joint matching shoe

45

46

47

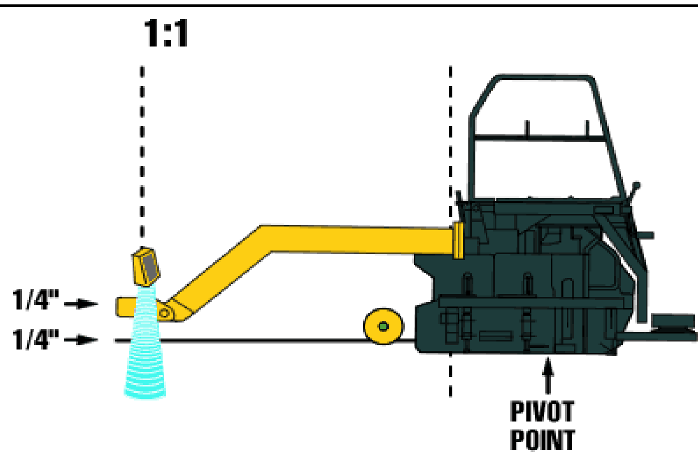
48



When the grade sensor is mounted rearward in line with the augers, it causes the screed to react very quickly to any detected deviation at the sensor. In this position if a 1/4" deviation is detected at the sensor, 1" of tow point movement will occur.

This is a very good position for joint matching or following a fixed stringline as the screed will react very quickly.

49

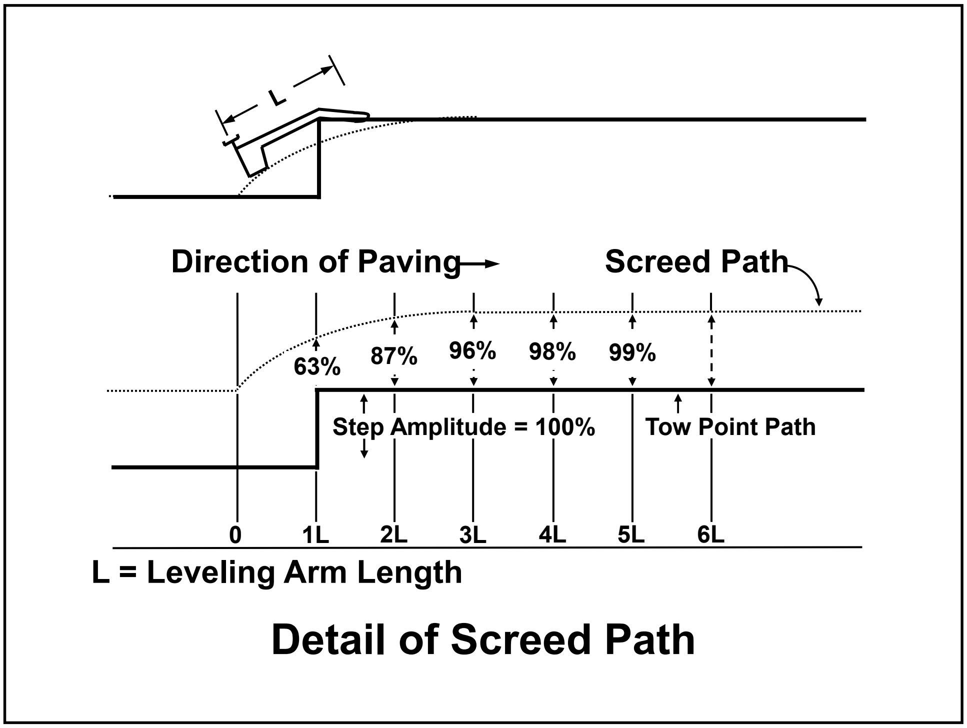


When the grade sensor is mounted forward close to the tow point cylinder, the screed reacts slowly. The change in mat thickness is spread out over a distance equal to five tow arm lengths.

In this position if a 1/4" deviation is detected at the sensor, 1/4" of tow point movement will occur. The screed will gradually change depth and smoothness is accomplished.

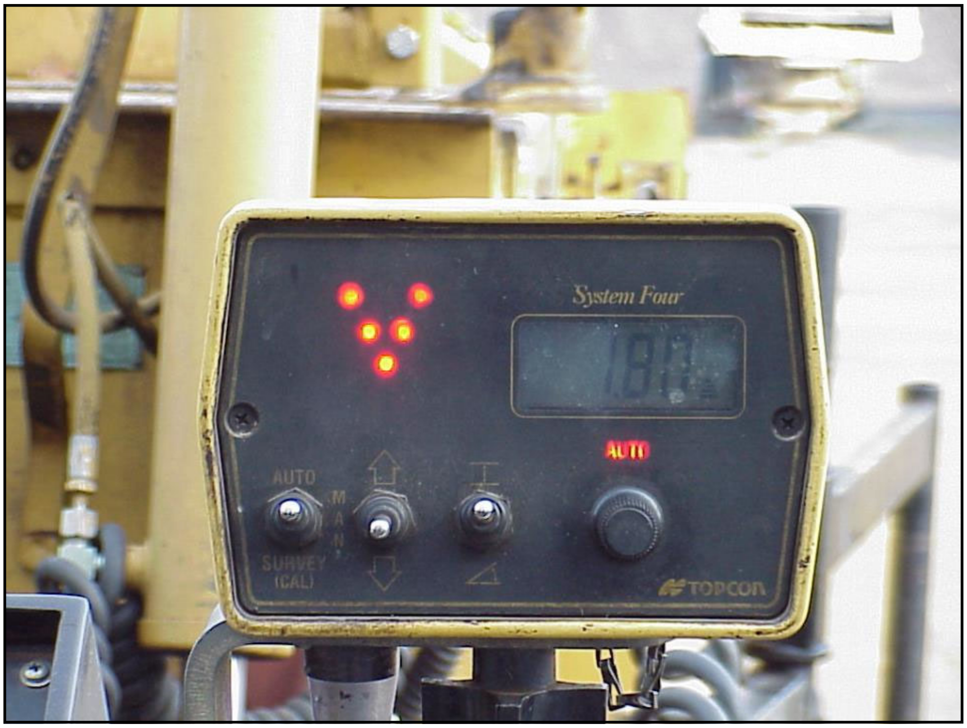
This is a very good position when used with an averaging ski as the screed will react gradually.

50

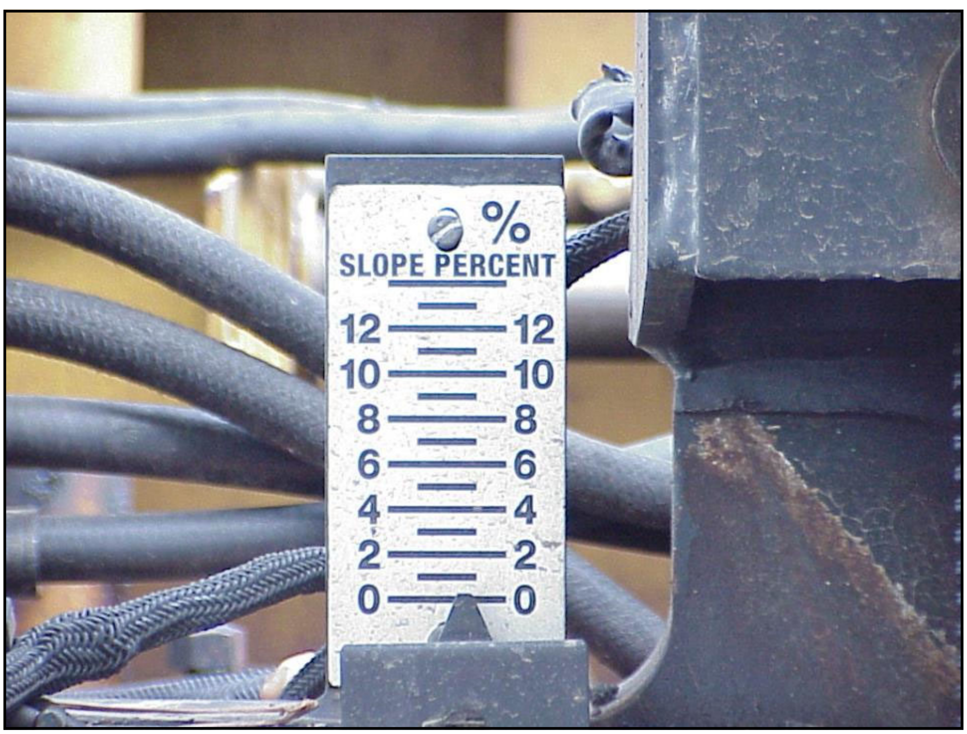

L
Direction of Paving
Screed Path
63%
87%
96%
98%
99%
Step Amplitude = 100%
Tow Point Path
0
1L
2L
3L
4L
5L
6L
L = Leveling Arm Length
Detail of Screed Path

51

52


System Four
AUTO
AUTO
MAN
SURVEY
(CAL)
TOPCON

53


%
SLOPE PERCENT
12 12
10 10
8 8
6 6
4 4
2 2
0 0

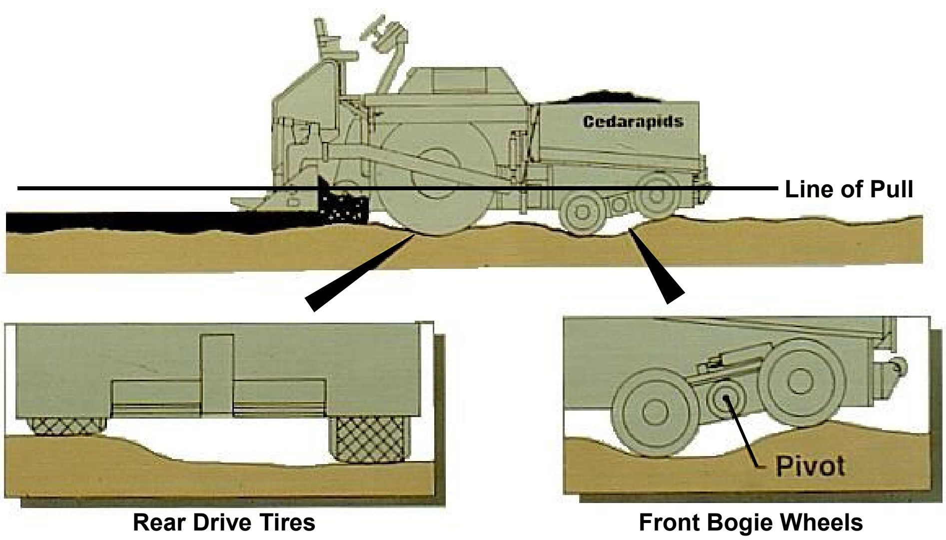
54

Operational Principles of the Screed

- Self-leveling concepts
- Screed response versus distance
- Forces acting on a screed

55

Self Leveling – Rubber Tired Paver



56

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Main Forces Acting on Screed

1. Speed of paver
2. Head of material
3. Angle of attack
4. Other forces
   - Pre-compaction
   - Screed weight

ODOT MATERIALS & INSPECTION

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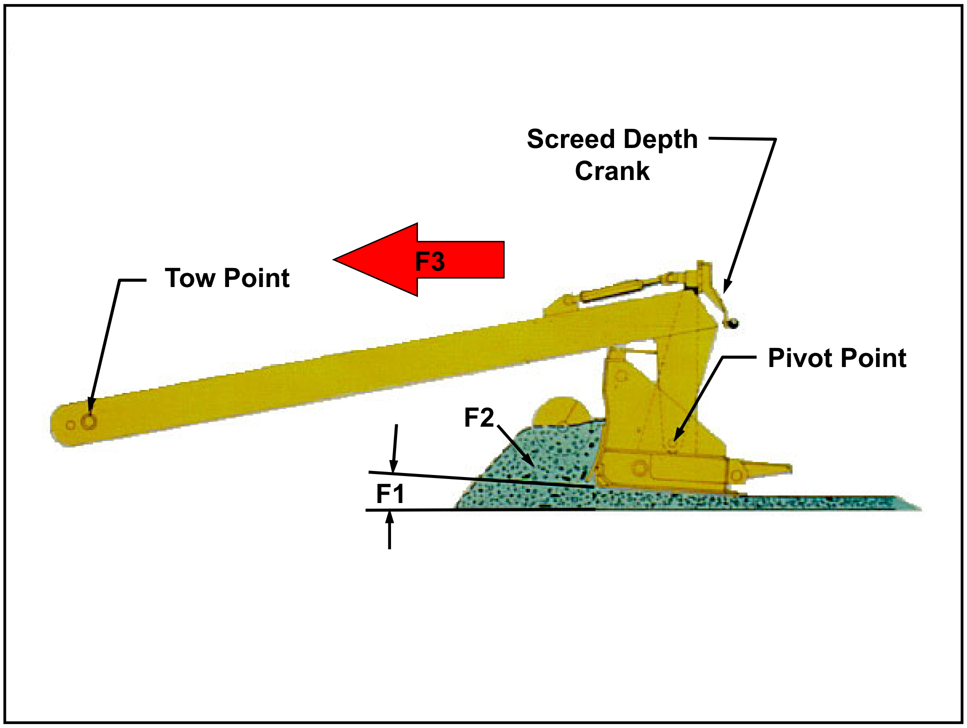
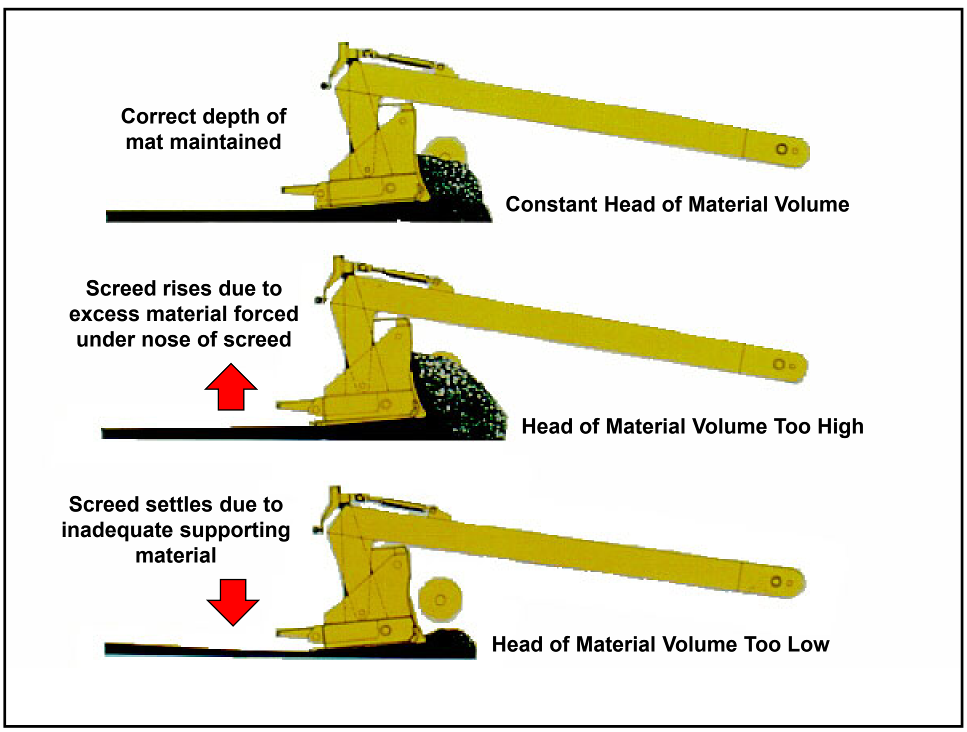

Screed Depth
Crank
Tow Point
F3
Pivot Point
F2
F1

59

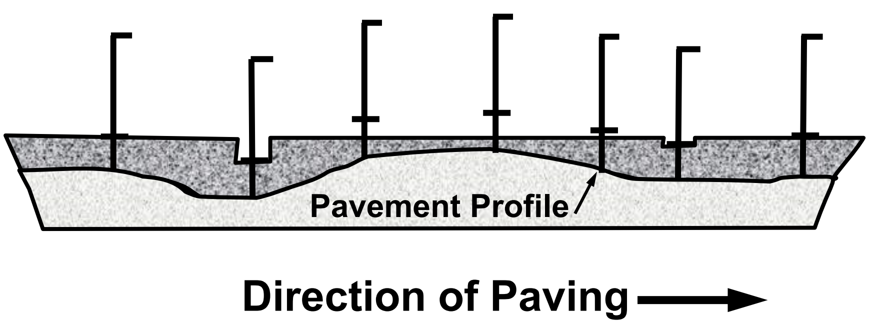

Correct depth of
mat maintained
Constant Head of Material Volume
Screed rises due to
excess material forced
under nose of screed
Head of Material Volume Too High
Screed settles due to
inadequate supporting
material
Head of Material Volume Too Low

60

Screed Control Systems

- Who's responsible for changes
- Sticking the mat
- Manual controls
- Automatic controls

61



62

Mat Problems

63

Correction of Defects

00745.60(b) Boils, Slicks, and Oversized Material – Before the ACP cools replace boils, slicks, and oversized materials with fresh mixture.

00745.60(c) Segregation – Take corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved by the Engineer.

00745.60(g) Other Defects – Remove and replace any ACP that:

- Is loose, broken, or mixed with dirt
- Shows visually too much or too little asphalt
- ~~Is defective in any way~~

64

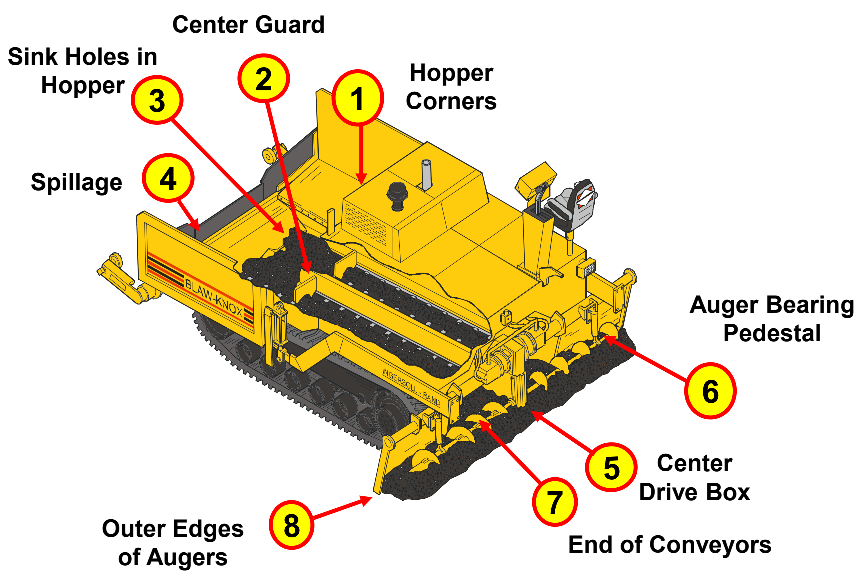
65

66

SEGREGATION!!!
SEGREGATION!!!
SEGREGATION!!!

67

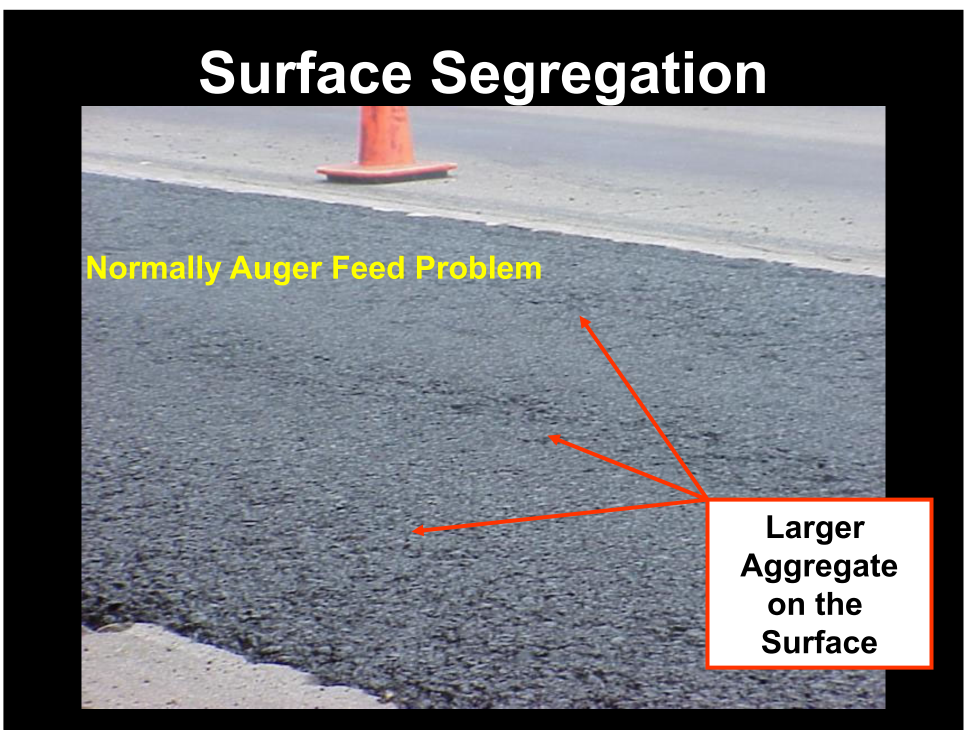
Eight Areas Where Segregation May Occur



68


Lines or Steps in the Mat
Steps or Lines
Requires a Screed Adjustment

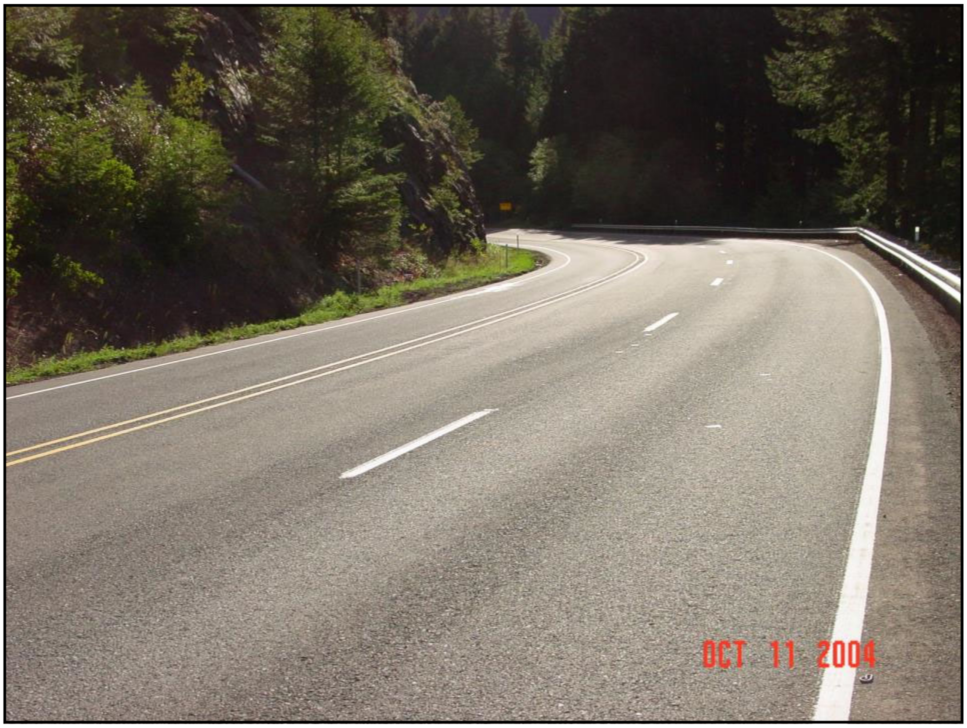
69


Surface Segregation
Normally Auger Feed Problem
Larger Aggregate on the Surface

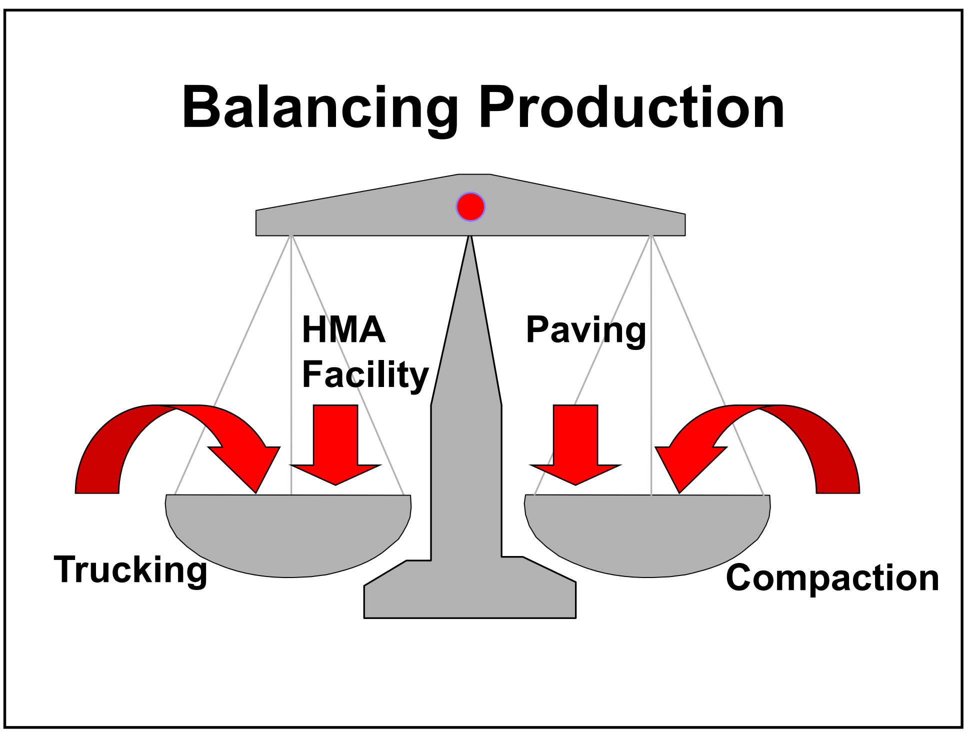
70

71

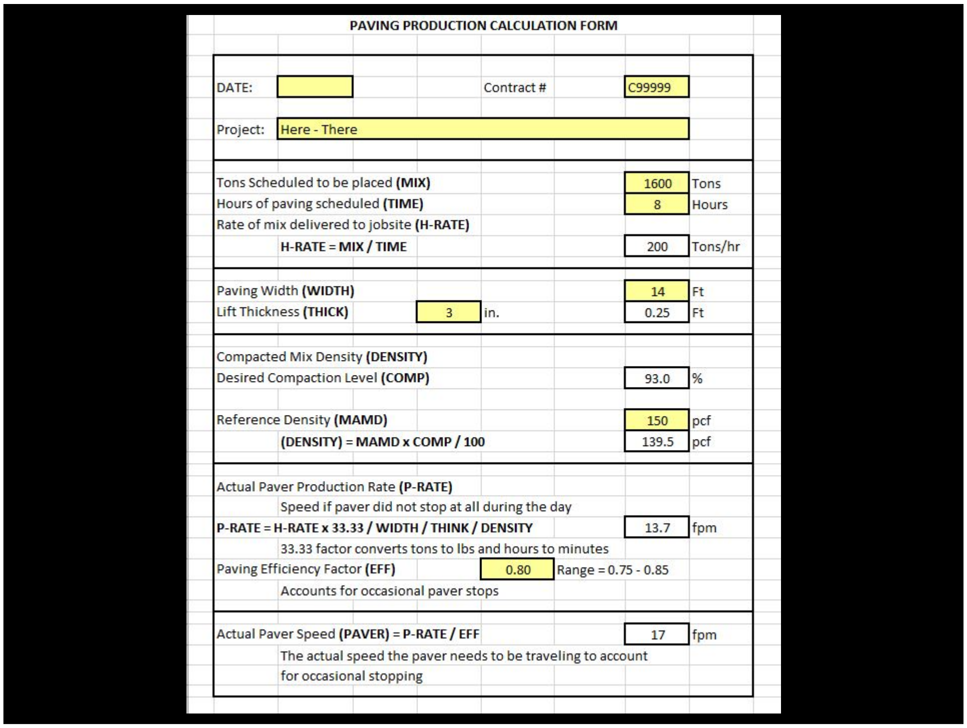
72


OCT 11 2004

73


Balancing Production
HMA
Facility
Paving
Trucking
Compaction

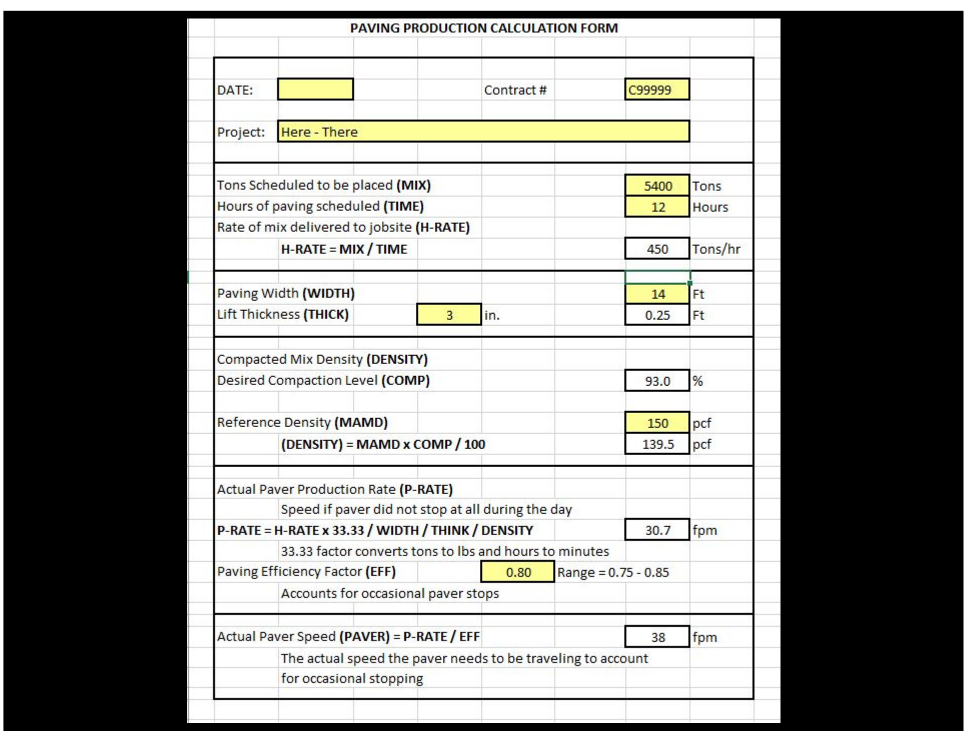
74



PAVING PRODUCTION CALCULATION FORM

DATE:		Contract #	C99999
Project:	Here - There		
Tons Scheduled to be placed **(MIX)**		1600	Tons
Hours of paving scheduled **(TIME)**		8	Hours
Rate of mix delivered to jobsite **(H-RATE)**			
H-RATE = MIX / TIME		200	Tons/hr
Paving Width **(WIDTH)**		14	Ft
Lift Thickness **(THICK)**	3 in.	0.25	Ft
Compacted Mix Density **(DENSITY)**			
Desired Compaction Level **(COMP)**		93.0	%
Reference Density **(MAMD)**		150	pcf
(DENSITY) = MAMD x COMP / 100		139.5	pcf
Actual Paver Production Rate **(P-RATE)**			
Speed if paver did not stop at all during the day			
P-RATE = H-RATE x 33.33 / WIDTH / THINK / DENSITY		13.7	fpm
33.33 factor converts tons to lbs and hours to minutes			
Paving Efficiency Factor **(EFF)**	0.80	Range = 0.75 - 0.85	
Accounts for occasional paver stops			
Actual Paver Speed **(PAVER) = P-RATE / EFF**		17	fpm
The actual speed the paver needs to be traveling to account for occasional stopping			

75



PAVING PRODUCTION CALCULATION FORM

DATE:		Contract #	C99999
Project:	Here - There		
Tons Scheduled to be placed **(MIX)**		5400	Tons
Hours of paving scheduled **(TIME)**		12	Hours
Rate of mix delivered to jobsite **(H-RATE)**			
H-RATE = MIX / TIME		450	Tons/hr
Paving Width **(WIDTH)**		14	Ft
Lift Thickness **(THICK)**	3 in.	0.25	Ft
Compacted Mix Density **(DENSITY)**			
Desired Compaction Level **(COMP)**		93.0	%
Reference Density **(MAMD)**		150	pcf
(DENSITY) = MAMD x COMP / 100		139.5	pcf
Actual Paver Production Rate **(P-RATE)**			
Speed if paver did not stop at all during the day			
P-RATE = H-RATE x 33.33 / WIDTH / THINK / DENSITY		30.7	fpm
33.33 factor converts tons to lbs and hours to minutes			
Paving Efficiency Factor **(EFF)**	0.80	Range = 0.75 - 0.85	
Accounts for occasional paver stops			
Actual Paver Speed **(PAVER) = P-RATE / EFF**		38	fpm
The actual speed the paver needs to be traveling to account for occasional stopping			

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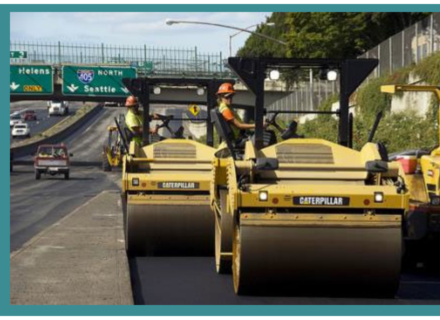
INSERT TAB

Compaction Fundamentals

Compaction Fundamentals

Module 7



1

Compaction Fundamentals

- Compaction – Importance to performance
- Engineering properties related to compaction
- Factors affecting compaction

2

Compaction

Effects on Performance

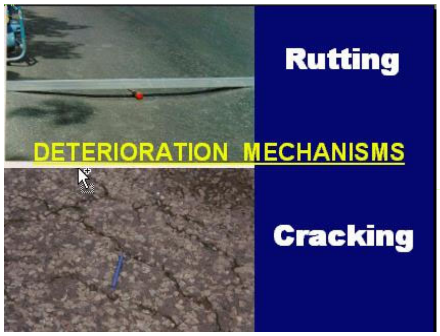
3

Importance of Compaction

- Improve mechanical stability
- Improve resistance to permanent deformation
- Reduce moisture penetration
- Improve fatigue resistance
- Reduce low-temperature cracking potential

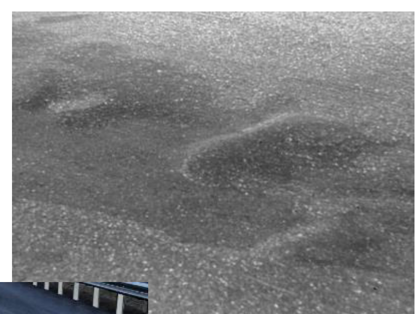
4

In-Place Air Voids
Keys to Performance



5

In-Place Air Voids & Performance
Past Studies – Air Voids < 3%



6

Air Voids > 8%

Cracking

Stripping

7

Permeability

- Measure of ability to drain water
- High permeability – Drains a lot of water
- Low permeability – Drains little or no water

8

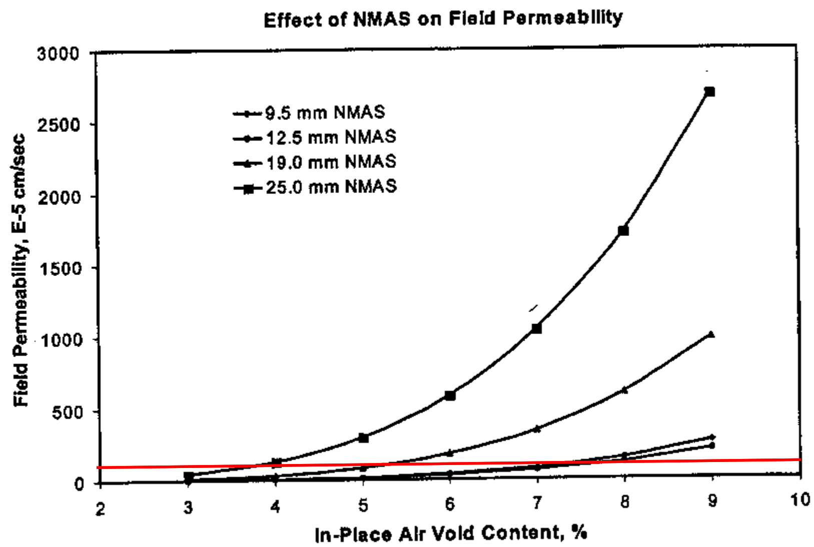


Figure 3.23: Effect of NMAS on permeability.

- Bold red line is impermeable line

9

Goal

- Construct pavements to In-Place Voids
  Low enough to be impermeable
- But not so low to get flushing or rutting

10

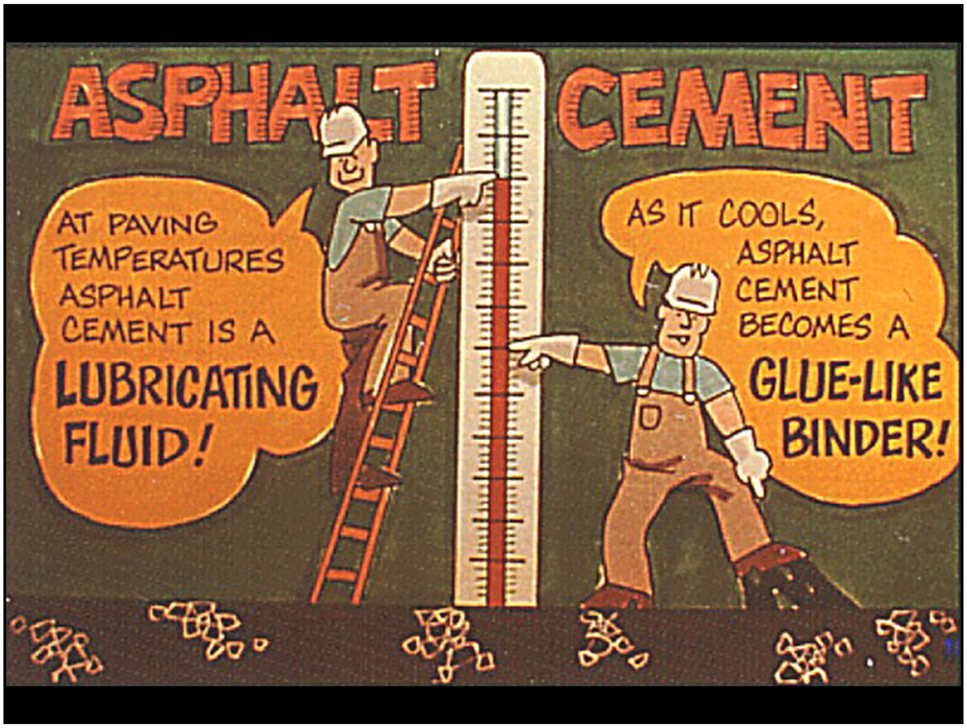
Factors Affecting Compaction

- Properties of the materials
- Environmental variables
- Laydown site conditions

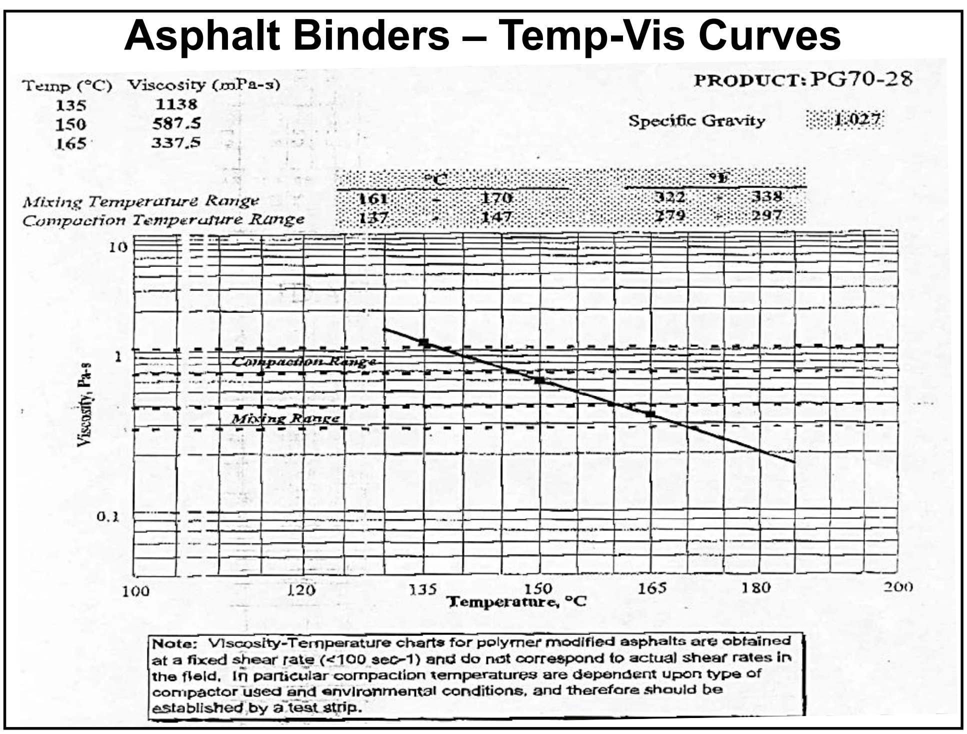
11

Asphalt Binders

12

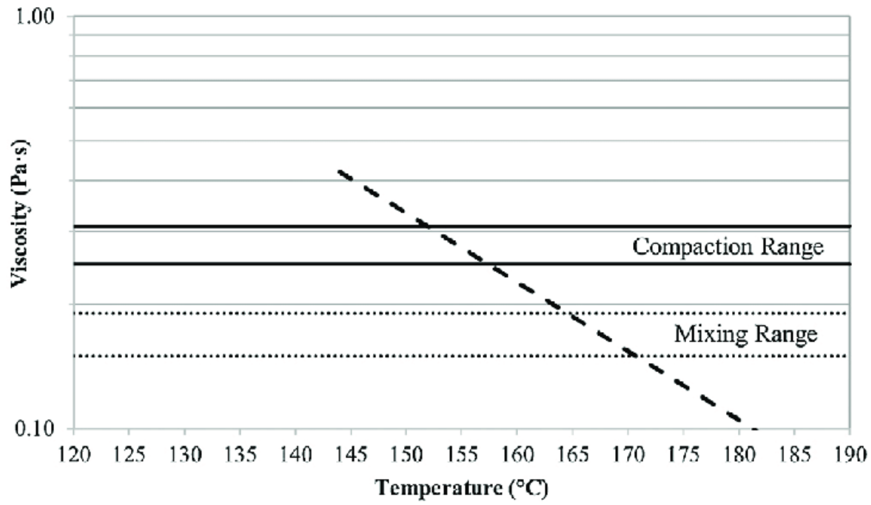

ASPHALT CEMENT
AT PAVING TEMPERATURES ASPHALT CEMENT IS A LUBRICATING FLUID!
AS IT COOLS, ASPHALT CEMENT BECOMES A GLUE-LIKE BINDER!

13


Asphalt Binders – Temp-Vis Curves
PRODUCT: PG70-28
Temp (°C) Viscosity (mPa-s)
135 1138
150 587.5
165 337.5
Specific Gravity 1.027
°C °F
Mixing Temperature Range 161 - 170 322 - 338
Compaction Temperature Range 137 - 147 279 - 297
Compaction Range
Mixing Range
Viscosity, Pa-s
10
1
0.1
100 120 135 150 165 180 200
Temperature, °C
Note: Viscosity-Temperature charts for polymer modified asphalts are obtained at a fixed shear rate (<100 sec-1) and do not correspond to actual shear rates in the field. In particular compaction temperatures are dependent upon type of compactor used and environmental conditions, and therefore should be established by a test strip.

14

Asphalt Binder Temp-Vis Curve



15

Asphalt Binders

- Placement temperatures given on JMF
- Properties of the binder can vary over the course of a summer
- Verify placement temperatures with binder supplier prior to start-up
- Verify placement temperatures if behavior of the mix changes during production

16

Asphalt Supplier:	Owens Corning	Transferred from Lab No.:	15-MD0051
Asphalt Grade:	PG64-22	Antistrip Information:	%
Gb (60°/60° F):	1.037		

RAP & binder properties and aggregate gravities updated for 2018.

Stockpile Information

Stockpile Size	1/2" - #4	#4 - #8	#4- 0	Sand	RAP		
Stockpile Source	05-004-1	05-004-1	05-004-1	Stkpile			
Stockpile Percentage	24.0	7.0	36.0	3.0	30.0	0.0	0.0
Bulk Specific Gravity (Gsb)	2.691	2.671	2.647	2.560	2.671	0.100	0.100

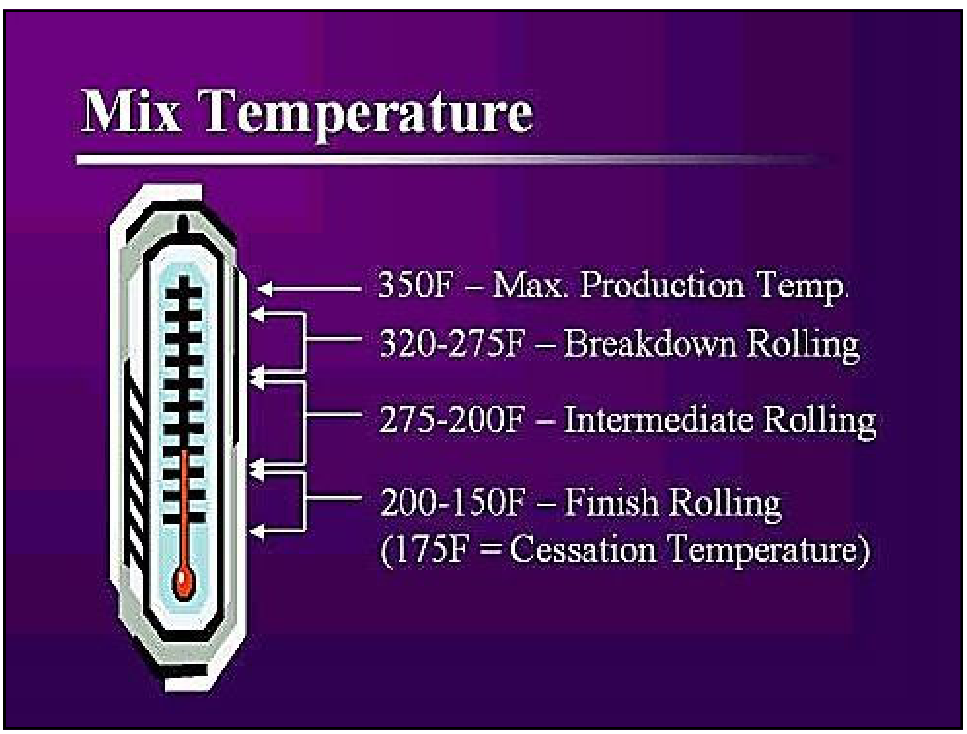
Job Mix Formula

Sieve		% Pass
3/4" (19mm)	-----------	100
1/2" (12.5mm)	-----------	96
3/8" (9.5mm)	-----------	86
1/4" (6.25mm)	-----------	68
No. 4 (4.75mm):	-----------	54
No. 8 (2.36mm):	-----------	36
No. 16 (1.18mm):	-----------	26
No. 30 (0.60mm):	-----------	20
No. 50 (0.30mm):	-----------	14
No. 100 (0.15mm):	-----------	10
No. 200 (0.075mm):	-----------	7.0

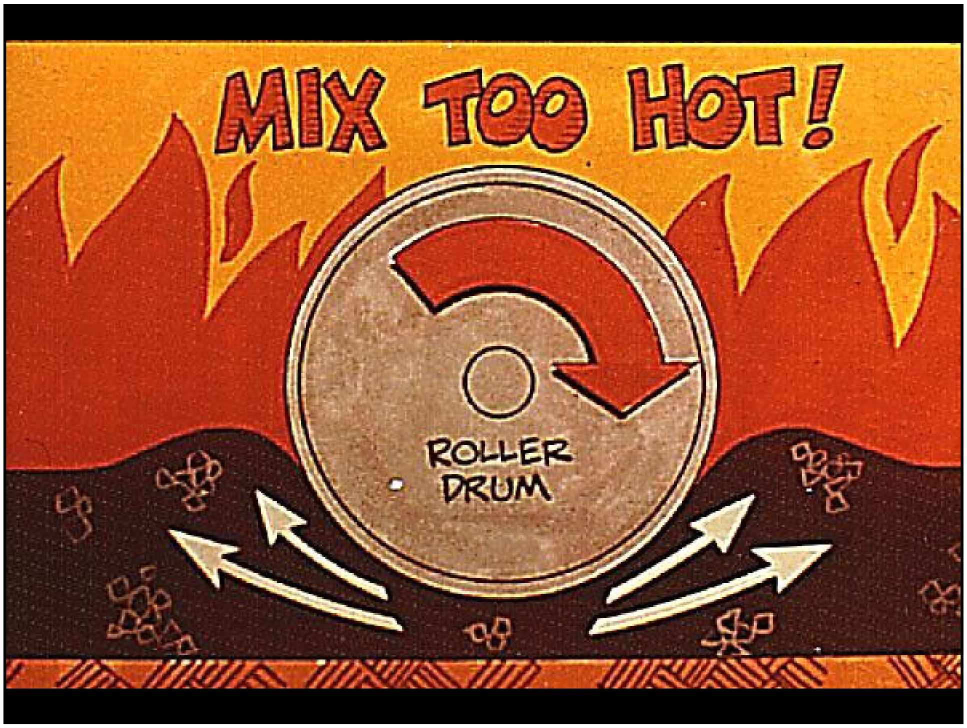
Paving Course		% Asphalt by Wt. of Mixture (Pb)	Maximum Specific Gravity (Gmm):
Wearing	☑	5.4	2.502
Base	☑		
Leveling	☑		
Temporary	☑		

VMA:	14.7	VFA:	73
Percent A/C in Rap:	5.1	Combined Aggregate Gravity (Gsb):	2.664
Number of Gyrations:	65	Gmb Sample Weight:	4730
Void Target (Va):	4.0	Mixing Temp Range:	311-322F
Tensile Strength Ratio:	85.6	Placement Temp Range:	291-299F

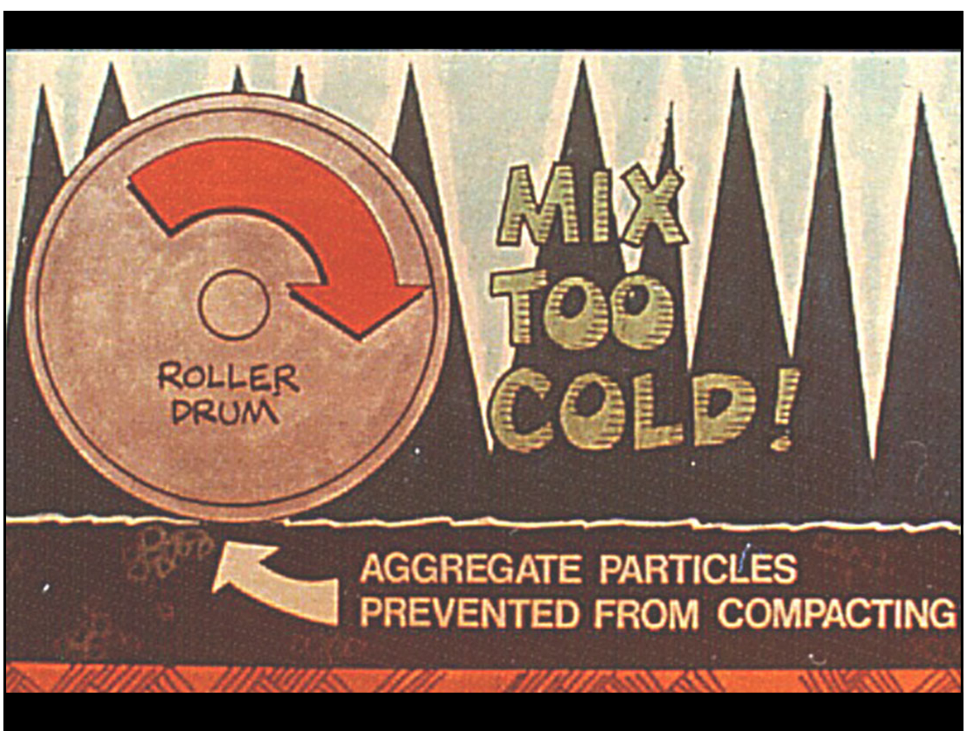
17



18


MIX TOO HOT!
ROLLER DRUM

19


ROLLER DRUM
MIX TOO COLD!
AGGREGATE PARTICLES PREVENTED FROM COMPACTING

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PG Binders

- **64 Grades (Dense Graded Mixes)**
  - Mixing temp (280-310° F)
  - Breakdown between 265-290° F
  - Likely to be tender
- **70 Grades (Dense Graded Mixes)**
  - Two times stiffer than 64 Grades
  - Higher mixing temp 320-340° F
  - Breakdown between 305-315° F
  - Challenging handwork
  - Cold weather difficulties
- **76 & ER Grades (Dense Graded Mixes)**
  - High traffic, urban areas & hot summer climates (Southern & Eastern OR)
  - High mixing (350° F +/-) and laydown temperatures
  - Very stiff mixes
  - Challenging handwork
  - Compacting while hot critical

ODOT MATERIALS & INSPECTION

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Aggregates

ODOT MATERIALS & INSPECTION

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Aggregate

- Particle shape, texture
- Aggregate absorption
  (effective asphalt)

23

Aggregate Shape

24

Aggregate Texture

25

Aggregate Fracture

26

Gradation

- Mixes too fine (too much dust) or too coarse (filling voids with oil) can be tender
- High sand content can cause tender mix

27

Mix Properties

- **Asphalt Content**

  For each 0.1% low, voids in field will be 0.3- 0.4% higher

- **P200**

  For each 1% P200, voids will be ~ 1% higher or lower

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Moisture

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Moisture
Effects on Binders

Asphalts are aged (hardened) to some degree during the ACP production process. The presence of excessive mix moisture can reduce the amount of aging that occurs to a binder. This can result in a less stiff binder that is softer, is more likely to act tender, and may need to cool to a lower temperature before opening to traffic.

30

Moisture
Mix Tenderness

Moisture in the mix acts as a lubricant. This lubrication can be beneficial in achieving compaction. However, if moisture is excessive, the total fluids content (oil + moisture) in the mix may get too high. High fluids content, in conjunction with the reduced aging effects of increased moisture described above, can result in a tender mix which may have to cool to a very low temperature to become stable enough to achieve final compaction. It is inconclusive as to whether tender mixes perform worse than non-tender mixes.

ODOT MATERIALS & INSPECTION

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Lift Thickness

Lift thickness does affect our ability to achieve compaction

- Too thin for a given aggregate size – Not enough room for particles to re-orient during compaction
  - Results - Low compaction, dragging
- Too thick – Push and shove, may not get compaction if the right equipment is not used

ODOT MATERIALS & INSPECTION

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Lift Thickness

- ODOT Revised Practice:
  - 1.0" Min for $^3/_8$" mixes (can also be used for leveling)
  - 2.0" Min for ½" mixes
  - 3.0" Min for ¾" mixes
- Based on national research for thicknesses to achieve optimum compaction…Local experience has been similar

ODOT MATERIALS & INSPECTION

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Temperature Measurement

ODOT MATERIALS & INSPECTION

34

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Temperature Specs
Minimum Surface Temperatures – (00745.40)

- Less than 2 inches – 60° F
- 2 inches and over – 40° F

- No field burners unless approved
- May Lower the temp 5° F between March 15 and September 30

37

Temperature Specs
Mixing and Placement Temperatures – 00745.43(b)

Mixing and compaction temperature established by JMF or by Suppliers recommendation

Maximum Temp at Plant = 350° F

Minimum Temp Behind Paver:

HMAC = 240° F

WMAC= 215° F

Temperatures my be adjusted up or down in 10° F increments if approved

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Time Available for Compaction (TAC)

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Environmental Factors Effecting Compaction

- base conditions
- mix temp
- surface temp
- air temp
- wind
- lift thickness
- shade
- moisture

40

“Pave-Cool” program can be used to estimate the time available for compaction

http://www.dot.state.mn.us/app/pavecool/

ODOT MATERIALS & INSPECTION

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INSERT TAB

Compaction Equipment

Compaction Equipment & Operations

Module 8

1

Compaction Equipment & Operations

- Types of rollers
  - Static steel
  - Vibratory
  - Oscillating
  - Pneumatic
- Proper roller procedures
- Tender mix considerations
- Number of rollers necessary?
- Opening to traffic

2

Types of Rollers

- Static steel wheel
- Vibratory
- Oscillating
- Pneumatic – rubber tired

3

Static Steel-Wheeled Rollers

4

Static Steel-Wheeled Rollers

00745.24(a) Steel-Wheeled Rollers – Steel-wheeled rollers shall have:

- A gross static weight of at least 8 tons
- If steel-wheeled rollers are used for finish rolling, they shall have: A gross static weight of at least 6 tons

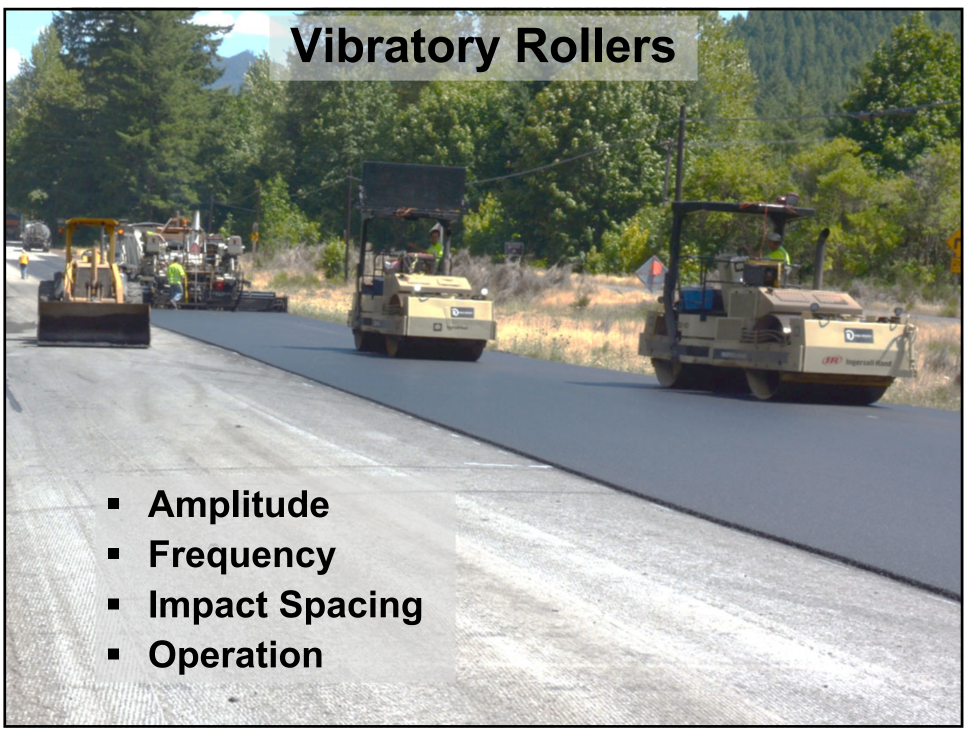
Section 00745.24(a)

Static Steel Wheeled rollers shall have a minimum gross static mass of:

	Level 1 & 2	Level 3	Level 4
BD & Intermediate	8 ton	10 ton	12 ton
Finish	6 ton	8 ton	10 ton

ODOT MATERIALS & INSPECTION QA

5



6

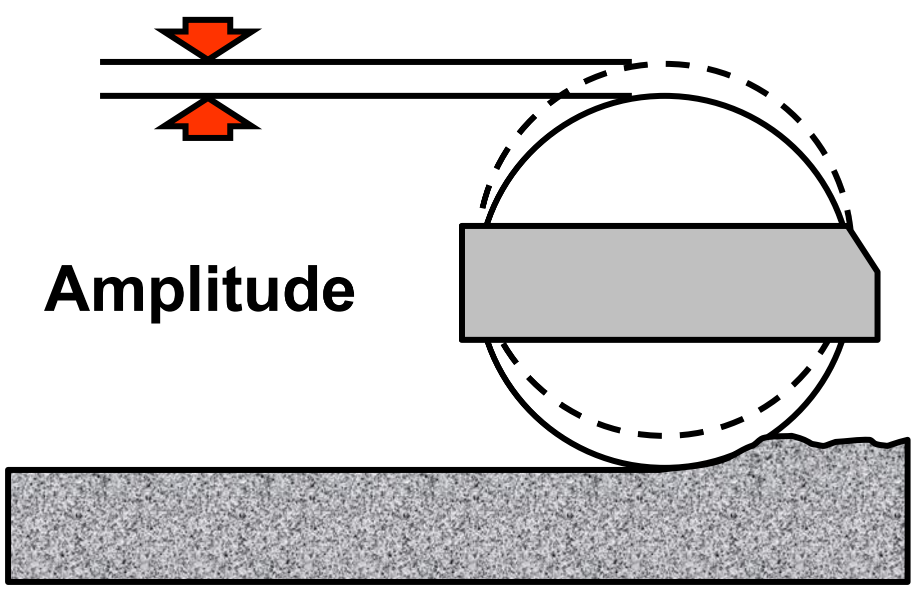
Vibratory Rollers

00745.24(b) Vibratory Rollers – Vibratory rollers shall be:

- Equipped with amplitude and frequency controls
- Specifically designed to compact ACP
- Capable of at least 2000 vibrations per minute
- Have a gross static weight meeting the requirements of 00745.24(a)

Do not operate in vibratory mode for Lifts thinner than two times the maximum Aggregate size for the type of ACP being compacted.

7



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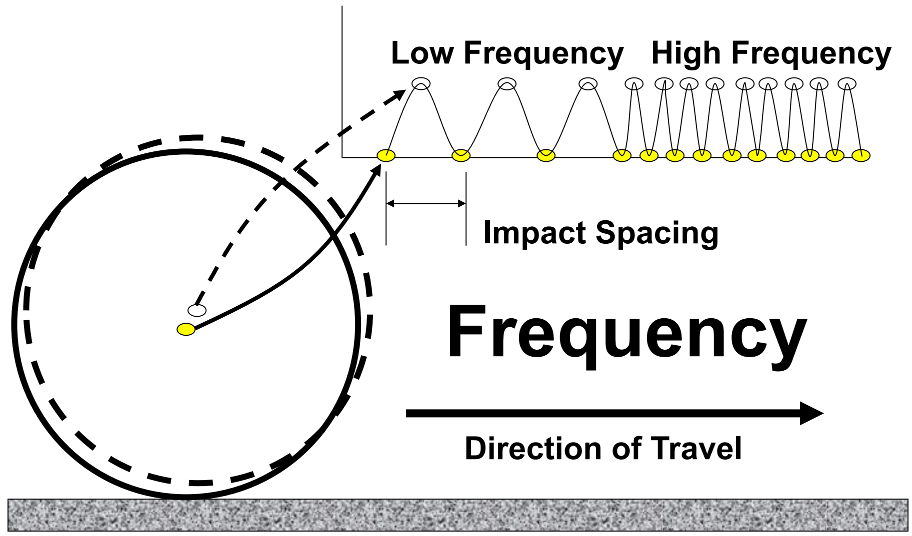


9

Typical Data for Vibratory Tandem Rollers

Vibratory Steel Tandem ton	Oper. Wt. lb	Drum Diam. in	Drum Width in	Static Drum lb/in	Dynamic Drum lb/in	VPM	Nom. Amp. in
5.5-8.0	14,700	43	54	136	258	2,900	.025
9.5-11.0	20,500	48	66	155	381	2,600	.030
> 13.0	30,000	60	84	179	420	2,400	.030

10

Vibratory Rollers

- Operate at speeds to get 10 blows per foot minimum
- Typically operate at High Frequency and Low Amplitude
- Can operate at High Amplitude for thicker mats

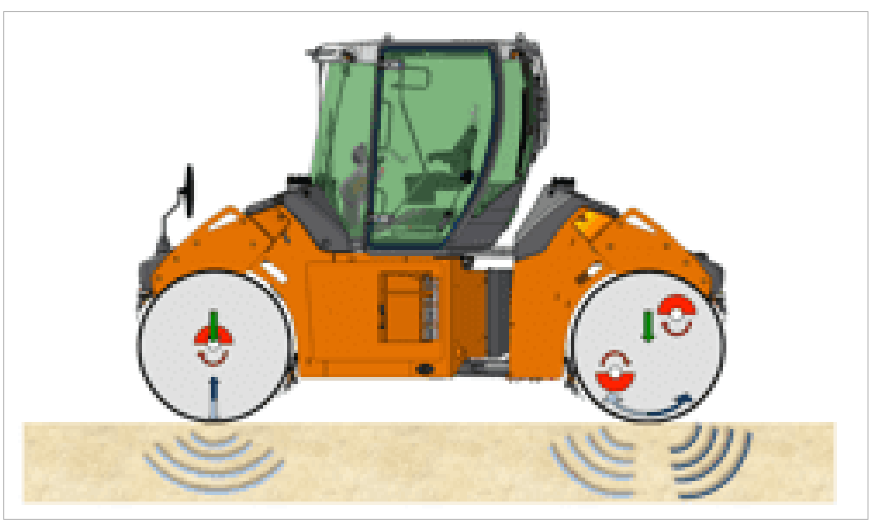
11

12

Oscillatory Rollers

- Not in 00745, but you may see it in the field.
- Two unbalanced masses
- Drum oscillates back and forth
- Horizontal motion vs. vertical motion
- Reduction in crushed aggregate
- Check weight requirements in 00745.24(a)

13



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Pneumatic-Tired Rollers

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

16

Pneumatic-Tired Rollers

00745.24(c) Pneumatic-tired Rollers – Pneumatic-tired rollers shall:

- Be tandem, or multiple axle, multiple wheel type
- Have smooth tread, pneumatic tires of equal size
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width
- Have a minimum total load of 2,800 pounds per tire with tire inflation pressures of 45 to 90 psi
- Be fully skirted to reduce tire heat loss and mixture pick up

Make sure they are ballasted. Most have a water tank that can be filled to maximize weight.

Pneumatic-tired rollers should NEVER stop!!!!

ODOT MATERIALS & INSPECTION

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CAT
501-08
PS-130

19


DON'T PARK ON THE MAT!
TO PREVENT
PICK UP ON TIRES
-GET THEM HOT!

20

Tire Inflation Pressure Vs. Ground Contact Pressure

21

Inflation Pressure & Ground Contact Pressure at Various Wheel Loads and Ply Ratings

Example	Ply Rating	Wheel Load lb	Tire Pressure PSI	Contact Area in^2	Ground Contact Pressure PSI
A	14	1250	130	16	78
	14	2800	130	30	92
B	14	2300	35	41	56
	14	2300	130	26	88
C	10	2800	90	38	73
	14	2800	130	30	92

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Compaction Procedures

ODOT MATERIALS & INSPECTION

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Compaction Procedures
Temperature

00745.49(a)(1) Temperature – Complete breakdown and intermediate compaction before the ACP temperature drops below 180° F, unless otherwise directed or required based on the control strip. For WMAC, complete breakdown and intermediate compaction before the ACP temperature drops below 160° F. When the rolling causes tearing, displacement, cracking or shoving, make necessary changes in compaction temperature, type of compaction Equipment, and rolling procedures.

It is not unusual to be obtaining additional density below 180° F. Use the control strip as a guide for proper temperature ranges.

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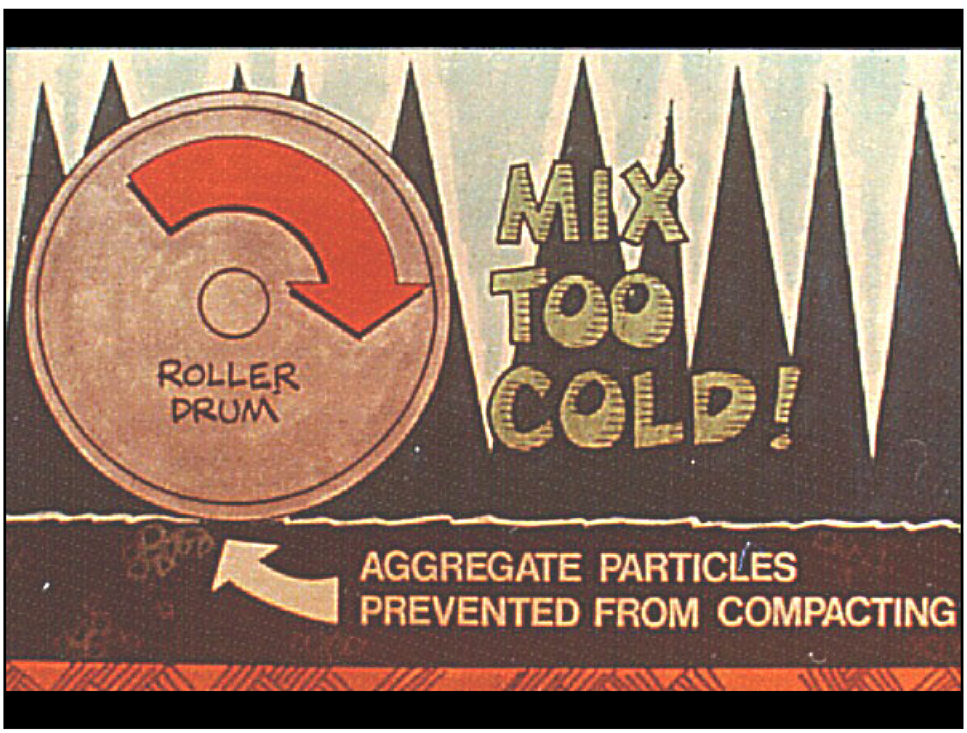

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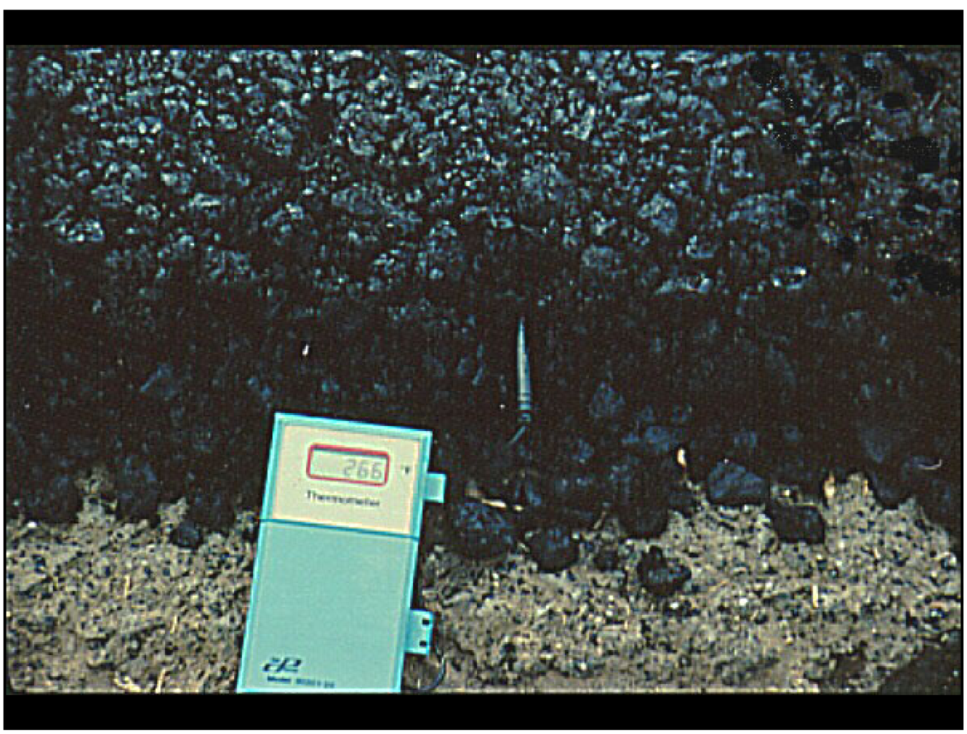

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Compaction Procedures

00745.49(a)(2) Rolling – Provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperature. Do not use equipment which crushes the Aggregate. Do not displace the line and grade of edges. Moisten steel roller wheels with a minimum amount of water, or other approved material, necessary to prevent the ACP from sticking to them and spotting or defacing the ACP.

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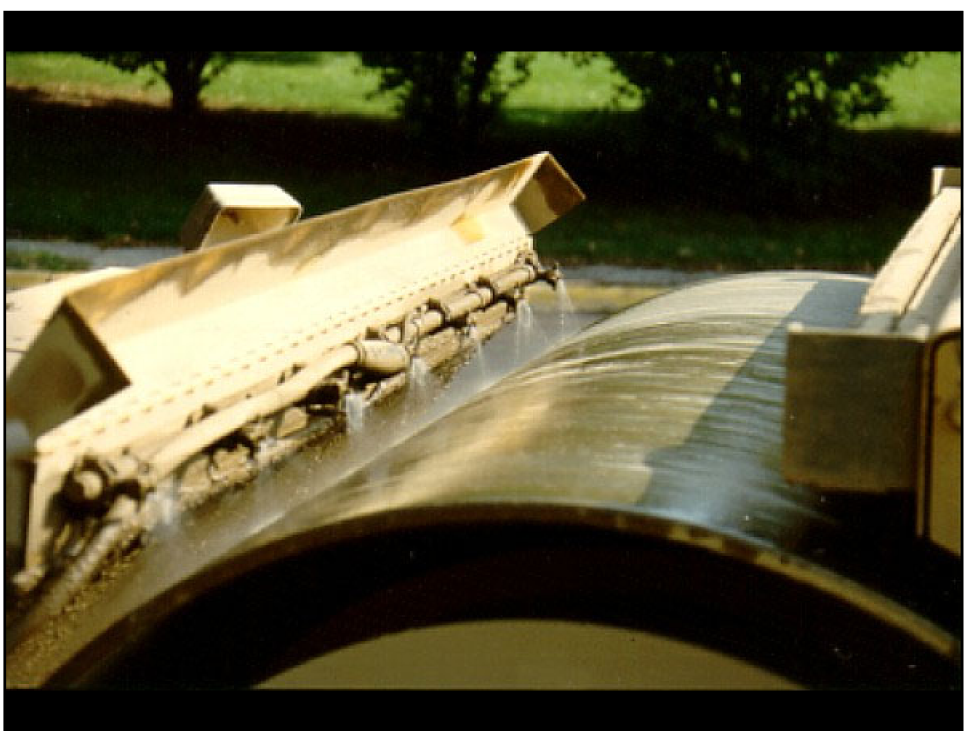

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Re-Watering During Paving

- Park off the mat if possible
- If on mat, park at an angle

38

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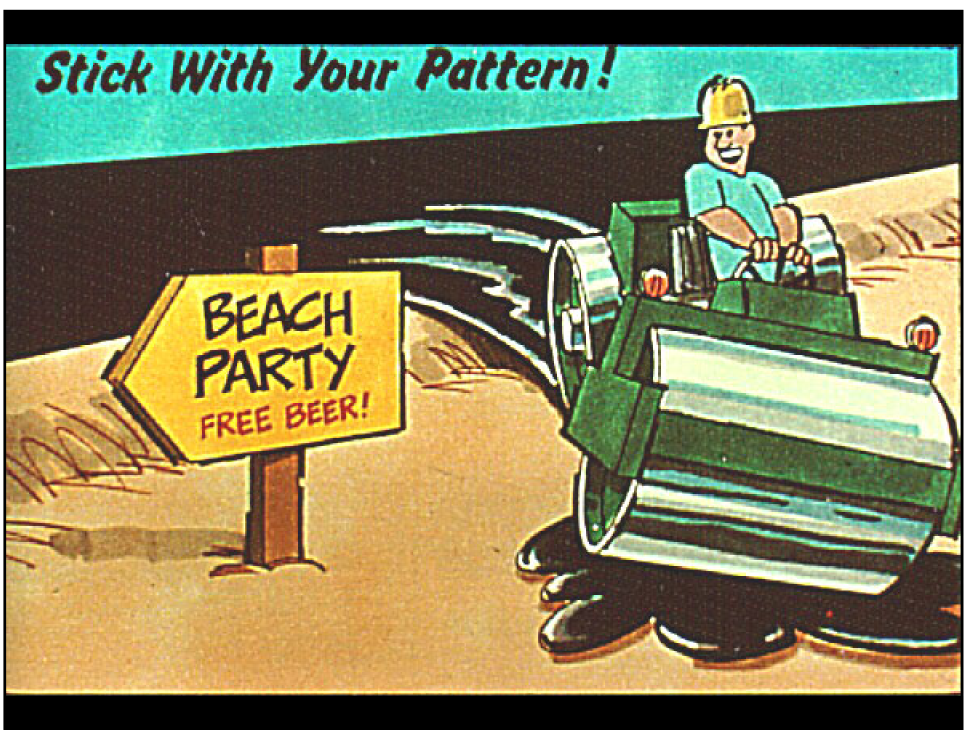

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Compaction Operations

00745.49(a)(2) Operate rollers at a slow, uniform speed recommended by the manufacturer. Drive rolls or wheels shall be nearest the paver unless otherwise approved. Operate pneumatic rollers no faster than 3 mph. Operate vibratory rollers at frequencies of at least 2000 vibrations per minute.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, gradually progressing to the center, unless otherwise directed. On super-elevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling pattern. Do not make sharp turns or park rollers on hot ACP. Stop each Pass at least 5 feet longitudinally from preceding stops.

ODOT MATERIALS & INSPECTION

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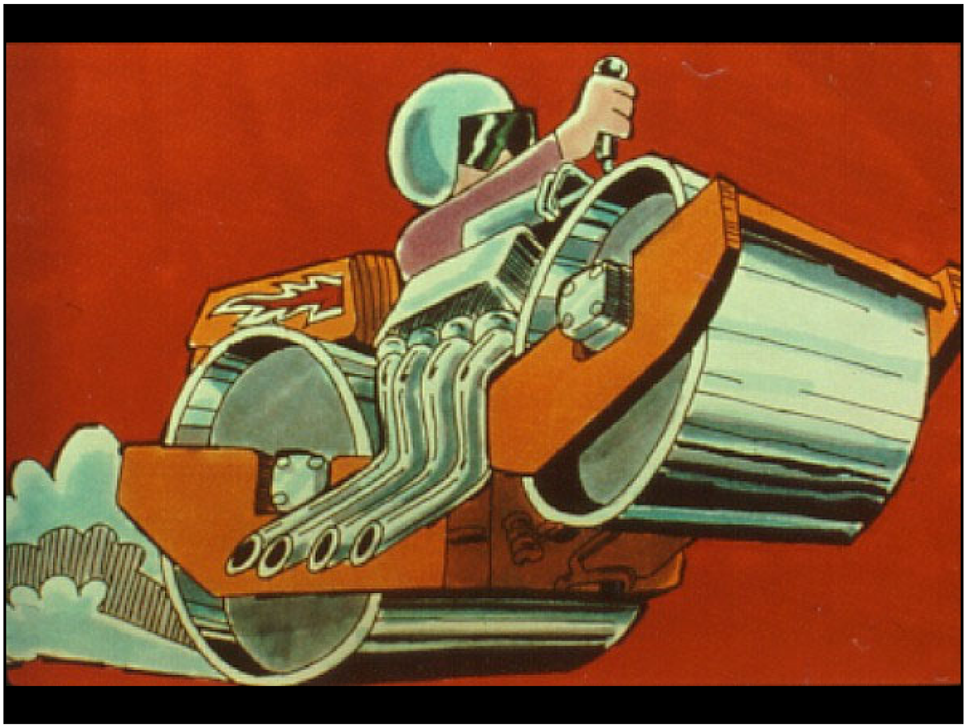

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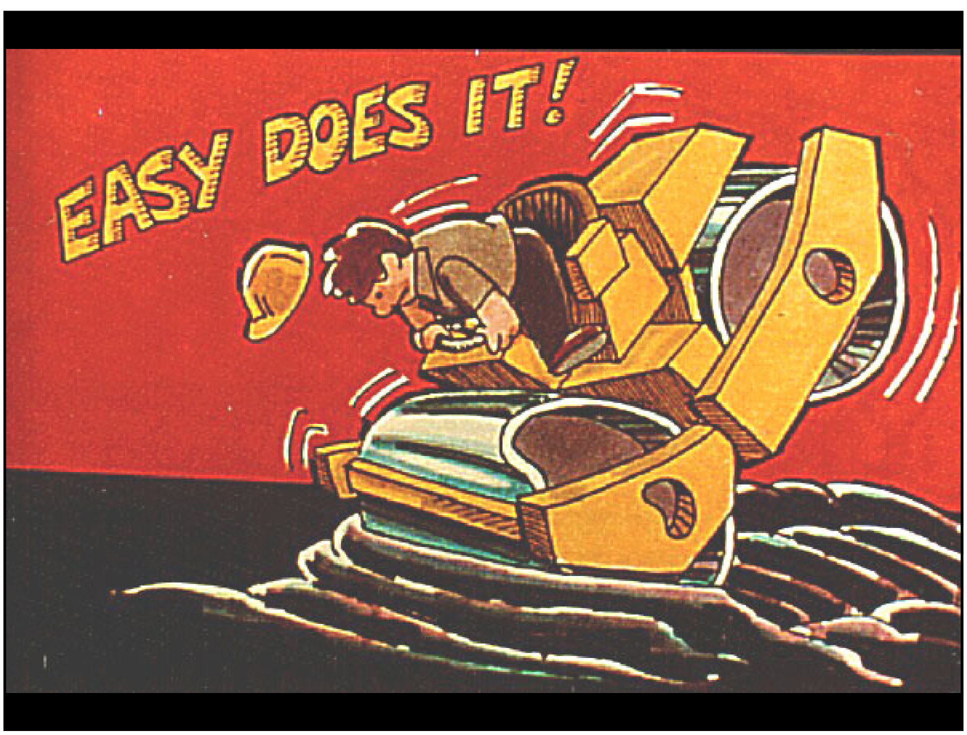

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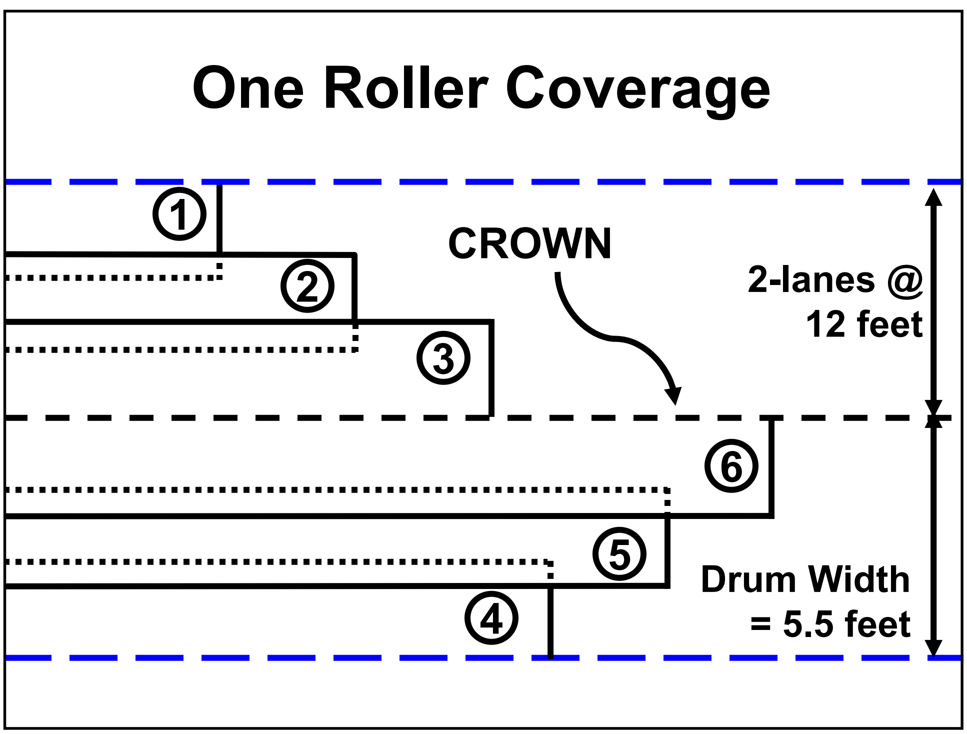
One Roller Coverage
1
2
3
CROWN
2-lanes @ 12 feet
6
5
4
Drum Width = 5.5 feet

46

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49

Compaction Operations

00745.49(a)(2) Perform finish rolling with rollers meeting the requirements of 00745.24(a) or 00745.24(b), and continue until all roller marks are eliminated.

It is sometimes necessary to make one or more vibratory passes with the finish roller to achieve compaction. This is contrary to 00745.24(b). It is ok as long as the mat is not damaged.

ODOT MATERIALS & INSPECTION

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Compaction Variables

- Roller speed
- Number of coverages
- Rolling zone
- Rolling pattern

53

Typical Range of Roller Speeds (mi/hour)

Type of Roller	Breakdown	Intermediate	Finish
Static Steel Wheel	2 to 3.5	2.5 to 4	3 to 5
*Pneumatic	2 to 3.5*	2.5 to 4*	4 to 7*
Vibratory	2 to 3	2.5 to 3.5	-------

**Default to 00745.49(a)(2) for Specification Limits on Pneumatic-tired Roller Speed*

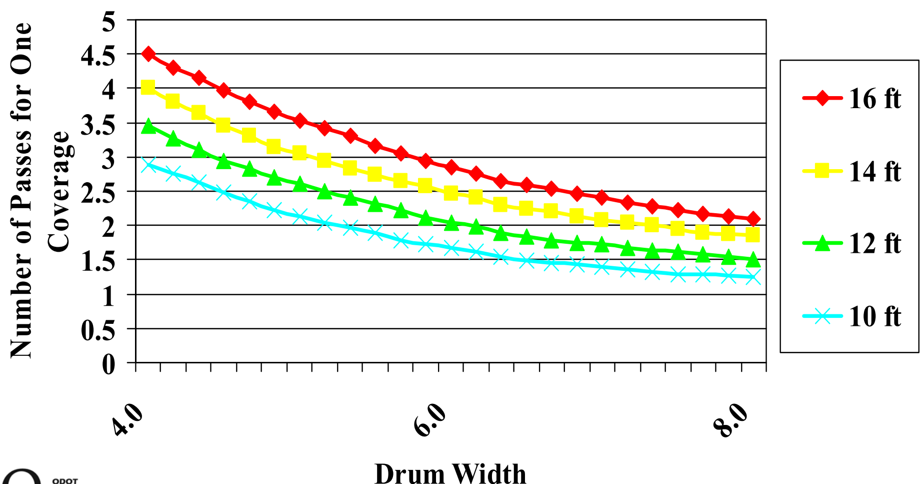
54

One Coverage

How many passes of the roller are needed to cover the width of the mat one time?

55

Drum Width vs. Lane Width



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Rolling Patterns

Established by:

- Control strips
- Local experience
- Width of paving
- Width of rollers
- Production rate

57

How many repeat coverages to assure density?

Established by the Control Strip
and local experience with the mix

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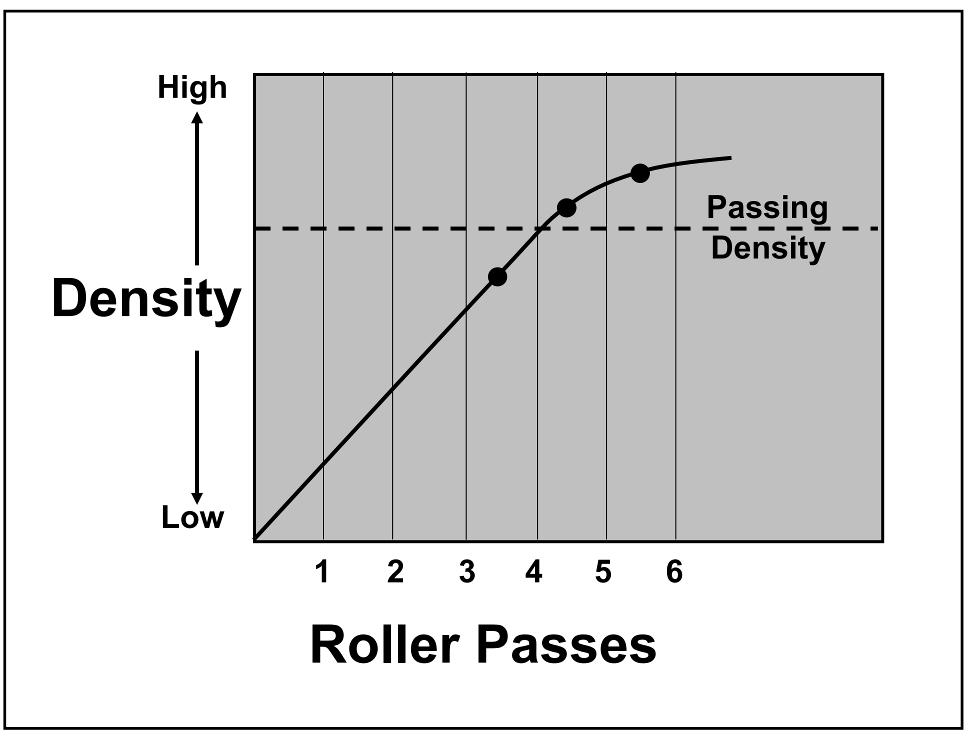
59



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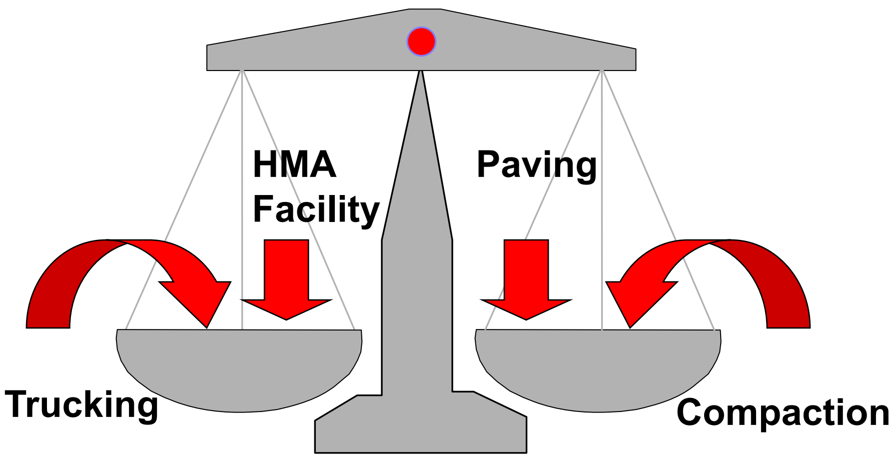
Balancing Production



61

Calculating Your Rolling Zone

- Effective Compaction (C-Rate) Production Rate equals 28 feet per minute.
- TAC from Environmental Variables chart equals 10 minutes for 2-inch thick mat with mix temperature of 250° F and base temperature of 50° F.
- C-Rate times TAC = 28 fpm x 10 minutes = 280 feet

ODOT MATERIALS & INSPECTION

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COMPACTION PRODUCTION CALCULATION FORM

DATE: Contract #: C99999

PROJECT Here- There

Vibratory Roller Vibrations per Minute (VPM) 2500 VPM
Measure with a Reed Tachometer
Specification is 2000 VPM minimum
Vibratory Impacts per foot (IPF) 10 IPF
A minimum of 10 IPF is recommended
Actual Roller Speed (ARS) = VPM / IPF 250 fpm
Roller Reversal Factor (RRF) = 0.10 x ARS 25 fpm
This accounts for the time it takes the roller to stop and reverse direction
Effective Roller Speed (EFF-SPEED) = ARS - RRF 225 fpm

Actual Roller Drum Width (DRUM) 87 in
Effective Drum Width (EFF-DRUM) = DRUM - 6 in 81" 6.75 ft
Accounts for 6 in overlap between passes

Panel Width (WIDTH) 14 ft
# Passes to cover Panel Width Once (PASS) = WIDTH / EFF-DRUM
PASS = 2.1 (round up) 3 passes
# Repeat Coverages to Achieve Density (COVERAGE) 3 coverages
Obtain this from Control Strip or Known Roller Pattern
Total # of Passes (T-PASS) = PASS x COVERAGE 9 passes
If T-PASS is an even number, add 1 pass to get the roller headed back towrds the paver T-PASS = 9 passes

Roller Efficeincy Factor (EFF) 0.80 *Range = 0.75 - 0.80*
Accounts for occasional stopping of roller to rewater, etc
Effective Compaction Production Rate (C-RATE)
C-RATE = EFF-SPEED x EFF / T-PASS = 20 fpm
This is the speed at which the roller train follows the paver.
***C-RATE should be equal to or greater than P-RATE to assure the rollers can keep up with the paver.*

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COMPACTION PRODUCTION CALCULATION FORM

DATE: Contract #: C99999

PROJECT Here- There

Vibratory Roller Vibrations per Minute (VPM) 2800 VPM
Measure with a Reed Tachometer
Specification is 2000 VPM minimum
Vibratory Impacts per foot (IPF) 10 IPF
A minimum of 10 IPF is recommended
Actual Roller Speed (ARS) = VPM / IPF 280 fpm
Roller Reversal Factor (RRF) = 0.10 x ARS 28 fpm
This accounts for the time it takes the roller to stop and reverse direction
Effective Roller Speed (EFF-SPEED) = ARS - RRF 252 fpm

Actual Roller Drum Width (DRUM) 96 in
Effective Drum Width (EFF-DRUM) = DRUM - 6 in 90" 7.5 ft
Accounts for 6 in overlap between passes

Panel Width (WIDTH) 14 ft
# Passes to cover Panel Width Once (PASS) = WIDTH / EFF-DRUM
PASS = 1.9 (round up) 2 passes
# Repeat Coverages to Achieve Density (COVERAGE) 3 coverages
Obtain this from Control Strip or Known Roller Pattern
Total # of Passes (T-PASS) = PASS x COVERAGE 6 passes
If T-PASS is an even number, add 1 pass to get the roller headed back towrds the paver T-PASS = 7 passes

Roller Efficeincy Factor (EFF) 0.80 *Range = 0.75 - 0.80*
Accounts for occasional stopping of roller to rewater, etc
Effective Compaction Production Rate (C-RATE)
C-RATE = EFF-SPEED x EFF / T-PASS = 29 fpm
This is the speed at which the roller train follows the paver.
***C-RATE should be equal to or greater than P-RATE to assure the rollers can keep up with the paver.*

64

Thin Lifts

00745.49(c) Thin Pavement – Compaction to a specified density will not be required for Leveling, patches, or where the nominal compacted thickness of a Course of ACP will be less than 2 inches. Perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.

A pneumatic-tired roller is recommended for leveling as long as the mat is not too thin or too short which would cause excessive pick-up by the tires. (The tires won't get hot enough!)

ODOT MATERIALS & INSPECTION

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Other Areas

00745.49(d) Other Areas – Compaction to a specified density will not be required on temporary Surfacing (see 00745.50), guardrail flares, mailbox turnouts, road approaches, Pavement repair, and areas less than 8 feet wide or limited length, regardless of thickness. Compact these surfaces according to 00749.45

ODOT MATERIALS & INSPECTION

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Opening to Traffic

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Opening to Traffic

- After finish rolling and density testing is completed
- Generally ok at 140° F for ACP unless they are still getting compaction
- Test for picking with a vehicle for open graded
- Flush with water only if absolutely necessary to open to traffic, but ensure density measurements have been taken first!

ODOT MATERIALS & INSPECTION

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Mat Problems

- Surface checking
  - Mix issues
  - Crusted mix
- Tenderness

ODOT MATERIALS & INSPECTION

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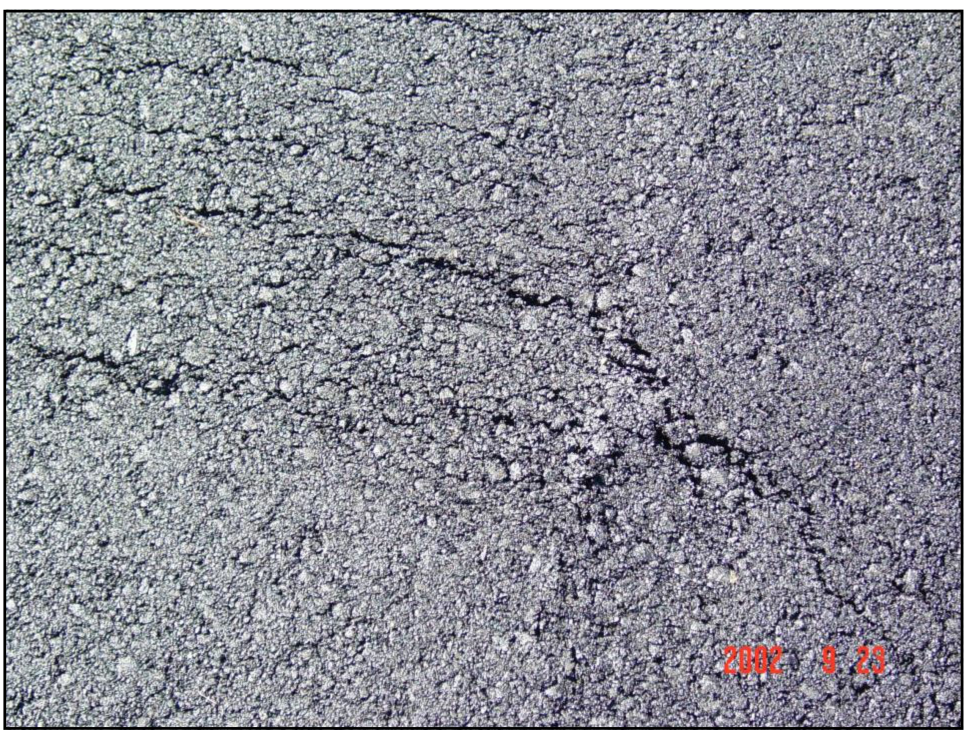

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Tender Mixes

- Check that mix is ok
- Use pneumatic in intermediate to put back together (could be used in finish if necessary); could also try in breakdown
- Check frequency and amplitude settings
- Stay off in intermediate zone
- Minimize water from steel wheels
- Make sure roller operators know what temperatures they can hit the mat

ODOT MATERIALS & INSPECTION

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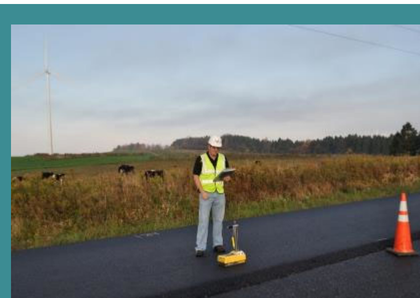
INSERT TAB

Compaction Testing

Compaction Testing

Module 9



1

Compaction Specifications
General

- MAMD Method required
- Compaction Testing required for lifts 2" and greater.
- Core Correlations
  - A Boilerplate Special Provision and Pay Item have been developed and will be in use on most larger paving projects.
  - Other Projects - optional for lifts 2" or thicker
- CDT Required
- Calibrated Nuclear Gauge Required

2

Compaction Specifications
Areas not subject to compaction measurement

00745.49(d) Other Areas – Compaction to a specified density will not be required on temporary surfacing, guardrail flares, mailbox turnouts, road approaches, pavement repair, and areas less than 8 feet wide or limited length, regardless of thickness. Compact these surfaces according to 00749.45.

3

Compaction Specifications

00749.45 Compacting Asphalt Concrete – Compact asphalt concrete according to the following or as directed:

- Compaction to a specified density will not be required, regardless of thickness. Perform breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.
- Along curbs and walls, on walks, irregular areas, and other areas not practically accessible to rollers conforming to 00744.24 or 00745.24, compact the mixture with small, self-propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

4

Compaction Specifications
Testing Requirements

00745.49(b)(2) Random Testing – Determine the density of each sublot by averaging five QC tests performed at random locations with the nuclear gauge operated in the backscatter mode. Lots and sublots shall correspond with those defined in 00745.02. In addition, perform at least one density test each day of production. The additional testing may be waived by the Engineer.

a. Testing – After completion of the finish rolling, test according to AASHTO T 355. Do not locate the center of a density test less than 1 foot from the panel edge. Complete density testing before traffic is allowed on the new mat.

5

Compaction Specifications
Density Requirements

00745.49(b)(3) When this method is used, compact the ACP to at least the percent of the MAMD applicable for the mix type and lift as follows:

Course of Construction	ACP
First ACP lift less than 3 inches placed on aggregate base	91.0 *
All other	92.0

*If any part of the width of a lift at a station requires 91.0%, then the entire width of that lift at that station shall be 91.0%

6

Control Strip

A tool for:

- Establishing and evaluating a roller pattern
- Determining the maximum density that can be achieved with conditions on the project
- Ensuring consistent density across the mat

7

Compaction Specifications
Control Strip

00745.49(b)(1) Construct a control strip at the beginning of work on each JMF on the project according to ODOT TM 306. The purpose of the control strip is to determine the maximum density that can be achieved for the JMF, paving conditions, and equipment on the project. Additional control strips are necessary when there is a change in compaction equipment or when JMF targets are adjusted according to 00745.16(b)(1)(a). The Engineer may waive the control strip for irregular areas or areas too small to establish a reasonable roller pattern.

Stop paving if three consecutive control strips fail to achieve the specified density. Take all actions necessary to resolve compaction problems. Do not resume paving until allowed by the Engineer.

8

Control Strip

	ROLLER TYPE AND DESCRIPTION (MANUFACTURER, WEIGHT, ETC)
BREAKDOWN	CAT-CB564D DDV
INTERMEDIATE	CAT-CB564D DDV
FINISH	CAT-CB534D DDV

CODES FOR ROLLER TYPES
P - PNEUMATIC
TS - TANDEM STEEL
3WS - THREE WHEEL STEEL
SDV-SINGLE DRUM VIBRATORY
DDV-DOUBLE DRUM VIBRATORY

NOTE: LENGTH OF CONTROL STRIP IS ALWAYS THE LENGTH OF CONTRACTOR'S ROLLING PATTERN (MAXIMUM 500ft)
DENSITY TEST CANNOT BE TAKEN BEHIND PNEUMATIC ROLLER WHEN USED IN THE BREAKDOWN POSITION.
INDICATE IF VIBRATION USED AND DIRECTION BY CIRCLING (F) FORWARD OR (B) BACK.

ROLLER →	Breakdown			Intermediate			Intermediate			Finish		
PASSES ↓	MIX TEMP °F	DENSITY	F/B	MIX TEMP °F	DENSITY	F/B	MIX TEMP °F	DENSITY	F/B	MIX TEMP °F	DENSITY	F/B
1	276	141.5	F	261	148.5	F	236	152.1	F	162	152.9	F B
2	276	141.5	B	255	148.3	B	235	149.8	B	156	156	F B
3	260	142.5	F	254	150.2	F			F B	155	154.7	F B
4	260	142.5	B			F B			F B			F B

"INITIAL POINT" (SANDED) DENSITY READING 1 155.9 lb/ft³
2 153.9 lb/ft³

If correlation applies enter
A = AVE + Correlation
AVE = A = 150.1 lb/ft³

9

Control Strip

NOTE: IF **A** IS LESS THAN **C** , MOVE AHEAD, CHANGE ROLLING PATTERN AND START OVER.

		1.0 Ft from LEFT	MIDPOINT LEFT	CENTER	MIDPOINT RIGHT	1.0 Ft from RIGHT
	STATION					
1	DENSITY lb/ft³	152.3	156.5	155.9	153.2	154.2
2	DENSITY lb/ft³	153.2	155.4	157.8	154.4	153.9
3	AVERAGE DENSITY (DENS 1+ DENS 2) / 2	152.8	156	156.9	153.8	154.1
Cf	CORE CORRELATION LINE 3 + -4.8	148	151.2	152.1	149	149.3
4	% COMPACTION DENSITY / MAMD	89.4	91.4	91.9	90.0	90.2

TARGET AVE = **B1** = 149.9 lb/ft³
AVE = **B2** = 90.6 %

Note: If any single value in row 4 is above 95% of **MAMD** contact the Project Manager

MAMD 165.5 lb/ft³ X PERCENT COMPACTION REQUIRE 92.0 % = C = 152.3 lb/ft³

REMARKS
Control Strip 1 FAILS

CONTROL STRIP IS VALID ONLY IF:

	YES	NO
1. **B1** is => C		X
2. Individual Results in Row 4 are all within ± 1.5 of **B2**	X	

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Compaction

Two Primary Measurement Methods

- Cores (physical measurement of density)
- Nuclear gauges (estimate of density using radioactive particle techniques)

ODOT MATERIALS & INSPECTION

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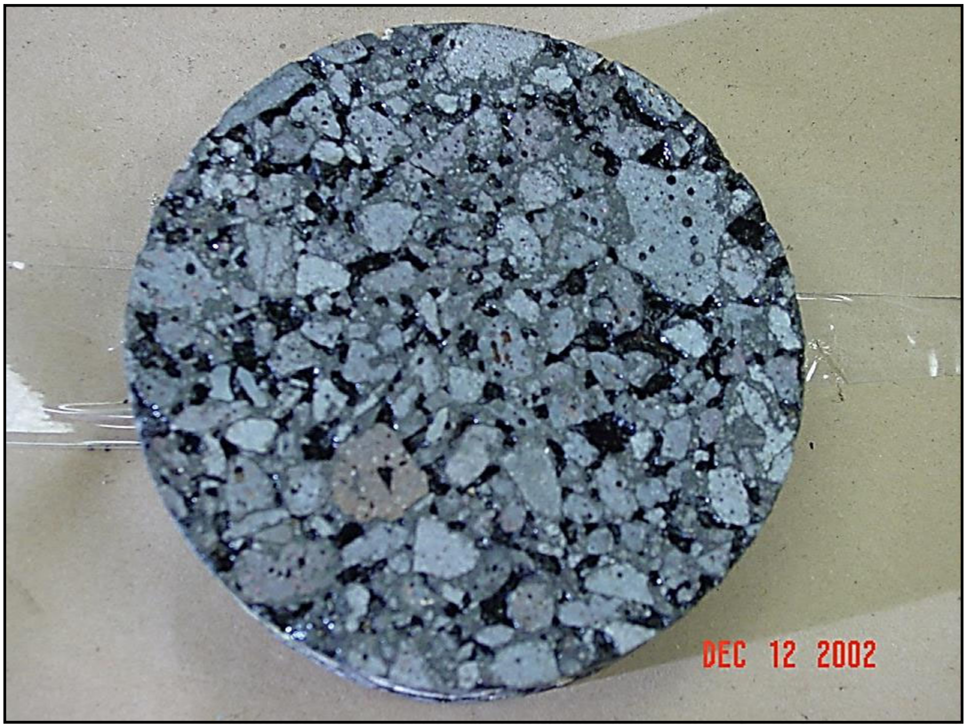
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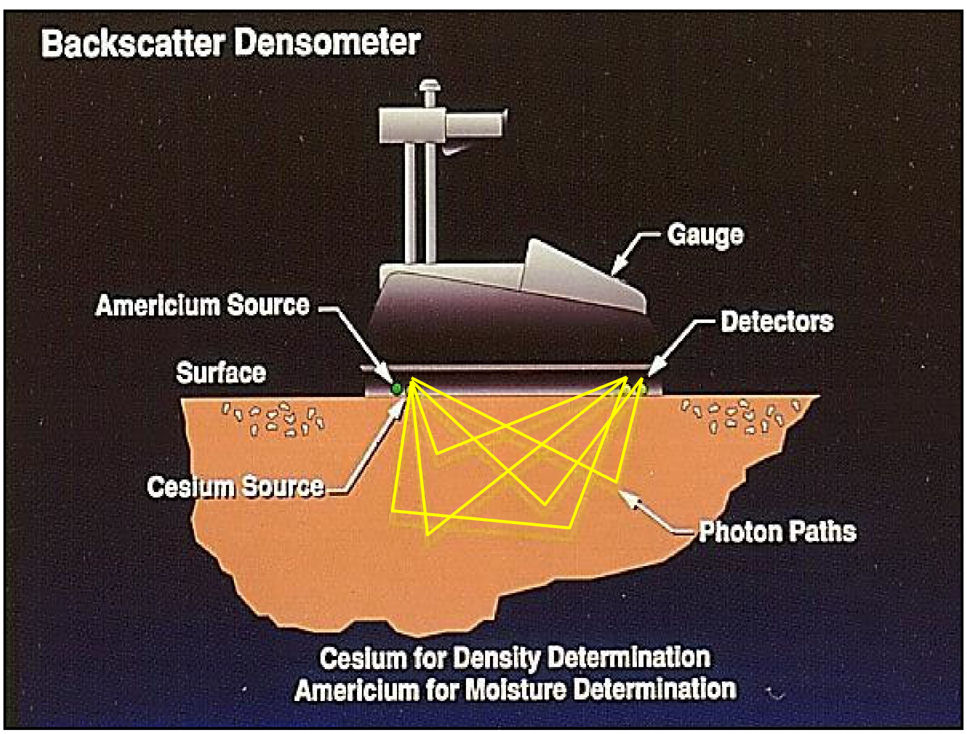
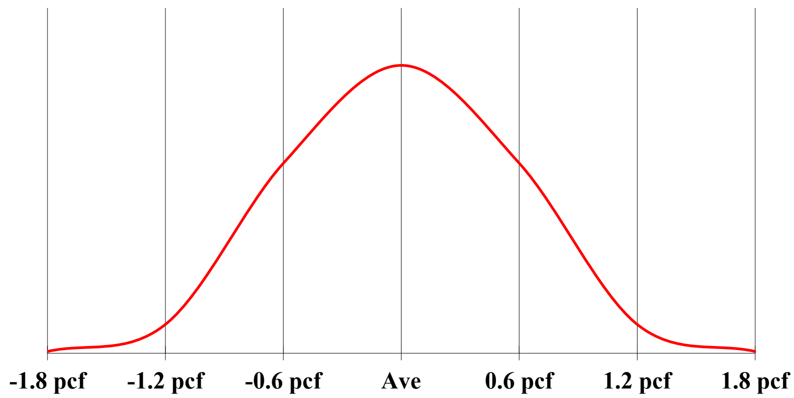

Backscatter Densometer
Gauge
Americium Source
Detectors
Surface
Cesium Source
Photon Paths
Cesium for Density Determination
Americium for Moisture Determination

14

Nuclear Gauge Precision



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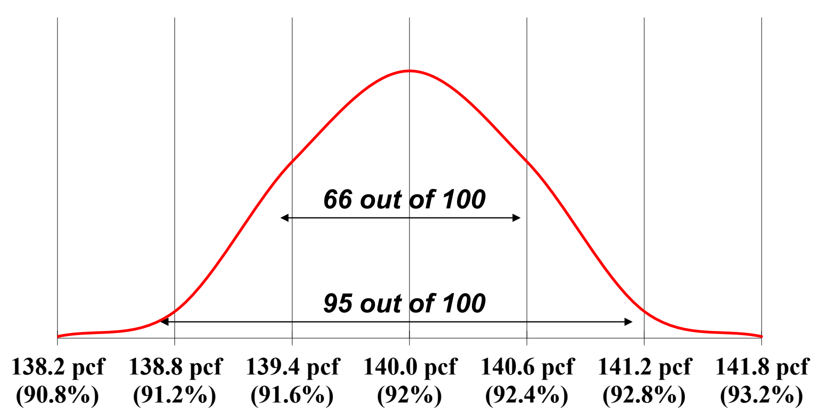
Nuclear Gauge Precision

100 tests at One Location



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Compaction Test Procedure
AASHTO T 355

Have QCCS or QA representative on-site at start-up to verify that proper procedures are being followed by the Contractor's CDT. Call them back in if a problem is suspected.

17

Things to Look For

- Is the technician's density test at the appropriate random test location?
- Does the test location violate any of the distance rules (30′-radioactivity, 10′-large objects, 2′-vertical mass, 1′-vertical pavement edge)?
- Was the test taken after the finish roller had completed the required passes?
- Was the test area sanded and excess sand removed?

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Things to Look For

- Was the footprint of the gauge marked and the gauge seated correctly?
- Was the gauge rotated about the center during the test?
- Is the technician using the correct MAMD value?
- Is the correct percentage compaction being obtained 91.0% or 92.0%?

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Things to Look For

- Are any tests less than 90.0% or exceeding 95.9% of the MAMD value?
- Watch for high or low density trends appearing on the roadway.
- The inspector should be notified of compaction results and any problems identified by the technician. SP00745.49(b)(1)

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Core Correlations

- Purpose: To adjust gauge readings to what the density would be if each test location was cored (**cores being the actual density**)
- Perform:
  - When required by spec
  - When gauge readings are questionable
  - When QC and QA results are substantially different
- A new correlation is required:
  - For each new lift
  - For each JMF

ODOT MATERIALS & INSPECTION

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Core Correlations
Procedure

- Select 10 random locations
  (ok to use control strip or sublot test locations)
- Test each location with both QC and QA gauges per ODOT TM 327
- Drill a core at each location
- Test the cores for density
- Develop correlation factor to apply to nuke gauge readings

ODOT MATERIALS & INSPECTION

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Example Problem

Sublot Compaction Report

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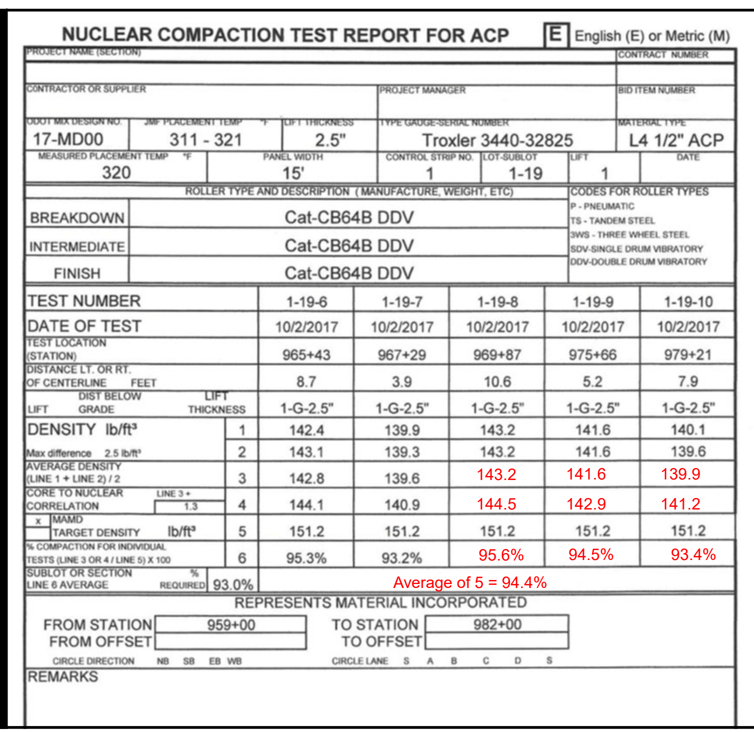

NUCLEAR COMPACTION TEST REPORT FOR ACP — E English (E) or Metric (M)

PROJECT NAME (SECTION)	CONTRACT NUMBER

CONTRACTOR OR SUPPLIER	PROJECT MANAGER	BID ITEM NUMBER

ODOT MIX DESIGN NO.	JMF PLACEMENT TEMP °F	LIFT THICKNESS	TYPE GAUGE-SERIAL NUMBER	MATERIAL TYPE
17-MD00	311 - 321	2.5"	Troxler 3440-32825	L4 1/2" ACP

MEASURED PLACEMENT TEMP °F	PANEL WIDTH	CONTROL STRIP NO.	LOT-SUBLOT	LIFT	DATE
320	15'	1	1-19	1	

	ROLLER TYPE AND DESCRIPTION (MANUFACTURE, WEIGHT, ETC)
BREAKDOWN	Cat-CB64B DDV
INTERMEDIATE	Cat-CB64B DDV
FINISH	Cat-CB64B DDV

CODES FOR ROLLER TYPES
P - PNEUMATIC
TS - TANDEM STEEL
3WS - THREE WHEEL STEEL
SDV-SINGLE DRUM VIBRATORY
DDV-DOUBLE DRUM VIBRATORY

TEST NUMBER		1-19-6	1-19-7	1-19-8	1-19-9	1-19-10
DATE OF TEST		10/2/2017	10/2/2017	10/2/2017	10/2/2017	10/2/2017
TEST LOCATION (STATION)		965+43	967+29	969+87	975+66	979+21
DISTANCE LT. OR RT. OF CENTERLINE FEET		8.7	3.9	10.6	5.2	7.9
LIFT DIST BELOW GRADE LIFT THICKNESS		1-G-2.5"	1-G-2.5"	1-G-2.5"	1-G-2.5"	1-G-2.5"
DENSITY lb/ft³	1	142.4	139.9	143.2	141.6	140.1
Max difference 2.5 lb/ft³	2	143.1	139.3	143.2	141.6	139.6
AVERAGE DENSITY (LINE 1 + LINE 2) / 2	3	142.8	139.6	143.2	141.6	139.9
CORE TO NUCLEAR CORRELATION LINE 3 + 1.3	4	144.1	140.9	144.5	142.9	141.2
x MAMD TARGET DENSITY lb/ft³	5	151.2	151.2	151.2	151.2	151.2
% COMPACTION FOR INDIVIDUAL TESTS (LINE 3 OR 4 / LINE 5) X 100	6	95.3%	93.2%	95.6%	94.5%	93.4%
SUBLOT OR SECTION LINE 6 AVERAGE % REQUIRED 93.0%		Average of 5 = 94.4%				

REPRESENTS MATERIAL INCORPORATED

FROM STATION	959+00	TO STATION	982+00
FROM OFFSET		TO OFFSET	

CIRCLE DIRECTION NB SB EB WB   CIRCLE LANE S A B C D S

REMARKS

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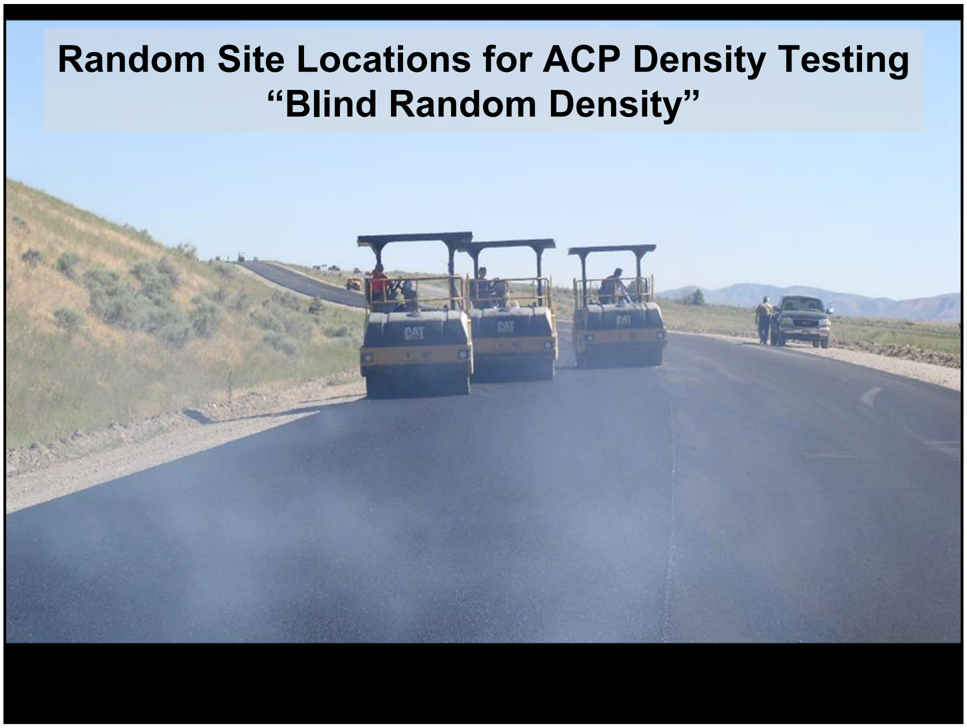

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Training Objectives

- Understanding Stratified Random Sampling
- Annex Terminology
- Process for generating Random Numbers
- Applying Random Numbers to tonnage increments
- Determining Test Station and Transverse Offset

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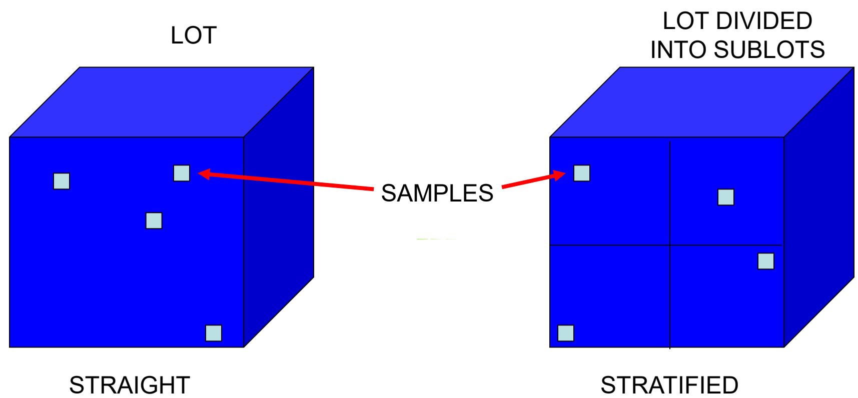
Random Sampling Concepts



ACP density sites
based on stratified method

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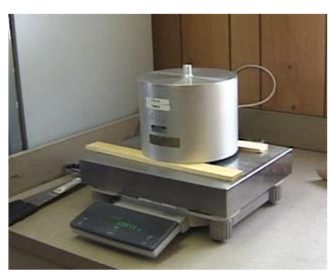
Annex Terminology

MAMD – Moving Average Maximum Density

- Expressed in lbs / ft^3
- Used to compute in-place density
- Determined according to ODOT TM 305 in conjunction with AASHTO T 209
- Determined at the beginning of the shift
- Based on a running average of 5 tests



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MAMD (Moving Average Maximum Density)

- MAMD will change to a certain degree daily and change the maximum compaction achievable.
- Change is due to fluctuations in the ACP during production based on:
  - Gradation
  - Oil content
  - Mix adjustments

ODOT MATERIALS & INSPECTION

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Compaction Specifications
Testing Requirements

SP00745.49(b)(2) Random Testing – Lots and sublots shall correspond with those defined in 00745.02. Each sublot will have five density test locations. Notify the Engineer when rolling operations are completed in a segment and it is ready for test location identification. The Engineer will use stratified random numbers to locate the QC tests according to ODOT TM400 Annex. The Engineer will mark where the QC tests are to be performed. Advise the Engineer when a sublot requires accelerated testing to achieve the required five QC tests. ODOT TM400 Annex is available from the Engineer. Each individual test will be used in statistical acceptance.

Allow 30 minutes for the Engineer to locate the final test locations after completion of finish rolling and any additional time required for testing. Test locations not located within this time frame shall be located by the CDT.

ODOT MATERIALS & INSPECTION

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Compaction Specifications

Testing Requirements

- **SP00745.49(b)(2) Random Testing** – Correspond lots and compaction sublots with those defined in 00745.02. Provide one density test location for each compaction sublot. Notify the Engineer when rolling operations are completed in a compaction sublot and it is ready for test location identification. The Engineer will use stratified random numbers to locate the QC tests according to ODOT TM 400 Annex. ODOT TM 400 Annex is available from the Engineer. The Engineer will mark where the QC tests are to be performed.
- Allow 30 minutes for the Engineer to locate the final test locations after completion of finish rolling and any additional time required for testing, prior to opening the travel lane to traffic. Have the CDT locate and document the test locations not identified within this time frame.

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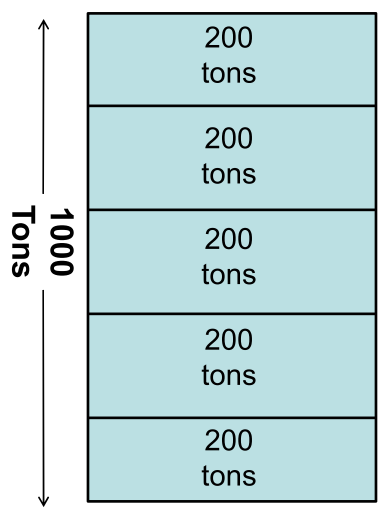
Annex Terminology

Lot and Sublot

- A lot represents the entire material as a whole.
- A sublot breaks the lot into 1000-ton increments.
- Each sublot is then stratified into 200-ton segments.

Note: Partial sublots, will no longer need to have 5 compaction sublots to be considered compete.



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Procedure

Step 1: Generate 5 random numbers. First 3 for longitudinal and remaining 2 for transverse or offset distance.

Convert the random number to a decimal. Take first 3 and multiply by 0.001 and remaining 2 and multiply by 0.01.

			Longitudinal		Transverse / Offset
1.	**16897**	168 x 0.001 =	0.168	97 x 0.01 =	0.97
2.	**16066**	160 x 0.001 =	0.160	66 x 0.01 =	0.66
3.	**85075**	850 x 0.001 =	0.850	75 x 0.01 =	0.75
4.	**92639**	926 x 0.001 =	0.926	39 x 0.01 =	0.39
5.	**35721**	357 x 0.001 =	0.357	21 x 0.01 =	0.21

35

Procedure

Step 2: Take the 1000-ton sublot and divide by 5 to create segments, each representing 200 tons.

Taking the random numbers generated in Step 1, apply to the 200-ton segmented areas to compute a random tonnage between each increment.

200 Ton	1st Segment Longitudinal Tonnage = 0.168 x 200 = 34 tons.
200 Ton	2nd Segment Longitudinal Tonnage = 0.160 x 200 = 32 tons.
200 Ton	3rd Segment Longitudinal Tonnage = 0.850 x 200 = 170 tons.
200 Ton	4th Segment Longitudinal Tonnage = 0.926 x 200 = 185 tons.
200 Ton	5th Segment Longitudinal Tonnage = 0.357 x 200 = 71 tons.

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Procedure

- The random tonnages computed in Step 2 only have relationship to the individual segments.
- To ensure the 200-ton stratification is maintained, each random tonnage within the 200-ton segments must be added to the next 200-ton segment.
- 1st segment, 0-200 tons has a random location of 34 tons, so this segment's random tonnage remains the same.
  0 + 34 = 34 tons.
- 2nd segment, 200-400 tons has a random location of 32 tons, so this segment's random tonnage would be
  32 + 200 = 232 tons.
- Process would continue until all 5 sites are located.

ODOT MATERIALS & INSPECTION

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Blind Random Numbers for ACP Density

Project Name: I-5 Paving			Contract Number: C99999
Project Manager: John Doe	Description: Level 3 - 1/2" ACP in Wearing Course	Mix Design Number: 21-MD9999	Bid Item No.: 0600 / Lot: 2

Lot - 2 Sublot L	S	#	Three Random Digits	Date	Random Tonnage	Asphalt Tonnage to Date (Cumulative Tonnage from Previous Shift)	Adjusted Daily Random Tonnage	Test Station (Ticket Taker or Calculated)	Two Random Digits (D)	Width of Panel Feet (E)	Distance From Right Edge ((E-2)*D)+1	Sublot Size 200 Tons
2	1	1	0.168		34		34		0.97			0
		2	0.160		232		232		0.66			200
		3	0.850		570		570		0.75			400
		4	0.926		785		785		0.39			600
		5	0.357		871		871		0.21			800
2	2	1	0.404		1081		1081		0.89			1000
		2	0.443		1289		1289		0.42			1200
		3	0.483		1497		1497		0.39			1400
		4	0.781		1756		1756		0.49			1600
		5	0.539		1908		1908		0.75			1800
2	3	1	0.472		2094		2094		0.92			2000
		2	0.345		2269		2269		0.42			2200
		3	0.073		2415		2415		0.53			2400
		4	0.703		2741		2741		0.61			2600
		5	0.333		2867		2867		0.61			2800
2	4	1	0.129		3026		3026		0.98			3000
		2	0.296		3259		3259		0.23			3200
		3	0.948		3590		3590		0.59			3400
		4	0.684		3737		3737		0.17			3600
		5	0.666		3933		3933		0.47			3800

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Blind Random Numbers for ACP Density

Project Name:	Contract Number
I-5 Paving	C99999

Project Manager:	Description:	Mix Design Number:	Bid Item	Date
John Doe	Level 3 - 1/2" ACP in Wearing Course	21-MD9999	600	

Random # * (A)	Random Tonnage *	Lot-Sublot-Test #	Load Number	Beginning Station (B)	Ending Station (C)	Test Station ((C-B)*A)+B	Random # * (D)	Panel Width (E)	Transverse Location ((E-2)*D)+1
0.168	34	2-1-1					0.97		
0.160	232	2-1-2					0.66		
0.850	570	2-1-3					0.75		
0.926	785	2-1-4					0.39		
0.357	871	2-1-5					0.21		
0.404	1081	2-2-1					0.89		
0.443	1289	2-2-2					0.42		
0.483	1497	2-2-3					0.39		
0.781	1756	2-2-4					0.49		
0.539	1908	2-2-5					0.75		

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Procedure

Step 3: Determine the test trucks, using the actual tonnage placed based on delivery invoices and the Material Delivery & Yield Check Sheet

PROJECT	I-5 Paving	CONTRACT	C99999
DATE	5/2/2020	SOURCE	All In Paving
BID ITEM	600	MATERIAL	Level 3 - 1/2" ACP in Wearing Course

MATERIAL DELIVERY

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS
1	76060	26.68	214+30	9:24:00 PM	26.68	Start at 213+00
2	76061	24.37	215+90	9:32:00 PM	51.05	
3	76062	24.11	216+90	9:36:00 PM	75.16	
4	76063	24.96	218+50	9:40:00 PM	100.12	
5	76064	24.96	219+90	9:43:00 PM	125.08	
6	76065	24.47	221+00	9:48:00 PM	149.55	
7	76066	24.48	222+50	10:00:00 PM	174.03	
8	76067	28.56	224+20	10:04:00 PM	202.59	
9	76068	25.64	225+40	10:08:00 PM	228.23	
10	76069	28.36	227+00	10:13:00 PM	256.59	
	(A) Total	256.59				

40

Procedure

Step 3: Determine the test truck, using the actual tonnage placed based on delivery tickets and the Material Delivery & Yield Check Sheet.

1st segment, 0-200 tons has a random location of 34 tons, so this segment's random tonnage remains the same.
0 + 34 = 34 tons

The random tonnage for segment 1, as determined on a previous slide, is 34 tons.

41

Procedure

Step 3: Determine the test trucks, using the actual tonnage placed based on delivery invoices and the Material Delivery & Yield Check Sheet

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS
1	76060	26.68	214+30	9:24:00 PM	26.68	Start at 213+00
2	76061	24.37	215+90	9:32:00 PM	51.05	
3	76062	24.11	216+90	9:36:00 PM	75.16	

We see that load 2 has an accumulated tonnage of 51.05 tons, so our random density test is in load two.

42

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS
1	76060	26.68	214+30	9:24:00 PM	26.68	Start at 213+00
2	76061	24.37	215+90	9:32:00 PM	51.05	
3	76062	24.11	216+90	9:36:00 PM	75.16	

We see that load two was placed between station 214+30 and 215+90, this give us 160 feet of material. **21590 – 21430 = 160**

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Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

			Longitudinal
1.	**16897**	168 x 0.001 =	0.168
2.	**16066**	160 x 0.001 =	0.160

We know our random number from a previous slide for segment 1 is 0.168. This can be converted to a percentage ~ 17%

44

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

Ending station 215+90 – Beginning station 214+30 = 160 feet
21590 – 21430 = 160

160 feet x .17 to determine the test station = 27 feet
160 x 0.17 = 27

45

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

Beginning station 214+30 + 27 feet to determine test location
21430 + 27 = 21457

21457 converted back to station format =
214+57

46

Procedure

Step 4: Find the load(s) that contain your random tonnage along with the corresponding random number and approximate station.

1st Test truck = 34 tons w/RN = .168

PROJECT: **I-5 Paving**
CONTRACT: **C99999**
DATE: **5/2/2020**
SOURCE: **All In Paving**
BID ITEM: **600**
MATERIAL: **Level 3 - 1/2" ACP in Wearing Course**

MATERIAL DELIVERY

LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS
1	76060	26.68	214+30	9:24:00 PM	26.68	Start at 213+00
2	76061	24.37	215+90	9:32:00 PM	51.05	**Test Location ~ 214+57**
3	76062	24.11	216+90	9:36:00 PM	75.16	
4	76063	24.96	218+50	9:40:00 PM	100.12	
5	76064	24.96	219+90	9:43:00 PM	125.08	
6	76065	24.47	221+00	9:48:00 PM	149.55	
7	76066	24.48	222+50	10:00:00 PM	174.03	
8	76067	28.56	224+20	10:04:00 PM	202.59	
9	76068	25.64	225+40	10:08:00 PM	228.23	
10	76069	28.36	227+00	10:13:00 PM	256.59	
	(A) Total	256.59				

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Blind Random Numbers for ACP Density

Project Name: I-5 Paving
Contract Number: C99999
Project Manager: John Doe
Description: Level 3 - 1/2" ACP in Wearing Course
Mix Design Number: 21-MD9999
Bid Item: 600
Date:

Random # * (A)	Random Tonnage *	Lot-Sublot-Test #	Load Number	Beginning Station (B)	Ending Station (C)	Test Station ((C-B)*A)+B	Random # * (D)	Panel Width (E)	Transverse Location ((E-2)*D)+1
0.168	34	2-1-1	2	214+30	215+90	214+57	0.97		
0.160	232	2-1-2					0.66		
0.850	570	2-1-3					0.75		
0.926	785	2-1-4					0.39		
0.357	871	2-1-5					0.21		
0.404	1081	2-2-1					0.89		
0.443	1289	2-2-2					0.42		
0.483	1497	2-2-3					0.39		
0.781	1756	2-2-4					0.49		
0.539	1908	2-2-5					0.75		

48

Let's find test location 2 by using the same method

2nd segment, 200-400 tons has a random location of 32 tons, so this segment's random tonnage would be 32 +200 = 232 tons.

The random tonnage for segment 2, as determined on a previous slide, is 232 tons.

49

Procedure

Step 3: Determine the test trucks, using the actual tonnage placed based on delivery invoices and the Material Delivery & Yield Check Sheet.

8	76067	28.56	224+20	10:04:00 PM	202.59	
9	76068	25.64	225+40	10:08:00 PM	228.23	
10	76069	28.36	227+00	10:13:00 PM	256.59	
	(A) Total	256.59				

We see that load 10 has an accumulated tonnage of 256.59 tons, so our random density test is in load 10.

50

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

8	76067	28.56	224+20	10:04:00 PM	202.59	
9	76068	25.64	225+40	10:08:00 PM	228.23	
10	76069	28.36	227+00	10:13:00 PM	256.59	
	(A) Total	256.59				

We see that load ten was placed between station 225+40 and 227+00, this give us 160 feet of material. **22700 – 22540 = 160**

51

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

			Longitudinal
1.	**16897**	168 x 0.001 =	0.168
2.	**16066**	160 x 0.001 =	0.160

We know our random number from a previous slide for segment 1 is 0.160. This converted to a percentage is 16%

52

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

Ending station 227+00 – Beginning station 225+40 = 160 feet
22700 – 22540 = 160

160 feet x 16% to determine the test station = 26 feet
160 x 0.16 = 26

53

Procedure

Step 4: Find the location within the load that contains the random number and determine the approximate station.

Beginning station 225+40 + 26 feet to determine test location
22540 + 26 = 22566

22566 converted back to station format =
225+66

54

Procedure

Step 4: Find the load(s) that contain your random tonnage along with the corresponding random number and approximate station.

2nd Test Truck = 232 tons w/RN = .160

PROJECT	I-5 Paving	CONTRACT	C99999
DATE	5/2/2020	SOURCE	All In Paving
BID ITEM	600	MATERIAL	Level 3 - 1/2" ACP in Wearing Course

MATERIAL DELIVERY						
LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS
1	76060	26.68	214+30	9:24:00 PM	26.68	Start at 213+00
2	76061	24.37	215+90	9:32:00 PM	51.05	
3	76062	24.11	216+90	9:36:00 PM	75.16	
4	76063	24.96	218+50	9:40:00 PM	100.12	
5	76064	24.96	219+90	9:43:00 PM	125.08	
6	76065	24.47	221+00	9:48:00 PM	149.55	
7	76066	24.48	222+50	10:00:00 PM	174.03	
8	76067	28.56	224+20	10:04:00 PM	202.59	
9	76068	25.64	225+40	10:08:00 PM	228.23	
10	76069	28.36	227+00	10:13:00 PM	256.59	**Test Location ~ 225+66**
	(A) Total	256.59				

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Blind Random Numbers for ACP Density

Project Name: I-5 Paving								Contract Number: C99999		
Project Manager: John Doe				Description: Level 3 - 1/2" ACP in Wearing Course			Mix Design Number: 21-MD9999	Bid Item: 600	Date	
Random # * (A)	Random Tonnage *	Lot-Sublot-Test #	Load Number	Beginning Station (B)	Ending Station (C)	Test Station ((C-B)*A)+B	Random # * (D)	Panel Width (E)	Transverse Location ((E-2)*D)+1
0.168	34	2-1-1	2	214+30	215+90	214+57	0.97		
0.160	232	2-1-2	10	225+40	227+00	225+66	0.66		
0.850	570	2-1-3					0.75		
0.926	785	2-1-4					0.39		
0.357	871	2-1-5					0.21		
0.404	1081	2-2-1					0.89		
0.443	1289	2-2-2					0.42		
0.483	1497	2-2-3					0.39		
0.781	1756	2-2-4					0.49		
0.539	1908	2-2-5					0.75		

56

We have now established longitudinal locations for our first two density tests.

1st Test truck = 34 tons w/RN = .168 2nd Test Truck = 232 tons w/RN = .160

PROJECT I-5 Paving CONTRACT C99999

DATE 5/2/2020 SOURCE All In Paving

BID ITEM 600 MATERIAL Level 3 - 1/2" ACP in Wearing Course

MATERIAL DELIVERY						
LOAD #	TICKET #	QUANTITY DELIVERED	LOCATION PLACED	TIME DELIVERED	CUMULATIVE DELIVERED	REMARKS
1	76060	26.68	214+30	9:24:00 PM	26.68	Start at 213+00
2	76061	24.37	215+90	9:32:00 PM	51.05	Test Location ~ 214+57
3	76062	24.11	216+90	9:36:00 PM	75.16	
4	76063	24.96	218+50	9:40:00 PM	100.12	
5	76064	24.96	219+90	9:43:00 PM	125.08	
6	76065	24.47	221+00	9:48:00 PM	149.55	
7	76066	24.48	222+50	10:00:00 PM	174.03	
8	76067	28.56	224+20	10:04:00 PM	202.59	
9	76068	25.64	225+40	10:08:00 PM	228.23	
10	76069	28.36	227+00	10:13:00 PM	256.59	Test Location ~ 225+66
	(A) Total	256.59				

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Procedure

- Now that we have established the longitudinal station of the density test, we need to also establish the transverse location.
- This should be done by the person marking out the location for the CDT and is based on the width of the panel paved at the identified station.

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Procedure

Step 5: Determine the transverse or offset distance at each longitudinal random location. Site location cannot be within 1′ of either edge of the panel. Offset Distance from Rt. Edge = ((Panel Width – 2) X random number) + 1

Let's assume a 16-foot panel width.

Transverse / Offset

97 x 0.01 =	0.97	Location 1 = ((14) x 0.97) +1 = 14.6'
66 x 0.01 =	0.66	Location 2 = ((14) x 0.66) +1 = 10.2'
75 x 0.01 =	0.75	Location 3 = ((14) x 0.75) +1 = 11.5'
39 x 0.01 =	0.39	Location 4 = ((14) x 0.39) +1 = 6.5'
21 x 0.01 =	0.21	Location 5 = ((14) x 0.21) +1 = 3.9'

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Blind Random Numbers for ACP Density

Project Name: I-5 Paving

Contract Number: C99999

Project Manager: John Doe

Description: Level 3 - 1/2" ACP in Wearing Course

Mix Design Number: 21-MD9999

Bid Item: 600

Date:

Random # * (A)	Random Tonnage *	Lot-Sublot-Test #	Load Number	Beginning Station (B)	Ending Station (C)	Test Station ((C-B)*A)+B	Random # * (D)	Panel Width (E)	Transverse Location ((E-2)*D)+1
0.168	34	2-1-1	2	214+30	215+90	214+57	0.97	16	14.6
0.160	232	2-1-2	10	225+40	227+00	225+66	0.66	16	10.2
0.850	570	2-1-3					0.75		
0.926	785	2-1-4					0.39		
0.357	871	2-1-5					0.21		
0.404	1081	2-2-1					0.89		
0.443	1289	2-2-2					0.42		
0.483	1497	2-2-3					0.39		
0.781	1756	2-2-4					0.49		
0.539	1908	2-2-5					0.75		

60

Procedure

- Once the site is identified, clearly mark the center point of the test location with lumber crayon or keel.
- Make the mark large enough to be seen that the CDT can easily find the test location
- Label the test location with Station and Test ID

Example:
Sta. 214+57 2 – 1 – 1
Lot 2 – Sublot 1 – Test 1

❖ ***Site Locations must be marked after finish rolling, ASAP, to prevent Construction delays.***

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Non-Density Testable or Irregular Areas

- Managing of ACP placement needs to be monitored continuously during the paving operation to account for the different paving features being constructed.
- Many sections will have various widths and geometric shapes that fall under the category of non-density testable (less than 8′ in width) or irregular areas.
- These tonnages need to be separated and placed into different lots, since they aren't density testable.

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Non-Density Testable or Irregular Areas

- The PM / Inspector should coordinate with the QCCS and contractor, regarding separation of quantities into various categories.
- All random number determinations shall be maintained and filed with the appropriate density reports. A new form is available to assist the inspector and can be used as supporting documentation.
- If assistance is needed for random site determinations don’t hesitate to call the regional Senior QAC for assistance.

ODOT MATERIALS & INSPECTION

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INSERT TAB

Smoothness Testing

Smoothness Testing

Module 10

1

Smoothness Testing

- Base Courses
- Wearing Courses
  - Standard Contracts
  - Contracts with Smoothness Bonus/Penalty

2

Base Courses

00745.70(b)(2) Multiple Course Construction – Test the surface of the Course on which the wearing Course is placed according to 00745.70(a).

00745.70(a) Level 1 and Level 2 ACP – Test with the 12-foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

Most use the "coffee cup" or "seat of the pants" method while driving to pick locations to test with the straightedge.

ODOT MATERIALS & INSPECTION

3

Base Courses
Corrective Work

00745.75(a-1) Base Course:

- Profile to a maximum depth of 0.4 inch with Equipment meeting the requirements of 00620.20
- Profile to a maximum depth of 0.4 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades
- Remove and replace the Base Lift

ODOT MATERIALS & INSPECTION

4

Wearing Courses
Standard Contracts

00745.70(a) Level 1 and Level 2 ACP – Test with the 12-foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

00745.70(b) Level 3 and Level 4 ACP:

(1) Single Course Construction – Test with the 12-foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The pavement surface shall not vary by more than 1/4 inch.

Most use the "coffee cup" or "seat of the pants" method while driving to pick locations to test with the straightedge.

ODOT MATERIALS & INSPECTION

5

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7

Wearing Courses
Standard Contracts

00745.70(b-2) Multiple Course Construction – Test the surface of the Course on which the wearing Course is placed according to 0745.70(a).

Test the wearing surface with the rolling straightedge in the designated wheel path of a 0.1 mile strip of each travel lane per mile, where directed, and on each transverse joint throughout the Project. Operate the rolling straightedge parallel to the centerline. The surface shall not vary more than 0.015 foot.

Also test the wearing surface with a 12-foot straightedge placed perpendicular to the centerline at least once within the above-mentioned 0.1 mile strip. It shall not vary by more than 1/4 inch.

If the 0.1 mile testing strip meets the Specifications, no further testing of the mile represented by the testing strip will be required, except at the transverse joints. If any part of the testing strip does not meet the Specifications, test both wheel paths of the entire mile.

8

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Wearing Courses
Corrective Work

00745.75(a)(2) Wearing Course:

- Remove and replace the wearing surface Lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades and apply an emulsion fog seal as directed.
- (b) Time Limit – Complete correction of all surface roughness within 14 Calendar Days following notification, unless otherwise directed.

ODOT MATERIALS & INSPECTION

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11

12

IRI (Smoothness) Specification Requirements

Schedule 1

- All interstate preservation and modernization projects over ½ mile long
- Multi-lift projects at least 1 mile long and 45 mph speed limit or higher
- Single lift projects over 1 mile long, 45 mph or greater and existing IRI below 90 in/mi.

Schedule 2

- Single lift projects over 1 mile long, 45 mph or greater and existing IRI between 90 and 115 in/mi.

ODOT MATERIALS & INSPECTION

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Why use IRI?

- IRI is reproducible and stable with time.
- Good general pavement condition indicator.
- Describes roughness that causes vehicle vibrations.
- Ties with our pavement management data collection and pavement design inputs.

ODOT MATERIALS & INSPECTION

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Smoothness Specification

Equipment

- 12-foot straightedge
- Profiler that meets ODOT TM 772 and is certified under ODOT TM 769
  - Provide an experienced operator
  - Operator shall meet with the Engineer prior to beginning measurements
  - Profiler Certification documentation must be provided 10 days prior to beginning measurements

ODOT MATERIALS & INSPECTION

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Profiler

16

Profiler

17

Smoothness Specification

Testing and Tolerances

- Test base course and all transverse joints with 12-ft. straightedge as directed
  - Shall not vary by more than ¼"
- Test the wearing course with a ODOT certified profiler (certification covered later)
- Compute IRI using ProVAL per ODOT TM 772

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Smoothness Specification

Quality Control

- Run the profiler over each traffic lane for the entire length of the project
- Obtain data in right and left wheel paths
- The Engineer shall be present during calibrations checks and testing and shall receive electronic files directly after testing.
- Profile analyzed by Contractor – 00745.73(d)
  - Profiler system generated printouts are okay as long as all data, stations and locations are detailed

ODOT MATERIALS & INSPECTION

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Smoothness Specification

- Complete all required smoothness testing no later than 14 Calendar Days after completion of paving or by October 15th of each calendar year for multi year projects
- Provide processed results within 24 hours following completion of required smoothness testing
- Data table includes: IRI left, IRI right and average IRI in 0.10 mile intervals
- Localized roughness with base length of 25 ft of 160 in/mi or greater addressed according to 00745.75(c)

ODOT MATERIALS & INSPECTION

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Smoothness Specification

Quality Assurance (at discretion of the Engineer)

- Agency or 3rd party profiler will run min. of 2/3 of project
  - Usually, entire project
- QC and QA profiler data compared
  - Overall mean IRI of both wheel paths ± 6 in/mi
  - Minimum of 90% of 0.1-mile segments ± 6 in/mi
- Project Manager resolves any discrepancies
  - Re-certification, 3rd party testing, etc.

ODOT MATERIALS & INSPECTION

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Smoothness Specification

Determination of IRI

- Sections begin 50′ into project
- Must still meet straightedge specification
- Many excluded areas

ODOT MATERIALS & INSPECTION

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Smoothness Specification

Excluded areas are:

- Profiles extending beyond project limits
- Bridge decks, end panels and pavement within 50′ of bridge end panels
- First and last 50′ of project
- Ramps, aux lanes less then 2,500’ in length
- Utility appurtenances adjusted by others

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Smoothness Specification

Excluded areas are (continued):

- Sections with less than 0.05 miles between excluded areas
- Portions of project with speed limit less than 45 mph

24

Smoothness Specification

Correction of Pavement Roughness

- Contractor responsible for locating areas that require corrective action for PM/Contractor drive through

Base Course: doesn't meet straightedge requirement

- Use Cold Plane Removal – max 0.4"
- Use Grinder (diamond) – max 0.4"

25

Smoothness Specification

Wearing Course: All 0.1-mile segments > 95.0 in/mi & localized roughness 190.0 in/mi or more require corrective action.

- Engineer and Contractor drive through to evaluate
- Grind w/multiple diamond blades to maximum 0.3" depth and apply fog coat, as directed
- Retest sections that receive corrective action

26

Smoothness Specification

Retest sections that receive corrective action

- Ensures corrective action has taken place
- Provides data on how well corrective measures improve ride
- Helps determine realistic tolerances

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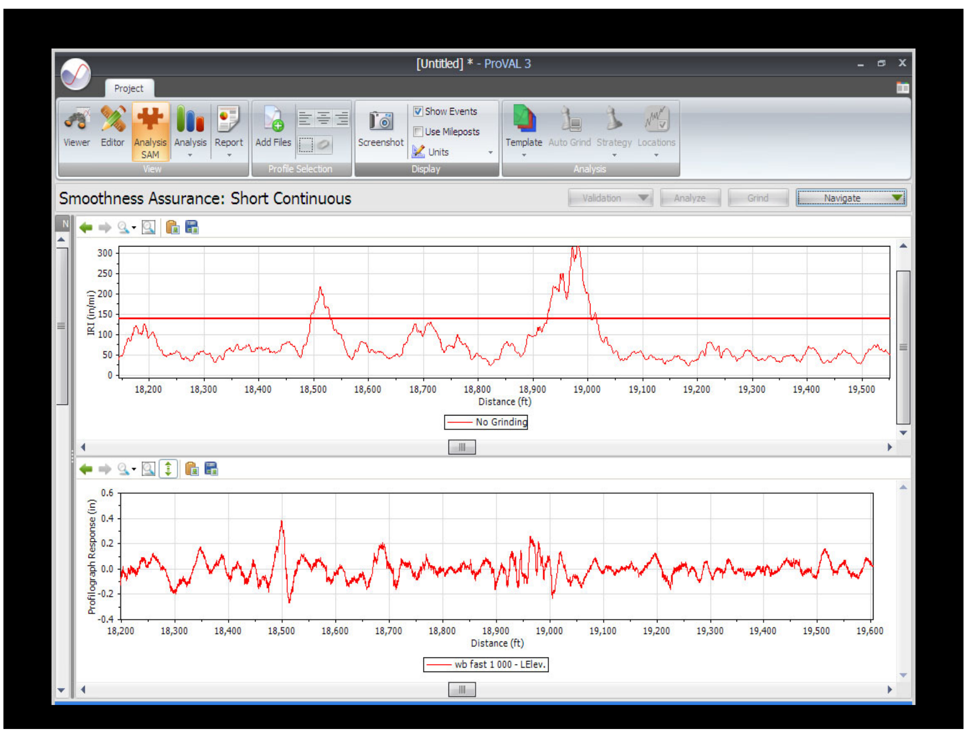

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Payment – Schedule 1

Averaged IRI (inches/mile)	Equation
≤ 35	Y = $500.00
35.01 – 60.00	Y = (– $20.00 × X) + $1,200.00
60.01 – 65.00	Y = $0.00
65.01 – 95.00	Y = (– $20.00 × X) + $1,300.00
> 95.00	corrective action
Y = The price adjustment for the segment or partial segment X = The averaged IRI value for the segment or partial segment	

*** No bonus available for areas that required corrective action**

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Incentive/Disincentive – Schedule 1

- Maximum incentive will be $500 per 0.1 of a mile for IRI values of 35 or less.
- No incentive/disincentive will be established at IRI values between 60 and 65.
- Maximum disincentive will be -$600 per tenth of a mile for IRI values of 95 (above 95 requires corrective action).

ODOT MATERIALS & INSPECTION

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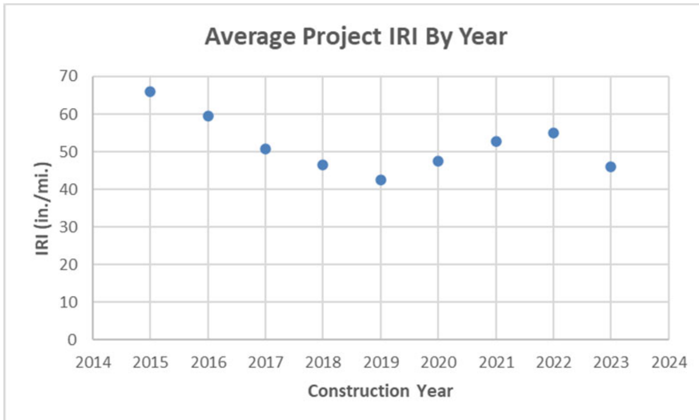
2015 - 2023 Average (unweighted) Project IRI Values



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Profiler Certification

ODOT will require that all inertial profilers used for smoothness acceptance testing will meet the requirements of ODOT TM 769.

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ODOT TM 769
Certification of Inertial Profiler-Operators and Equipment

Highlights

- **Horizontal and Vertical Calibration**
  Check: Distance measuring device and the laser
- **Bounce Test**
  Check: Accelerometer
- **5 Runs over the Reference Profile**
  Check: Repeatability and Accuracy

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ODOT Reference Profiler
Sur PRO 2000

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Reference Profile Location

- ODOT Pavement Services will designate the location.
- The location could be a low traffic area, or a paving job site.
- 5 runs over the reference profile.
  Repeatability 90% and Accuracy 88%. Evaluation will be performed by ProVAL profiler certification module.

ODOT MATERIALS & INSPECTION

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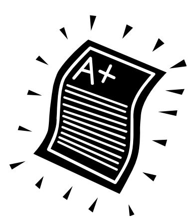
Profiler Approval

- Profiler must pass the vertical and horizontal calibration checks.
- Profiler must pass the bounce test.
- Profile data is submitted immediately after testing in PPF format.
- Data analyzed on-site using Pro VAL Profiler Certification Module.
- Our goal – Approval/Disapproval of each profiler is determined the day of testing.
- Profilers not approved may perform and submit additional runs for approval after adjustments are made.
- Three attempts allowed, unless it gets dark.



ODOT MATERIALS & INSPECTION

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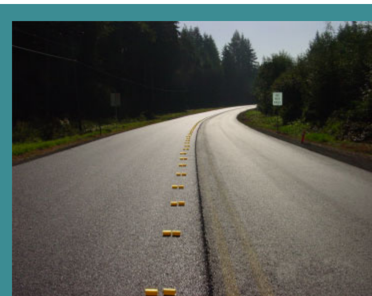
INSERT TAB

Joints

Joints

Module 11



1

Joint Construction

- Transverse Joints
- Longitudinal Joints

2

Joint Construction

- All pavements have one internal weakness – joints
- Poorly constructed joints can result in performance problems
- The final appearance and quality of the joints determines the overall appearance and quality of the finished mat.

ODOT MATERIALS & INSPECTION

3

Transverse Joints

ODOT MATERIALS & INSPECTION

4

Transverse Joints
Specs - 00745.48

(1) Temporary End Panel – Maintain pavement depth, line and grade at least 4 feet beyond the selected transverse joint location, and from that point, wedge down on the appropriate slope until the top of the course being laid meets the underlying surface (assuming a pavement course thickness of 2 inches) as follows:

- For wedges that will be under traffic for less than 24 hours, construct an 8-foot long wedge (1V:50H taper rate)
- For wedges that will be under traffic for 24 hours or longer, construct a 25-foot long wedge (1V:160H taper rate)
- Construct, maintain, remove and dispose of the temporary wedge at no expense to the Agency. ACP for the temporary wedge will be paid for at the pay item price.

5

Transverse Joints – Travel Lanes
Specs - 00745.48(a)

(2) Vertical Face – After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the course being laid at the location selected for the joint by sawing, cutting or other approved method.
- Remove the ACP material from the joint to the end of the panel. If removed before resuming paving beyond the joint, reconstruct the temporary end panel immediately by placing a bond-breaker of paper, dust, or other suitable material against the vertical face and on the surface to be occupied by the temporary end panel. Construct a full-depth panel at least 4 feet long, beginning at the sawed or cut joint, and taper it on a 1V:50H slope to zero thickness.

6

Transverse Joints
Specs - 00745.48

(3) Excess ACP – After completing a temporary end panel as specified, dispose of unused, remaining ACP as directed. Payment will be made for the entire load of ACP but will be limited to only one load per joint per panel.

ODOT MATERIALS & INSPECTION

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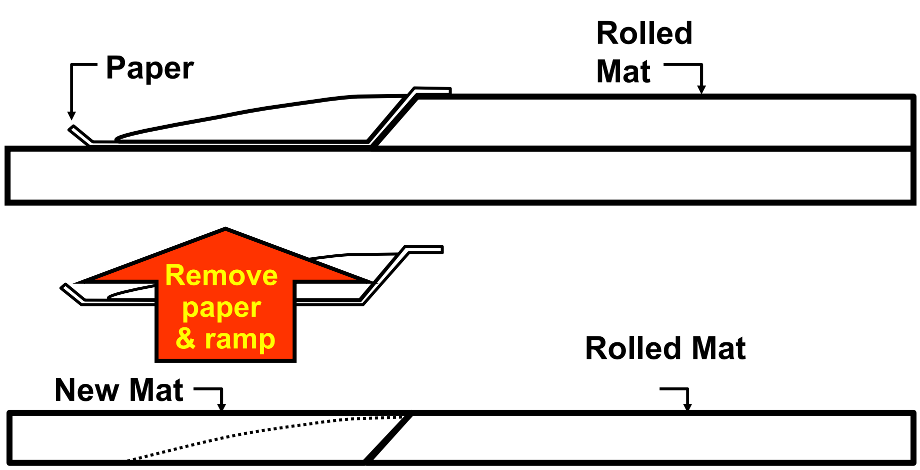
Papered Transverse Joint



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Transverse Joints
Specs - 00745.48

(4) Resume Paving – When permanent paving resumes, remove the temporary end panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(5) Joint Requirements – Compact both sides of the joint to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to the specified surface tolerances. (00745.70)

ODOT MATERIALS & INSPECTION

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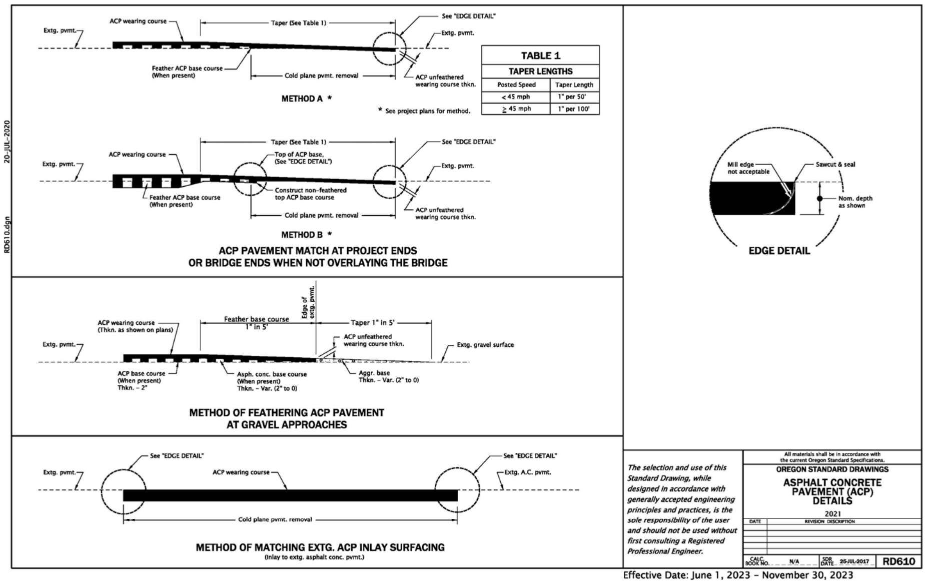
RD 610 Transverse Joint 'Edge Detail'



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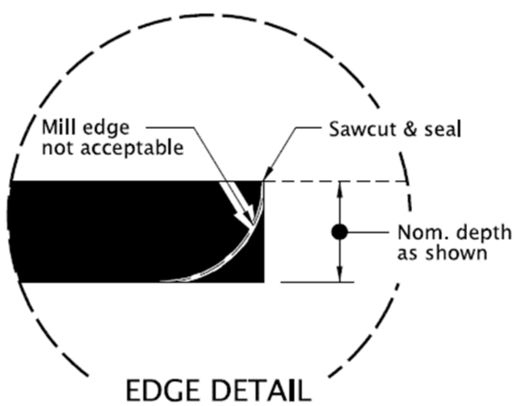
Standard Drawing RD610 for Transverse Joint Prep. at Takeoff



ODOT MATERIALS & INSPECTION

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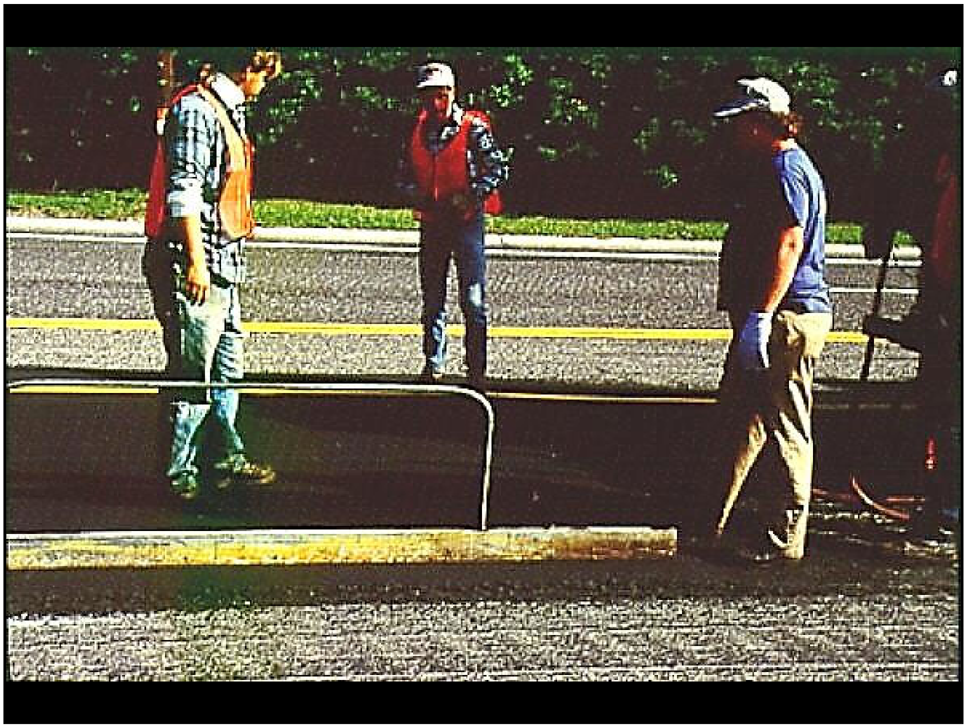

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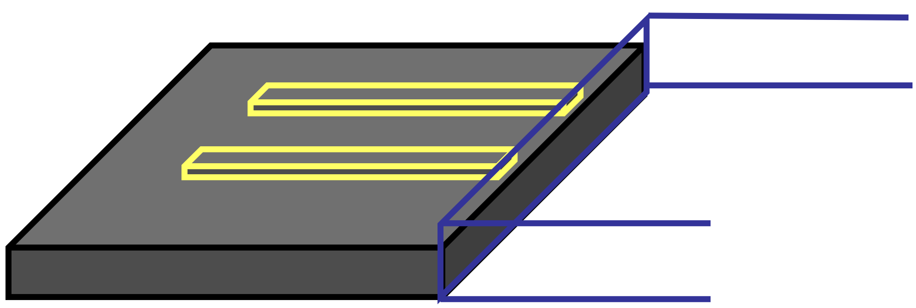
A good rule of thumb is to raise the screed 20 percent more than the compacted thickness.



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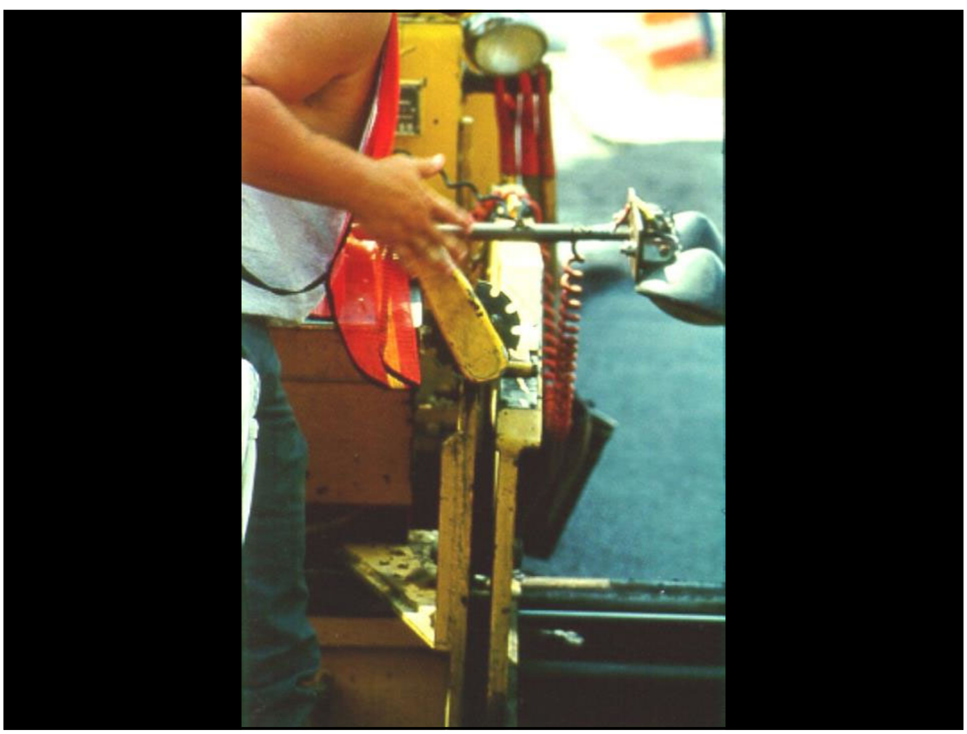

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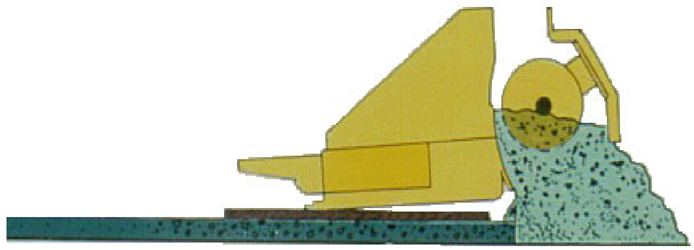

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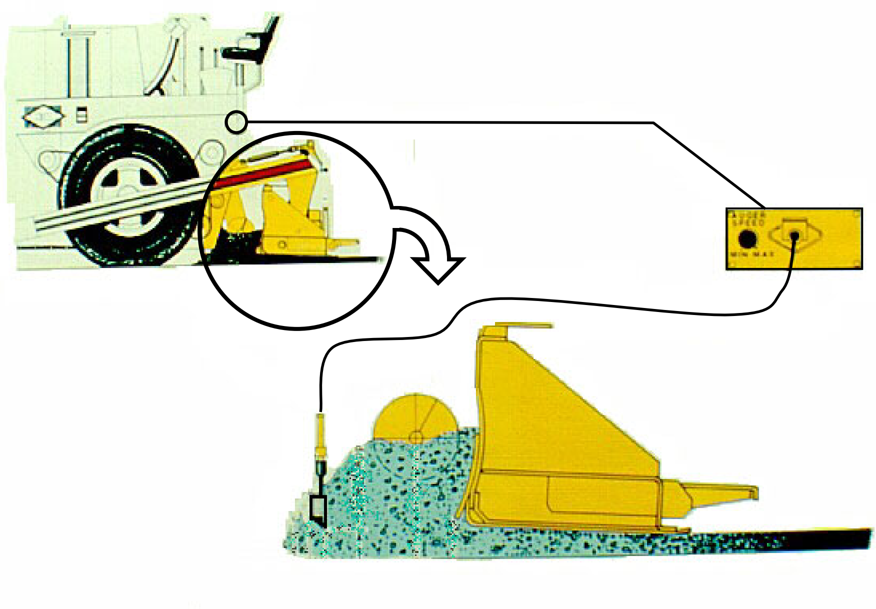

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Re-Checking Settings

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

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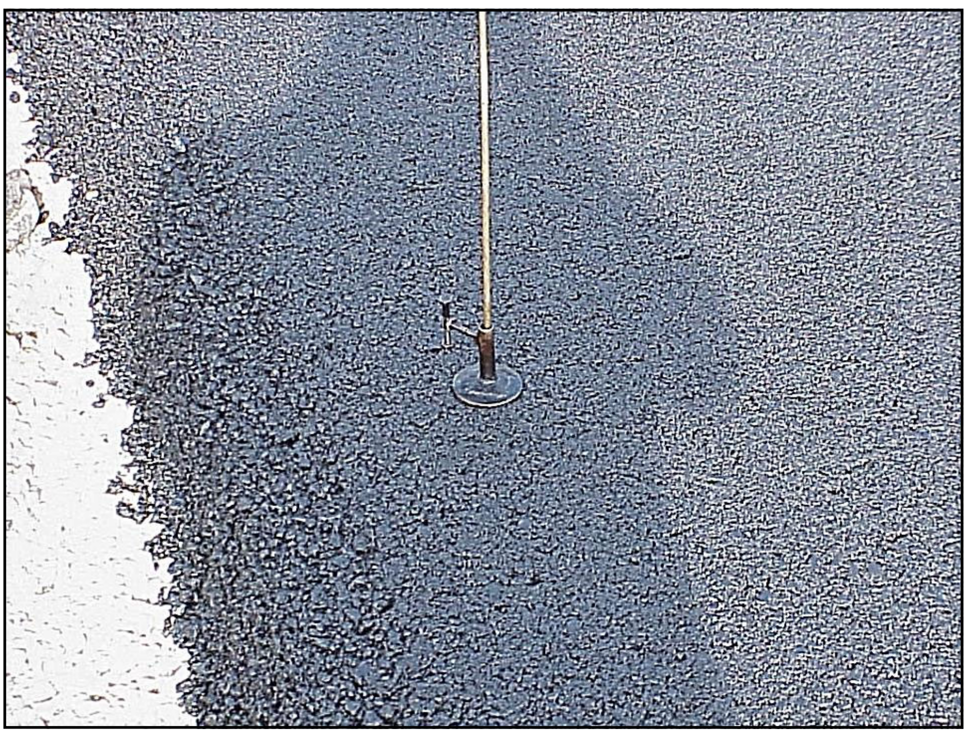

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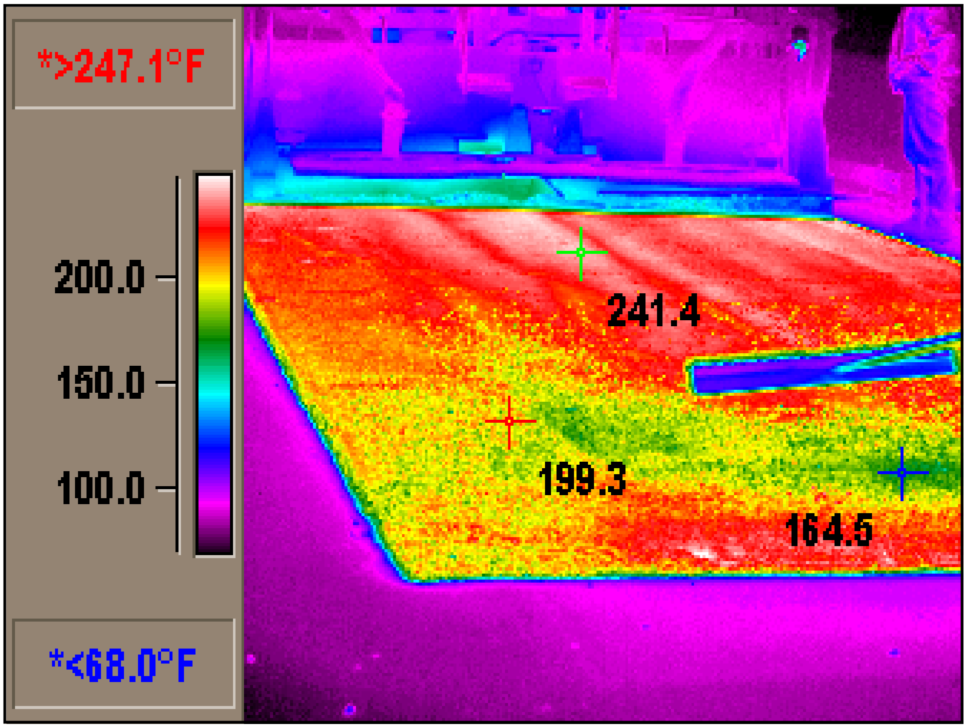
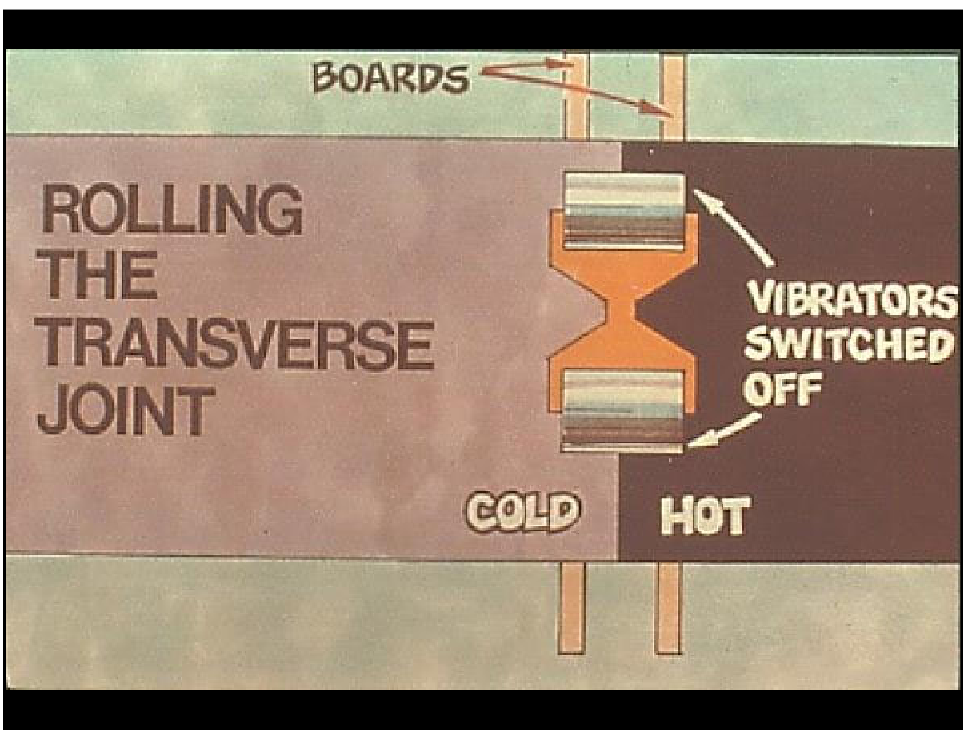

*>247.1°F
200.0
150.0
100.0
*<68.0°F
241.4
199.3
164.5

35


BOARDS
ROLLING THE TRANSVERSE JOINT
VIBRATORS SWITCHED OFF
COLD
HOT

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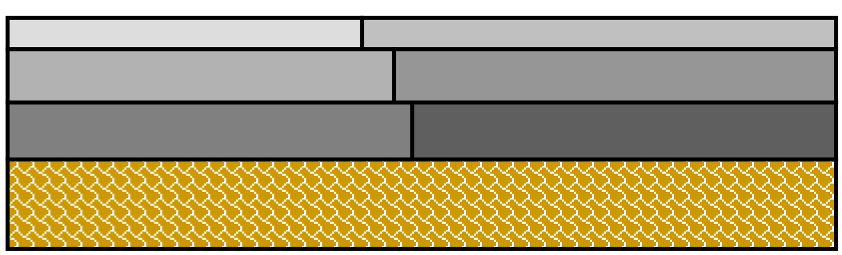
Longitudinal Joints

47

Staggered Longitudinal Joints

00745.47 (a) Location – Place the ACP in panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one panel by at least 6 inches from the longitudinal joints in the panel immediately below.



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Longitudinal Joints
00745.47(a) – Location

(1) **Base Course** – Place base course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) **Wearing Course** – Construct longitudinal joints at either lane line or fog lines, or as shown or directed.

PLAN YOUR PULLS!!!!!

Verify with Striping Plan

ODOT MATERIALS & INSPECTION

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Longitudinal Joints
00745.47

(c) Placing ACP Under Traffic – When placing ACP pavement under traffic, schedule work for the nominal thickness being laid as follows:

(1) More Than 2 Inches – Schedule work so at the end of each working shift the full width of the area being paved, including shoulders, is completed to the same elevation with no longitudinal drop-offs.

(2) Less Than or equal to 2 Inches – Schedule work so that at the end of each working shift one panel of new travel lane pavement does not extend beyond the adjoining panel of new travel lane pavement more than the distance normally covered by each shift. At the end of each workweek, complete the full width of the area to be paved, including shoulders, to the same elevation with no longitudinal drop-offs.

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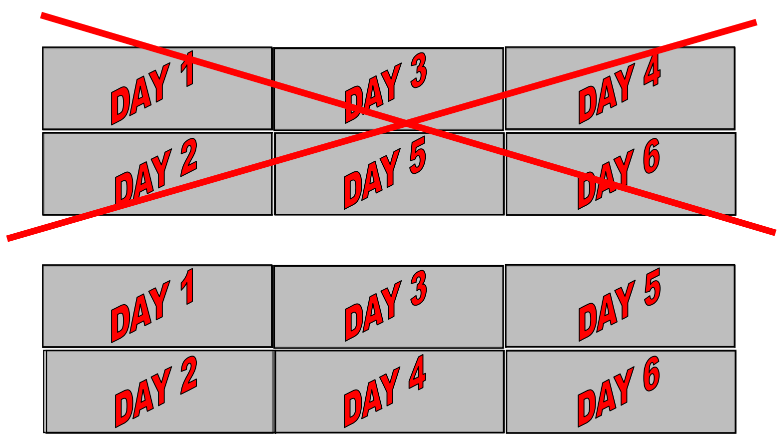

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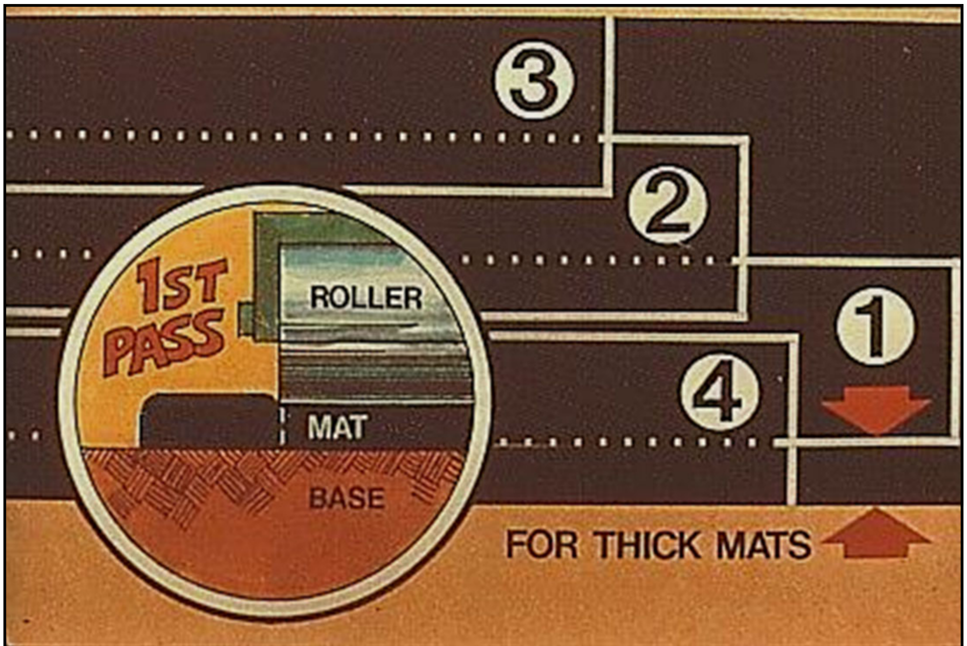

Works for tender mixes, too – minimize mat creep

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Longitudinal Joints

00745.47 Longitudinal Joints – At longitudinal joints, bond, compact and finish the new ACP equal to the ACP against which it is placed.

00745.60 Correction of Defects
(e) Longitudinal Joints – Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved.

QA ODOT MATERIALS & INSPECTION

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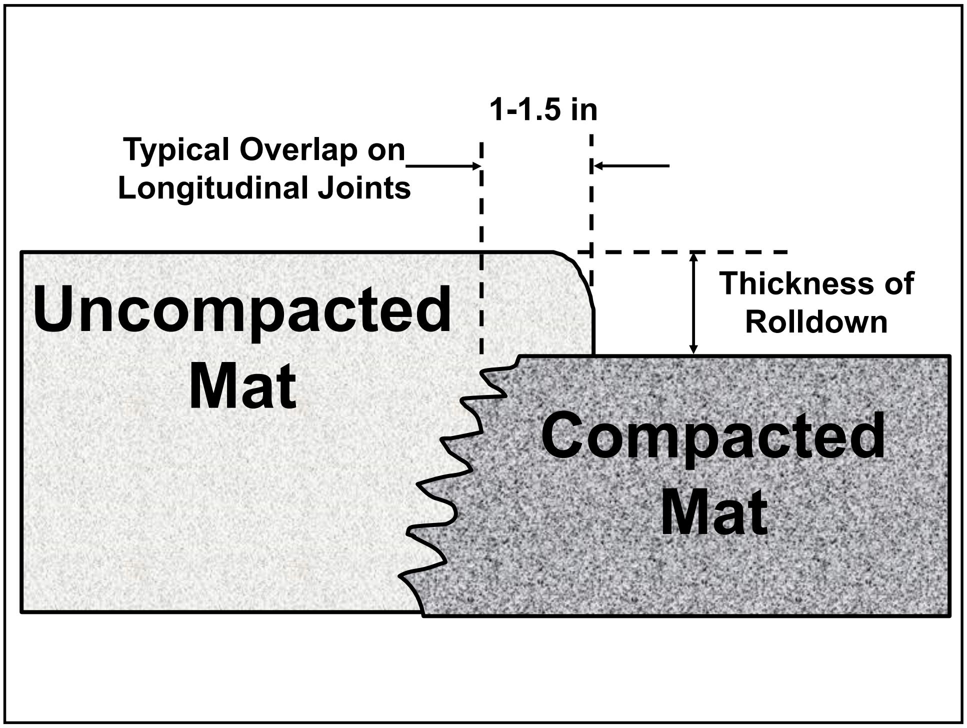
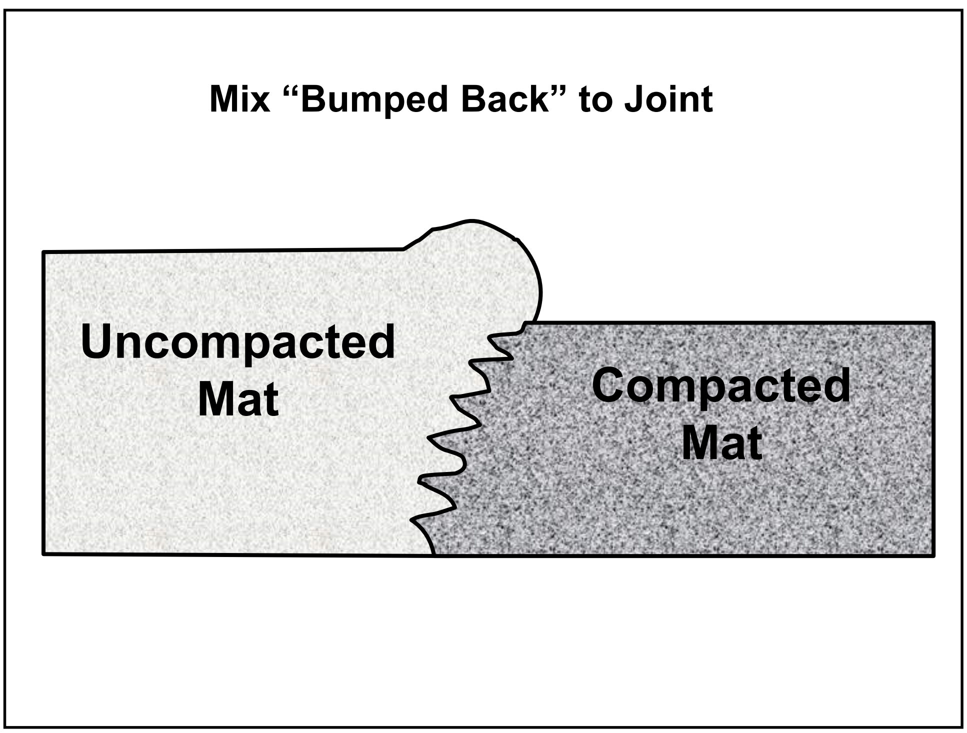

1-1.5 in
Typical Overlap on
Longitudinal Joints
Thickness of
Rolldown
Uncompacted
Mat
Compacted
Mat

65


Mix “Bumped Back” to Joint
Uncompacted
Mat
Compacted
Mat

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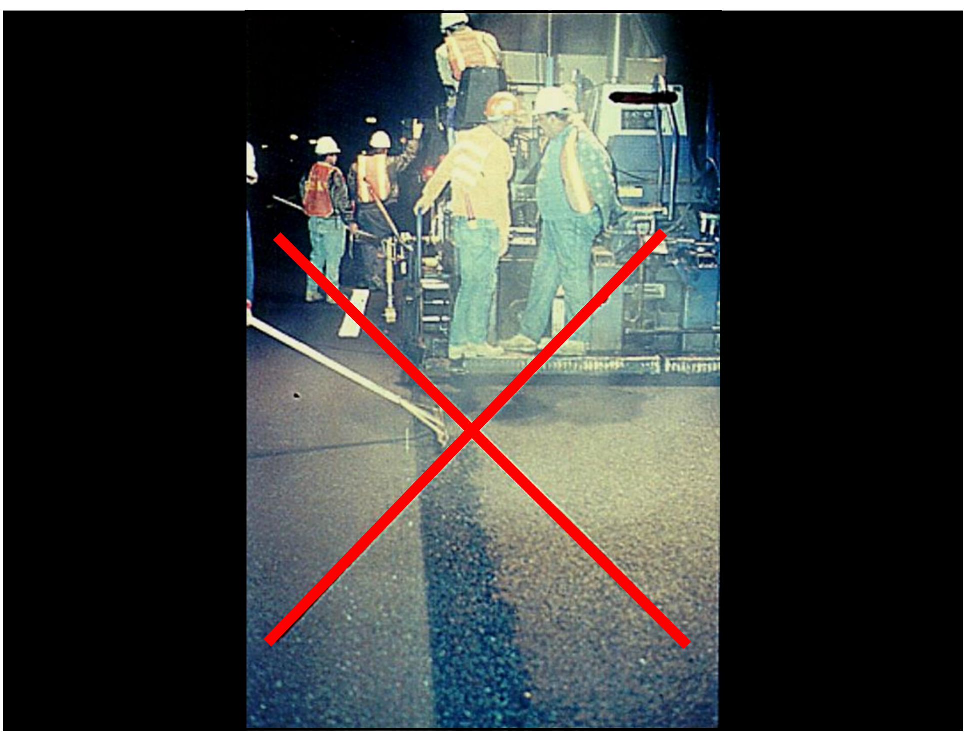

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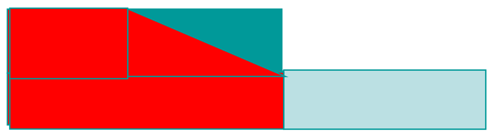
Pushing too much material away from the joint will result in low density at the joint



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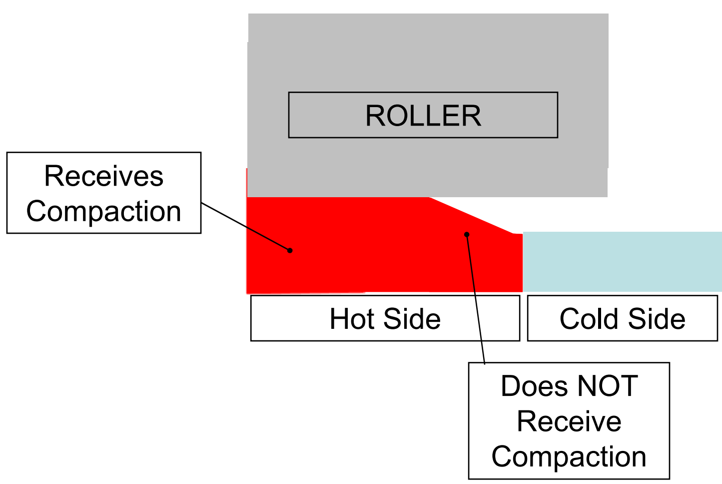

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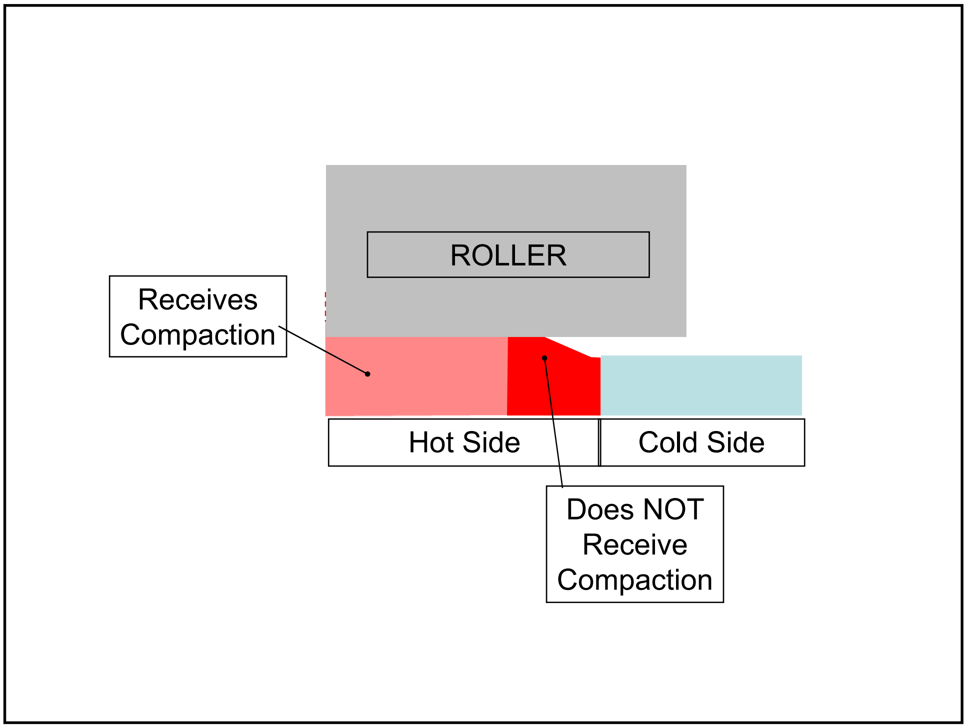
ROLLER
Receives Compaction
Hot Side
Cold Side
Does NOT Receive Compaction

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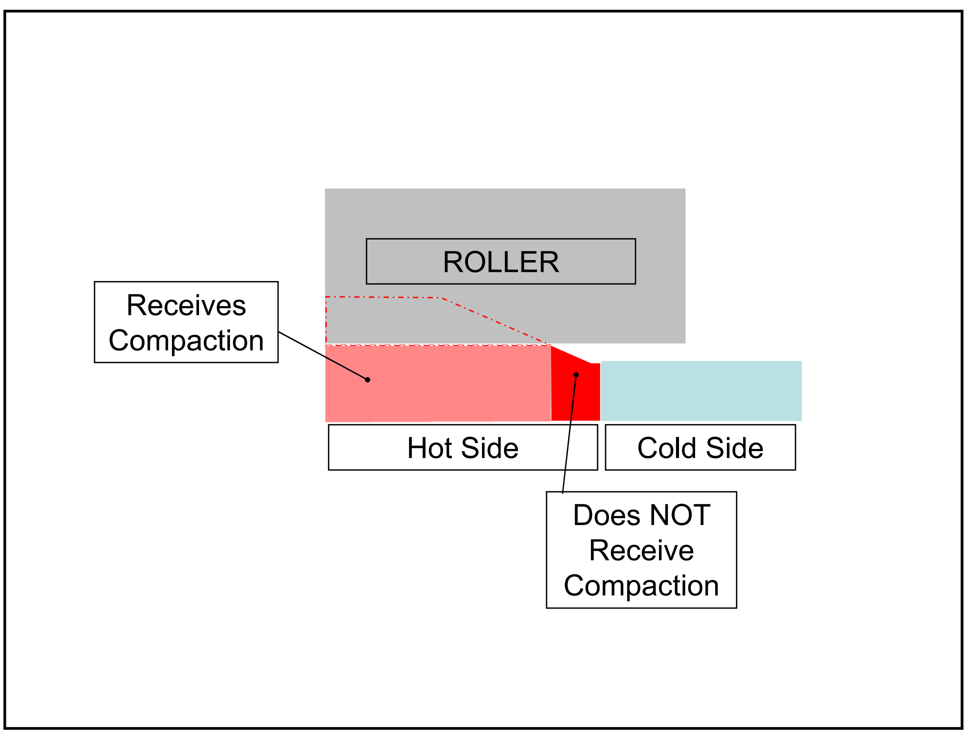
ROLLER
Receives Compaction
Hot Side
Cold Side
Does NOT Receive Compaction

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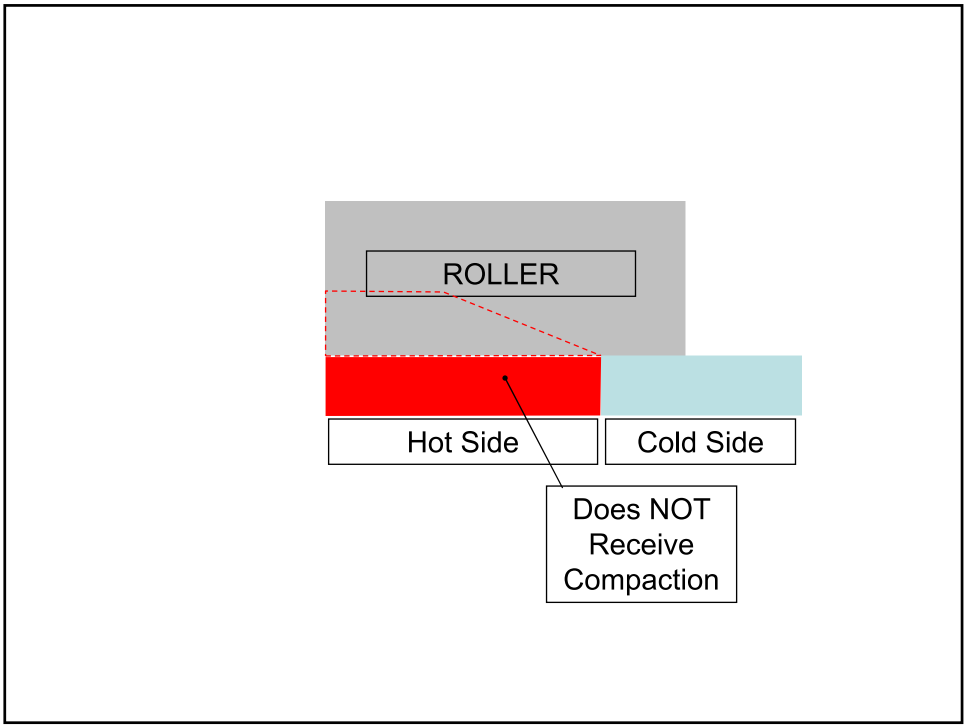
ROLLER
Hot Side
Cold Side
Does NOT Receive Compaction

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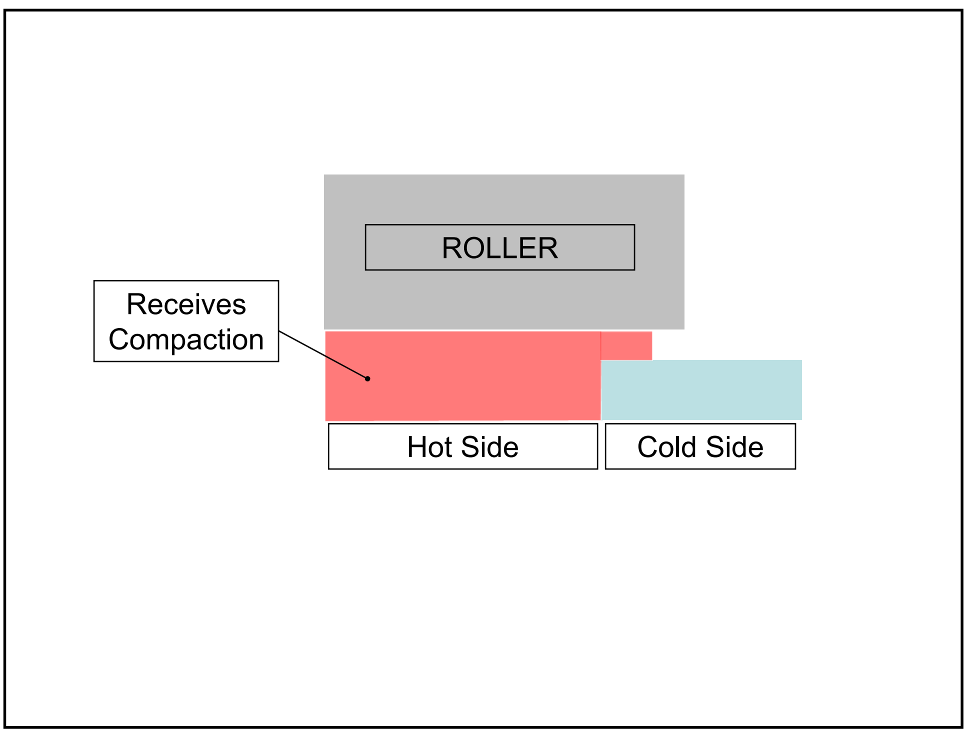
ROLLER
Receives Compaction
Hot Side
Cold Side

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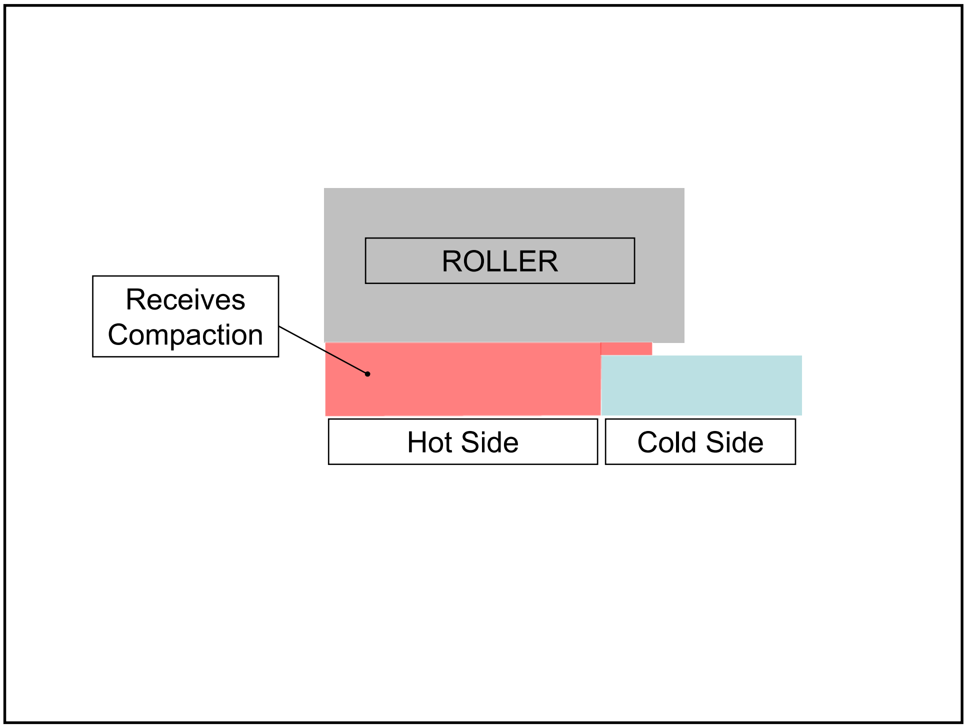
ROLLER
Receives
Compaction
Hot Side
Cold Side

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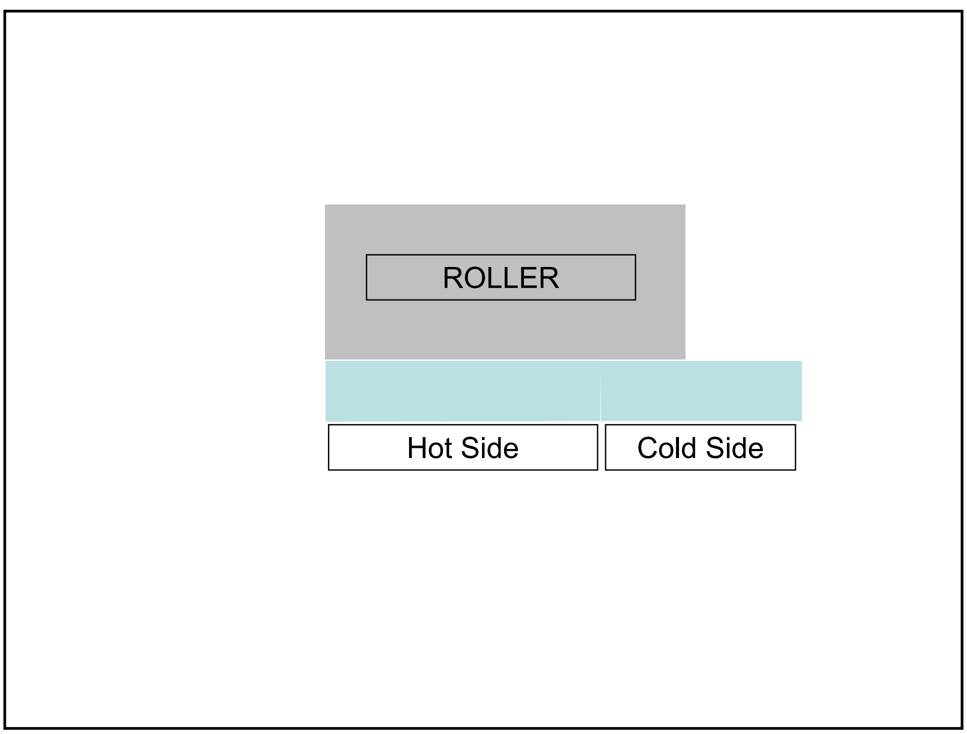
ROLLER
Hot Side
Cold Side

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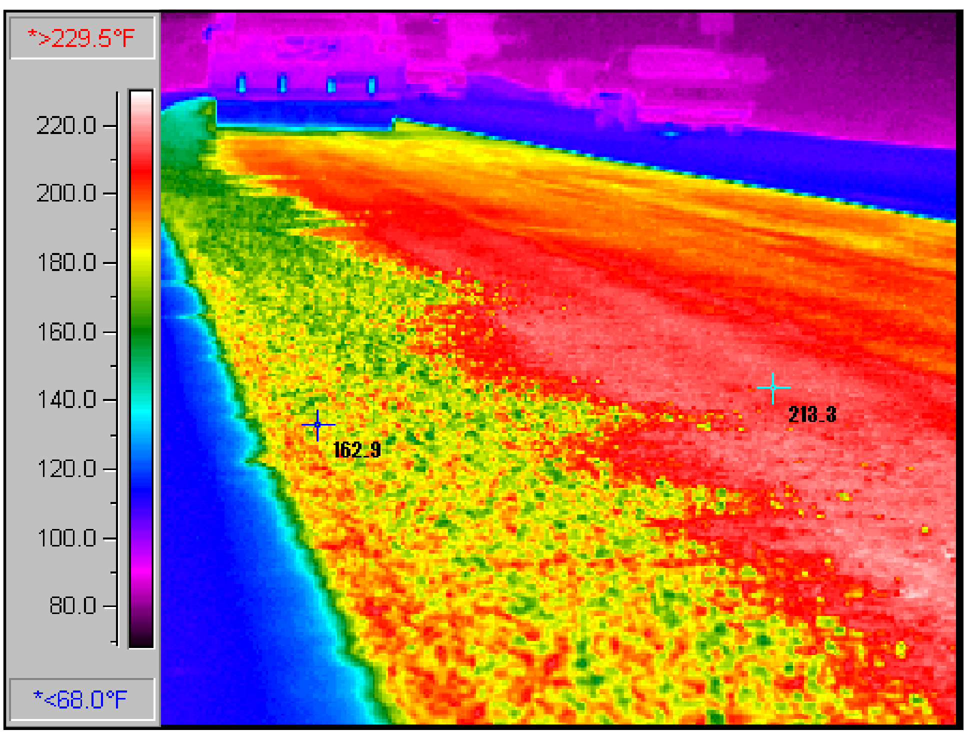

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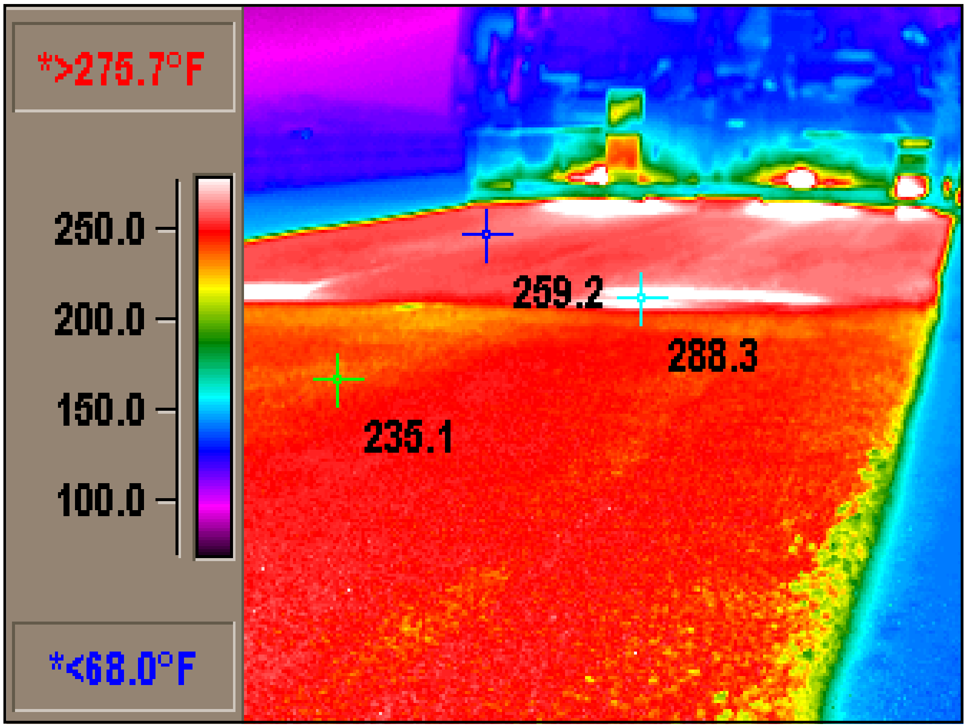

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NCAT Longitudinal Joint Study
Evaluated 8 Methods

- Rolling hot side
- Rolling cold side
- Rubberized joint material
- Joint maker
- Cutting Wheel
- Rolling hot side 6" away
- Edge restraining device
- N.J. wedge

ODOT MATERIALS & INSPECTION

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6-Year Performance Evaluation (1995-2001)

RANKINGS	SCORE
Rubberized joint maker	9.88
Cutting wheel	9.12
Rolling hot side 6" away	8.75
N.J. wedge	7.75
Edge restraining device	6.75
Joint maker	5.50
Rolling from hot side	4.75
Rolling from cold side	4.62

0=Unacceptable 2=Poor 4=Fair 6=Good 8=V.Good 10= Excellent

ODOT MATERIALS & INSPECTION

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Best Practices

Longitudinal Joint Construction

- Pass #1 hot side 6" off joint
- Return pass lap 6" onto cold side to pinch joint
- Complete pattern to cover mat

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Longitudinal Joints

The Good & The Bad

ODOT MATERIALS & INSPECTION

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ODOT MATERIALS & INSPECTION

SPEC Notes

July 2, 2013 Number 3

Longitudinal Joint Construction

- ✓ Discuss longitudinal joint construction at pre-pave meeting
- ✓ Stagger joints at least 6" horizontally from layer below
- ✓ Follow all best practices for HMAC placement
- ✓ Apply tack including face of the joint
- ✓ Overlap existing lane 1" +/-0.5" (overlap milled edge 0.5" for inlays)
- ✓ Avoid pushing material away from the joint. Don't rake!
- ✓ First pass of breakdown roller should be on the hot mat 6" from the cold joint or with a 6" overhang on the cold mat.
- ✓ Check compacted joint to ensure that overlap height is 0.1", confirming that no bridging occurred.

Resources

- 2008 Oregon Standard Specifications for Construction Sec. 00745.61
- ODOT HMAC Inspector Certification Manual *http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/pages/ hmac_inspection_manual.aspx*
- Longitudinal joint training through FHWA, Asphalt Institute *http://www.asphaltinstitute.org/public/engineering/longitudinal-joint-information.dot*

Technical Contact

Larry Ilg, Pavement Quality & Mat'ls Engineer
Phone: 503-986-3072
larry.d.ilg@odot.state.or.us

Spec Notes are prepared by the Construction Section QA Unit for inspectors to provide background information around design elements and specifications.

If you have a topic you would like to see addressed in this format, please contact Liz Hunt at ODOT.

745.61 Longitudinal Joints

All pavements have one internal weakness – joints. Premature joint failures are the result of a combination of low density, permeability, segregation and lack of adhesion at the interface. According to a recent FHWA and Asphalt Institute study, improving HMAC joint quality is probably the single most important thing that can be done to improve pavement performance.

Q – So what's so bad about raking?

A – Raking can remove material away from the pavement edge creating a trench area that does not get adequately compacted. As shown in Figure 1 on the next page.

If the red material (Box A) is removed from the hot mat, the roller bridges the area as shown in Box B. When the mat is finally compacted, the area under the wedge of material has experienced no compaction (Box C) so has a high void content and is most likely more permeable than the surrounding mat.

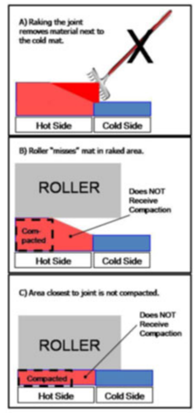

Figure 1. Pushing too much material away from the joint will result in low density at the joint as shown in Box C.

Q – What if the contractor doesn't rake the joint but places hot mix right at the face of the cold joint?

A – This method would be good and fine if all pavements were uniform and smooth. Most contractors use a ski to determine pavement depth that is averaged over the length of the ski.

If there are intermittent high spots along the length of the cold joint, insufficient material will be placed to provide a tight joint. Also, the high spots could be bridged creating marginally compacted areas as shown above.

Q – What is the best process for building a longitudinal joint?

A – Best practices include:

- First, overlap the existing lane (of a butt joint constructed with the paver) 1 inch +/-0.5". When the butt joint is constructed by milling or cutting back the existing lane, the overlap should be about ½ inch. If the overlap exceeds 1.5", carefully remove the excess with a shovel. See Figure 2.
- Don't rake the joint and only bump the joint if more material is needed. Ensure that enough material is at the joint - thickness of rolldown – 25% (2" lift – ½").
- Compact the supported edge of joint with the first pass of vibratory roller drum on the hot mat, but staying back from the joint 6 to 8" on the 1st pass. The 2nd pass should then overlap onto the cold mat 4 to 6". Watch for any stress cracks developing in the mat that are parallel and 6 to 8" off the joint. If cracks develop, switch to the method presented in the next bullet.
- An alternative compaction process is to have the 1st pass of the vibratory roller on the hot mat overlapping 4 to 6" onto the cold mat. A concern is that if an insufficient depth of HMAC is placed next to the cold mat (starving the joint), the roller will bridge over and not compact the hot material completely as shown in Figure 1.

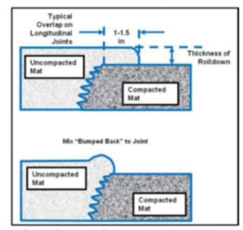

Figure 2. Best practices for placing mix at a longitudinal joint.

https://www.oregon.gov/ODOT/Construction/Pages/QA.aspx

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Longitudinal Joints

Flexible to Rigid Pavements

ODOT MATERIALS & INSPECTION

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Rigid to Flexible Pavement Joints – Don't…

101

Overlap
Good for
Flexible-Flexible

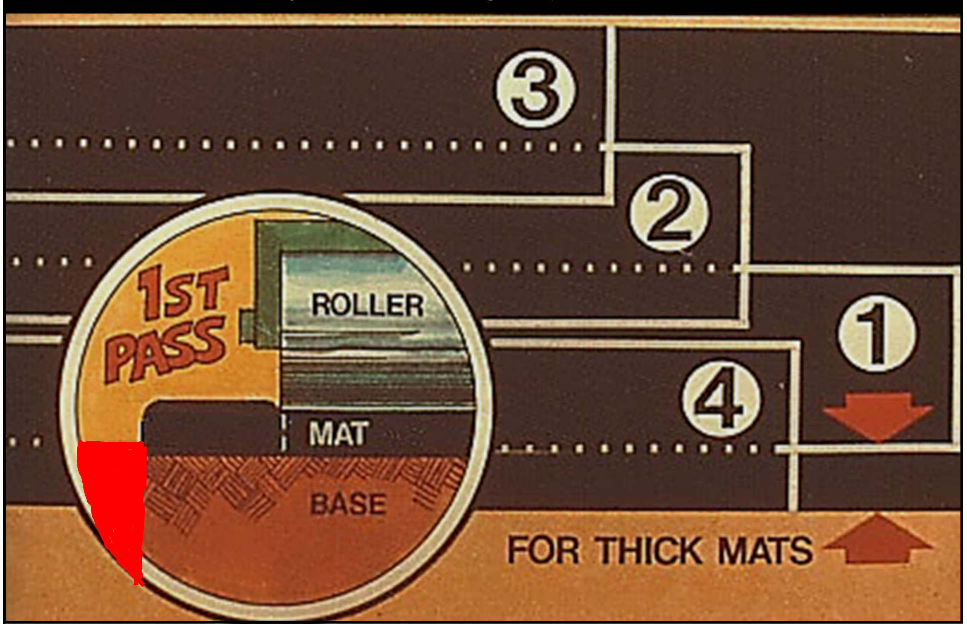
Not so good for
Flexible-Rigid

102

Best – Edge of screed at edge of rigid
No overlap, but no starved joint

103

Hold roller edge 6″ into hot mat for 1st pass, adjacent to rigid pavement



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SPEC Notes

ODOT MATERIALS & INSPECTION

February 1, 2024 Number 3

Longitudinal Joint Construction

- ✓ Discuss longitudinal joint construction at pre-pave meeting
- ✓ Stagger joints at least 6” horizontally from layer below
- ✓ Follow all best practices for HMAC placement
- ✓ Apply tack including face of the joint
- ✓ Overlap existing lane 1” +/-0.5” (overlap milled edge 0.5” for inlays)
- ✓ Avoid pushing material away from the joint. Don’t rake!
- ✓ First pass of breakdown roller should be on the hot mat 6” from the cold joint or with a 6” overhang on the cold mat.
- ✓ Check compacted joint to ensure that overlap height is 0.1”, confirming that no bridging occurred.

Resources

- 2024 Oregon Standard Specifications for Construction Sec. 00745.61
- ODOT HMAC Inspector Certification Manual *http://www.oregon.gov/ODOT/HWY/ CONSTRUCTION/pages/ hmac_inspection_manual.aspx*
- Longitudinal joint training through FHWA, FHWA Tech Brief: https://www.fhwa.dot.gov/pavement/asphalt/ pubs/hif21023.pdf

Technical Contact

Chris Duman, Pavement Quality & Mat’ls Engineer Phone: 503-559-4994
christopher.l.duman@odot.oregon.gov

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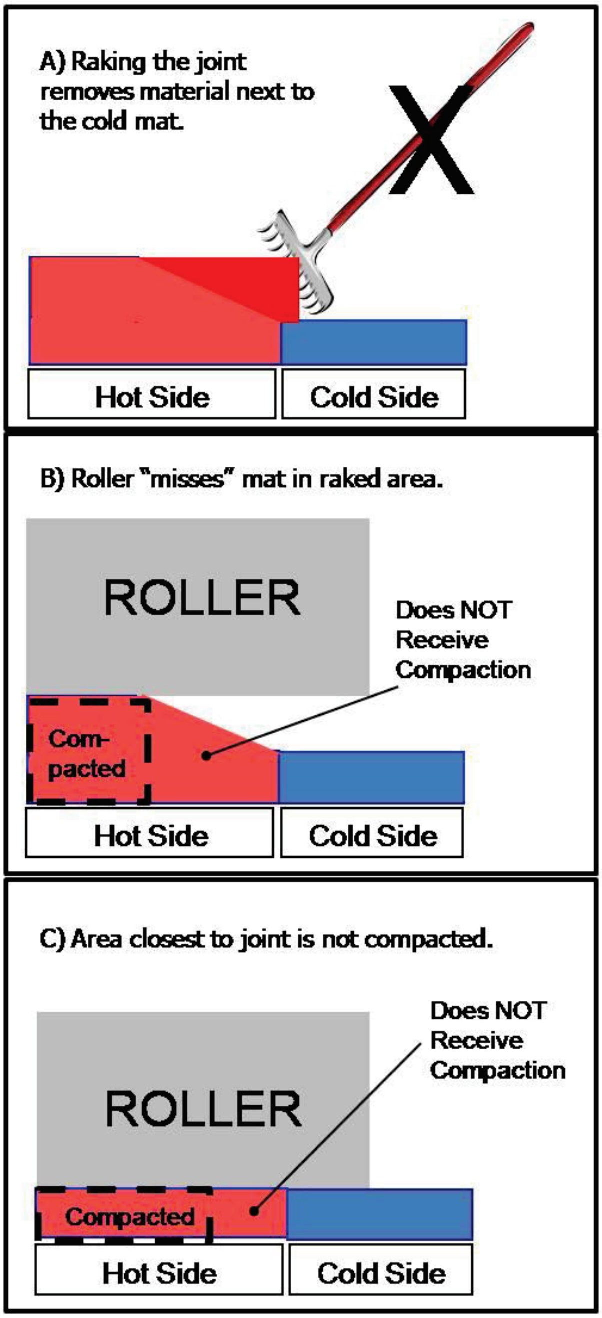

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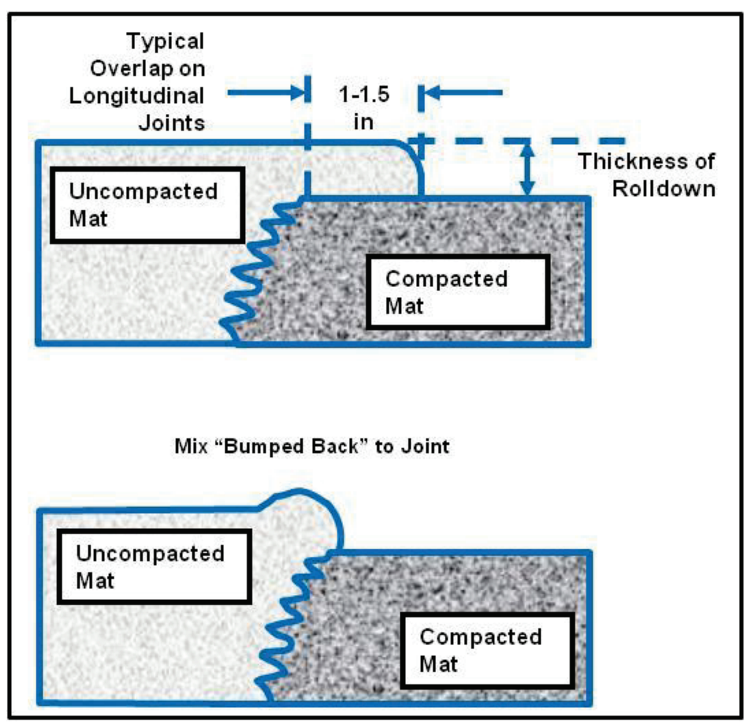

Figure 2. Best practices for placing mix at a longitudinal joint.

INSERT TAB

Miscellaneous Items

Miscellaneous Issues

Module 12

ODOT MATERIALS & INSPECTION

1

Miscellaneous Issues

- Pre-paving meetings
- Dailies for ACP
- Late season or cold weather paving
- Communication
- Other paving specifications

ODOT MATERIALS & INSPECTION

2

Pre-Paving Meetings

3

Pre-Paving Meetings

00745.41 Prepaving Conference – Have a prepaving conference with all Contractor supervisory personnel, all Subcontractors who are to be involved in the paving Work, and the Engineer. Meet at a mutually agreed time and discuss all methods of accomplishing all phases of the paving Work. When Level 3 and Level 4 mixes quantities are greater than 5,000 tons include in the prepaving conference a Contractor representative who is responsible for Project quality control.

4

Pre-Paving Meetings

- Gain understanding of Contractor's overall plan for paving
- Come to agreement on any specification issues
- Lay out quality and workmanship expectations
- Discuss Blind Random Processes – Density and Field Samples if they apply to the project.
- Discuss Traffic Control and when it can be picked-up at the end of the shift.
- Discuss the expectations and agree on the procedure for collecting tack tickets and samples.

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5

Pre-Paving Issues

Contractor

- Personnel Roles and Responsibilities
- Paving Plan
- Paving Methodology

Agency

- Roles and Responsibilities
- Miscellaneous Issues

ODOT MATERIALS & INSPECTION

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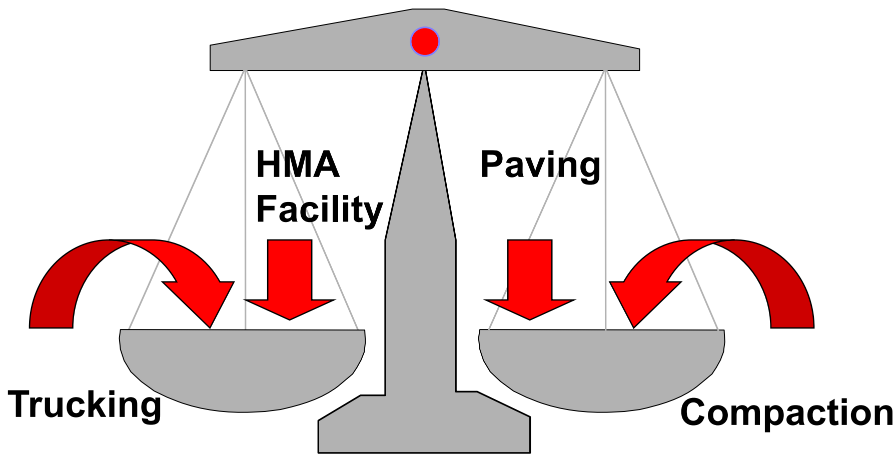
Balancing Production



7

Dailies for ACP

ODOT MATERIALS & INSPECTION

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Dailies for ACP

- Review General Daily Progress Report (form 734-3474)
- Review Paving Diary Developed by Roseburg Crew
- Other ideas??

ODOT MATERIALS & INSPECTION

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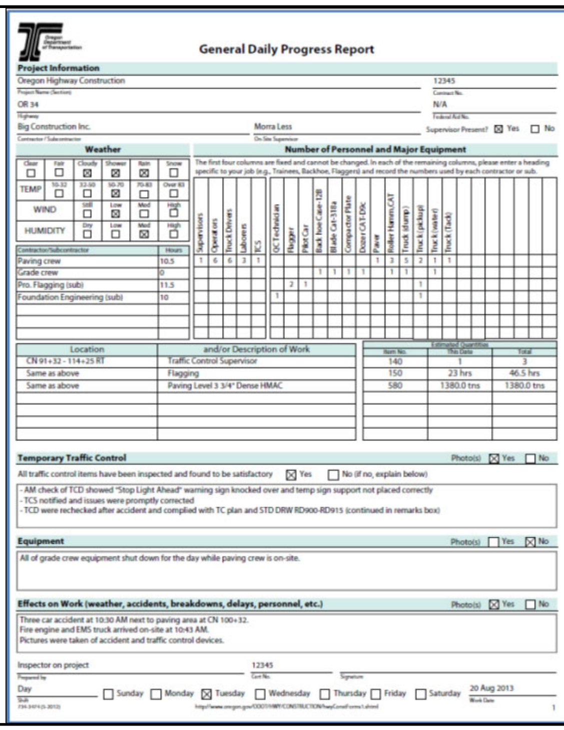

Oregon Department of Transportation

General Daily Progress Report

Project Information

Project Name (Section): Oregon Highway Construction
Contract No.: 12345
Highway: OR 34
Federal Aid No.: N/A
Contractor / Subcontractor: Big Construction Inc.
On-Site Supervisor: Morra Less
Supervisor Present? ☒ Yes ☐ No

Weather

	Clear ☐	Fair ☐	Cloudy ☒	Shower ☒	Rain ☒	Snow ☐
TEMP	10-32 ☐	32-50 ☐	50-70 ☒	70-83 ☐	Over 83 ☐	
WIND		Still ☐	Low ☒	Med ☐	High ☐	
HUMIDITY		Dry ☐	Low ☐	Med ☒	High ☐	

Number of Personnel and Major Equipment

The first four columns are fixed and cannot be changed. In each of the remaining columns, please enter a heading specific to your job (e.g., Trainees, Backhoe, Flaggers) and record the numbers used by each contractor or sub.

Contractor/Subcontractor	Hours	Supervisors	Operators	Truck Drivers	Laborers	TCS	QC Technician	Flagger	Pilot Car	Back hoe Case-128	Blade Cat-318a	Compactor Plate	Dozer CAT-D6c	Paver	Roller Hamm,CAT	Truck (dump)	Truck (pickup)	Truck (water)	Truck (Tack)
Paving crew	10.5	1	6	6	3	1								1	3	5	2	1	1
Grade crew	0									1	1	1	1		1	1		1	
Pro. Flagging (sub)	11.5							2	1								1		
Foundation Engineering (sub)	10						1										1		

Location	and/or Description of Work	Estimated Quantities Item No.	This Date	Total
CN 91+32 - 114+25 RT	Traffic Control Supervisor	140	1	3
Same as above	Flagging	150	23 hrs	46.5 hrs
Same as above	Paving Level 3 3/4" Dense HMAC	580	1380.0 tns	1380.0 tns

Temporary Traffic Control Photo(s) ☒ Yes ☐ No

All traffic control items have been inspected and found to be satisfactory ☒ Yes ☐ No (if no, explain below)

- AM check of TCD showed "Stop Light Ahead" warning sign knocked over and temp sign support not placed correctly
- TCS notified and issues were promptly corrected
- TCD were rechecked after accident and complied with TC plan and STD DRW RD900-RD915 (continued in remarks box)

Equipment Photo(s) ☐ Yes ☒ No

All of grade crew equipment shut down for the day while paving crew is on-site.

Effects on Work (weather, accidents, breakdowns, delays, personnel, etc.) Photo(s) ☒ Yes ☐ No

Three car accident at 10:30 AM next to paving area at CN 100+32.
Fire engine and EMS truck arrived on-site at 10:43 AM.
Pictures were taken of accident and traffic control devices.

Prepared by: Inspector on project Cert No.: 12345 Signature:

Shift: Day ☐ Sunday ☐ Monday ☒ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday Work Date: 20 Aug 2013

734-3474 (5-2012) 1

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General Daily Progress Report

Oragon Highway Construction — Project Name (Section)

20 Aug 2013 — Work Date

Materials Rejected Photo(s) ☐ Yes ☒ No

None

Project Visitors Photo(s) ☐ Yes ☒ No

ODOT QA technician, Iam Checking, on-site at 1230 and took required density tests on first lift of paving. The lift passed with 92.8% compaction.

Remarks Photo(s) ☒ Yes ☐ No

Include condition of traffic control and roadway; important discussions with contractors regarding rejected work or materials and reasons; delays, difficulties, accidents, utility damage and other unusual conditions and events; arrivals and departures of major equipment, visitors.

-Paving Crew on-site at 0730. Joe Tester, QC Tech from Foundation Engineering, on-site at 0800. Paving started at CN/CL intersection and proceeded south on CN alignment. Check with Joe Asphalt shows that all five trucks are loaded and on the road at this time.
-Discussed the need for tack application to sawcut edge of existing roadway.
-Confirmed with Joe Tester 91% first lift and 92% second lift compaction requirements.
-Also confirmed each lift will be in separate lots.
-First truck of mix on-site at 0810 and paving started at 0830.
-Noted that inspection of sawcut edge was not tacked.
-First lift of paving completed at 11:45 AM.
-Paving 2nd lift began again at CN/CL intersection.
-First lift compaction passed with 92.3%.
-It began to rain at 1630.
-Discussed with Joe Asphalt(Foreman) the rain procedure.
- The last five trucks began at Station 113+20 (paint mark made on existing roadway).
-Foreman is confident that the last trucks will cover the remaining portion of lift 2.
-Foreman also said that each truck will be tarped.
-There is no standing water in area but foreman is warned that he is proceeding at his own risk. -
Paving finished at 1715.
-Rolling finished at 1745.
-Foreman said paving for tomorrow is canceled as grade crew did not bring up to grade the CL widening.
-Joe tester showed that 2nd lift passed compaction with 92.8%.

Continuation of Traffic Control -
-Pictures were taken.
-TCD removed at 1800.
-Inspection of job-site showed Stop/Street Sign at station CL 35+18 has not been re-installed.
-TCS was notified and returned to job-site with laborer at 1900.
-Sign re-installed; TCS and laborer left at 1945

734-1434 (1-2013) http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/hwyConstForms1.shtml 2

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PAVING INSPECTORS DAILY REPORT

PROJECT NAME: I-5: Anlauf - Elkhead RD Paving

DATE:

CONTRACT NO. 14777

F.A. NUMBER: NHPP_S001(457)

PERSONNEL

Paving Inspector:

Ticket Taker:

Contractor QC @ Plant:

Contractor QC On Grade: Mike Potridge

Paving Foreman:

TP & DT: K&E Excavating

Paving Start Time:

Paving End Time:

Weather Conditions:

SKY	TEMP	WIND	HUMIDITY
Clear	to 32°F	Still	Low
Fair	32° - 50°F	Low	Medium
Cloudy	50° - 70°F	High	High
Rain	70°F +		
Snow			

Time &Surface Temp:

HOT MIX ASPHALT INFORMATION

Type of Mix Being Placed: L3, 1/2" dense HMAC

Production - Tons Per Hour: Tn/Hr Tn/Mh

Mix Design Number: 16-MD0005 Specific Gravity: 2.457

Asphalt Brand & Supplier: McCall/ PG64-22

Recommended Laydown Temperature: 281-291

Laydown Temperature Behind the Paver:

Sta.		Sta.	
Temp.		Temp.	
Sta.		Sta.	
Temp.		Temp.	
Sta.		Sta.	
Temp.		Temp.	

Page 1

DAILY QUANTITIES

BI #	DESCRIPTION	QUANTITY THIS DATE EST.	QUANTITY THIS DATE ACT.	ACCUMULATIVE QUANTITY EST.	ACCUMULATIVE QUANTITY ACT
4005 E	Level 3, 1/2 Inch HMAC				
730	Emulsified Tack Coat	Gallons Used			

ARE ANY OF THE AC QUANTITIES PLACED THIS DATE ACCEPTED AS SMALL QUANTITY? YES______NO_

(Describe on reverse in daily narritive)

LOCATION OF WORK

Note: See Attached theoritical Yeild Sheet for location of worl

PASSING LANES

NB____ SB____ "A" Lane____ "B" Lane____

RIGHT: STA____________ to STA____________ M.P.____________ to M.P.____________

LEFT: STA____________ to STA____________ M.P.____________ to M.P.____________

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TACK OIL SPREAD RATE CALCULATIONS

*** Spread Rate Specifications Per Sec. 00730.44 ***

140°F - 185°F 0.05 - .20 Gallons/square yard

Tack oil used on existing AC edge's only

Gal			Gal			Gal			Gal		
W x L/9	( )x( )/9	-	W x L/9	( )x( )/9	-	W x L/9	( )x( )/9	-	W x L/9	( )x( )/9	-

AC SURFACING CALCULATION

Note: See Attached theoritical Yeild Sheet for Theoritical Yeild

Width Ft x	Length Ft. x	Depth inches x	Factor - (Density/2000)	Tons or	Actual Tons (From Delivery Ticket

EQUIPMENT ON PAVING PROJECT

Page 2

PAVER (Brand Name & Model #)
BREAKDOWN ROLLER
INTERMEDIATE ROLLER
FINISH ROLLER
MISC. EQUIPMENT

NARRATIVE (Include any problems, Delays, Compaction Results, etc.)

See general daily for narrative.

PRODUCED BY:__________ SIGNATURE __________

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Late Season or Cold Weather Paving

ODOT MATERIALS & INSPECTION

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Paving Dates

- **Base Courses, Shoulders and Temporary Surfacing**
  May be placed all year, subject to minimum surface temperature requirements.
- **Travel Lane Wearing Courses**
  May only be placed between March 15 & September 30
  - Need approval from PQME to deviate…a CCO is normally required

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Why a September 30 Cut-Off??

- Primarily related to studded tire usage
  - Studded tires allowed on November 1
- Mix surface (both open and dense ACP) needs some time under traffic during warm weather to seal and knead the surface to minimize chances of studded tires "picking" or raveling the surface aggregates away. Also allows for more Secondary Compaction of mix under traffic.

16

Can I allow the Contractor to pave into October?

- Assessment of risk to ODOT
  - Safety (drainage)
  - Contract Costs (previous delays due to ODOT)
  - Staging and associated costs
  - Buy in from Region, Maintenance, and Construction Section

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Risk Reducing Measures

- Use Multi-Cool program to evaluate the TAC for the anticipated conditions
- Assure yourself that the Contractor will have adequate rollers to complete the required compaction
- DO NOT pave in drizzle or rain (or snow)….period!!! Might get away with it in the summer but will be a disaster in October!!!!!

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Risk Reducing Measures
Temperature

- Raise mixing temperature
  - Oil ok up to about 350° F
  - May be limited for Open Graded Mixes due to draindown
- Tarp all loads…regardless of weather or haul distance. Make contractor aware we will reject any untarped loads
- Use insulated (double walled) trucks
- Borrow thermal camera to evaluate Contractor's paving process

ODOT MATERIALS & INSPECTION

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Risk Reducing Measures
Surface Conditions

- Enforce surface temperature requirements
- Ensure surface is dry
- Avoid paving the day after a rain
  - Moisture in base mix can cause debonding in cooler conditions
  - Try to schedule paving after a couple of days of dry weather

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Risk Reducing Measures
Tack

- See if supplier can provide warmer material
- Consider switching from CSS-1(h) to a CRS-1 or CRS-2. The latter are designed to break quicker and are allowed options in 00730.11.
- Consider paving grade “hot” tack
  - Difficult to shoot uniformly at very small application rates
  - Requires larger “snivies”

ODOT MATERIALS & INSPECTION

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Risk Reducing Measures
Paver

- Consider a material transfer vehicle
- Minimize length of windrow in front of the paver
- Do not let the mix level in the hopper go below 1/2 full
- Make sure the screed is properly heated
- If the paver has an activated (vibrating) screed, turn it on.
- Go slow…do not stop unless absolutely necessary

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Risk Reducing Measures
Compaction

- Ensure enough rollers available to complete pattern at anticipated production rates before mix cools.
- Keep breakdown rollers close to the paver
- Minimize watering of drums
- Consider extra compaction testing

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Risk Reducing Measures
Compaction (continued)

- Make 5 +/- passes with a pneumatic-tired roller after finish rolling is complete but the mat is still warm….This will help knead and seal the surface.
- For Open Graded Mixes, may need to do this the following day after the sun has heated the mat somewhat…avoid tires picking aggregates
- Allow traffic on the mat while it is still warm

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Communication

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Communication

- **Project Manager**
  - Delegated authority?
  - Preferred documentation process
- **QCCS**
  - Ensure material quality issues taken care of
  - Issues with CDT or CAT-I
- **QA Staff**
  - Check in with QAT when they are on-site
  - Advice from Senior QAC when problems arise
  - QA staff a resource for inexperienced inspectors

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Communication (continued)

- **Construction Section Staff**
  - Advice from PDE for pavement repair, milling, or overlay questions
  - PQME or Assistant PME for mix design or materials questions or issues
  - PQME, Assistant PME, or PQS for any ACP questions, issues or assistance for inexperienced inspectors
  - Lab personnel for emulsion or asphalt sample testing issues

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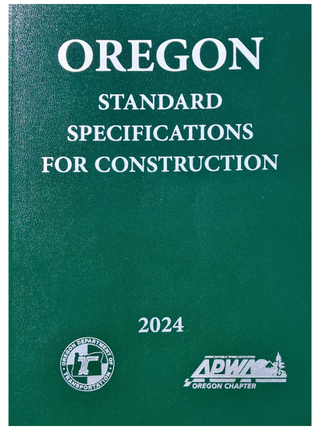
Communication (continued)

- **Contractors** (what they expect)
  - Clarify our expectations
  - Point out problems as they arise…don't wait for PM, APM, or PC to after the fact
  - Know the specs…in particular when a stop work order is to be issued
  - Ask questions….
  - Work together to resolve problems….
  - Apply good common sense

28

Other Paving Specifications

- **00740** – Commercial Asphalt Concrete Pavement
- **00743** – Porous Asphalt Concrete
- **00744** – Asphalt Concrete Pavement



ODOT MATERIALS & INSPECTION

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Section 00740
Commercial Asphalt Concrete Pavement

- Use outside of travel lanes, turn lanes, or bus parking
- Intended for driveway approaches, mixed use paths, sidewalks, slope paving, minor shoulder widening, etc.
- 500 tons max
- Use in travel lanes could be considered on very low volume routes, but only with the approval of the ODOT Pavement Design Engineer
- Does not need to be an ODOT approved mix design
- No testing

ODOT MATERIALS & INSPECTION

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Section 00743
Porous Asphalt Concrete

Primary intent is for Storm Water Infiltration.

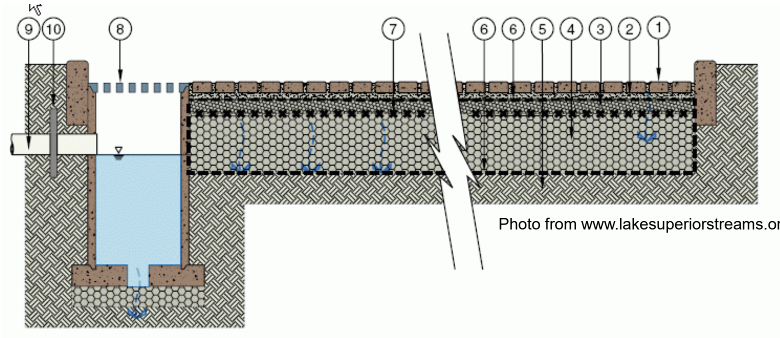

Photo from www.lakesuperiorstreams.org

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Section 00743
Porous Asphalt Concrete

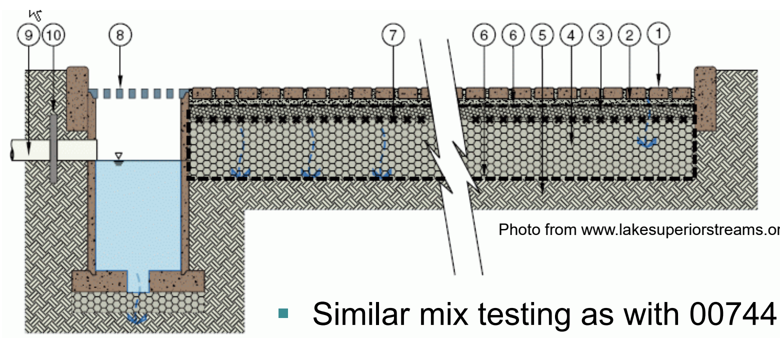

Photo from www.lakesuperiorstreams.org

- Similar mix testing as with 00744
  - No density testing
- No separate binder payment

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Section 00744
Asphalt Concrete Pavement

- Written as primary spec for Local Agency use.
- Allowance for Warm Mix
- Allowance for RAS
- No separate Binder Payment

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Section 00744
Asphalt Concrete Pavement

- Testing, but no STATSPEC
  - Engineer may waive testing
- Each 1000 tons / min 1 per day (min: 3 per project)
  - Asphalt Content
  - Gradation
  - Mix Moisture
  - Max Specific Gravity
- Compaction
  - 1 shot per 100 tons / min 10 shots per shift
  - Average shift results

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Section 00744
Asphalt Concrete Pavement

ODOT Special Provisions

- Lower volume roads
- Less than 2500 tons
- Testing of density higher priority than mix
  - Testing only waived for production days less than 500 tons

ODOT MATERIALS & INSPECTION

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INSERT TAB

Critical Inspection Items

Critical Inspection Items

Module 13

1

Critical Inspection Items

STOP POOR PRACTICES!
Bad Quality & Bad Workmanship

ADDRESS CRITICAL ITEMS on the grade to ensure good long term performance

2

Critical Inspection Items

1. Milling & Clean Surface
2. Uniform Tack
3. Continuous Paving
4. Segregation
5. Uniform Surface Texture
6. **Compaction**
7. Smoothness
8. Approaches & Utilities
9. Joints – *tight, even, straight*
10. Late Season & Weather

4:	SURFACE PREP
5 & 6 :	DELIVERY, PAVERS & LAYDOWN
7, 8, 9 & 10:	COMPACTION & SMOOTHNESS
11:	JOINTS
12:	MISC ISSUES

ODOT MATERIALS & INSPECTION

3

Critical Inspection Items

6. Compaction

- Spec Equipment
- Proper Temperature
- Adequate Compactive Effort
- Achieve Required Density
- Monitor Rolling Pattern
- Proper Compacted Thickness

ODOT MATERIALS & INSPECTION

4

#1
Milling & Clean Surface

Module 4: Surface Preparation

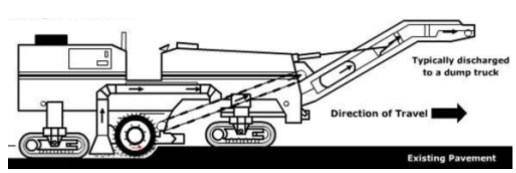
ODOT MATERIALS & INSPECTION

5

Milling Operations – Section 00620 "Cold Plane Pavement Removal"

Purpose:

- Remove existing cracks
- Remove existing ruts
- Remove poor quality materials
- Adjust elevation

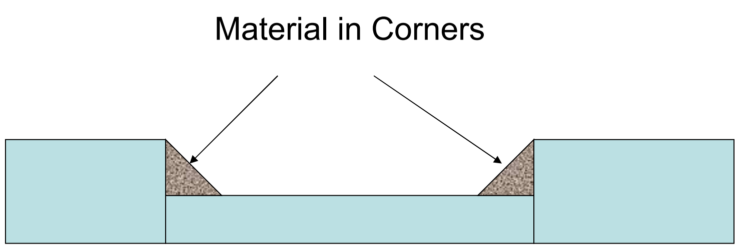


#1 - Milling & Clean Surface

6

7

Milling Operations
Problem Area for Cleaning Inlays



#1 - Milling & Clean Surface

8

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10

11

#2
Uniform Tack
Module 4: Surface Preparation

ODOT MATERIALS & INSPECTION

12

Section 00730
Emulsified Asphalt Tack Coat

Objectives

- **90% coverage!!!**
- Proper application rate
- Suitable dilution
- Proper temperature
- Proper spray bar height
- No plugged nozzles
- Triple lap coverage
- Don’t fill in valleys on milled surfaces

ODOT MATERIALS & INSPECTION

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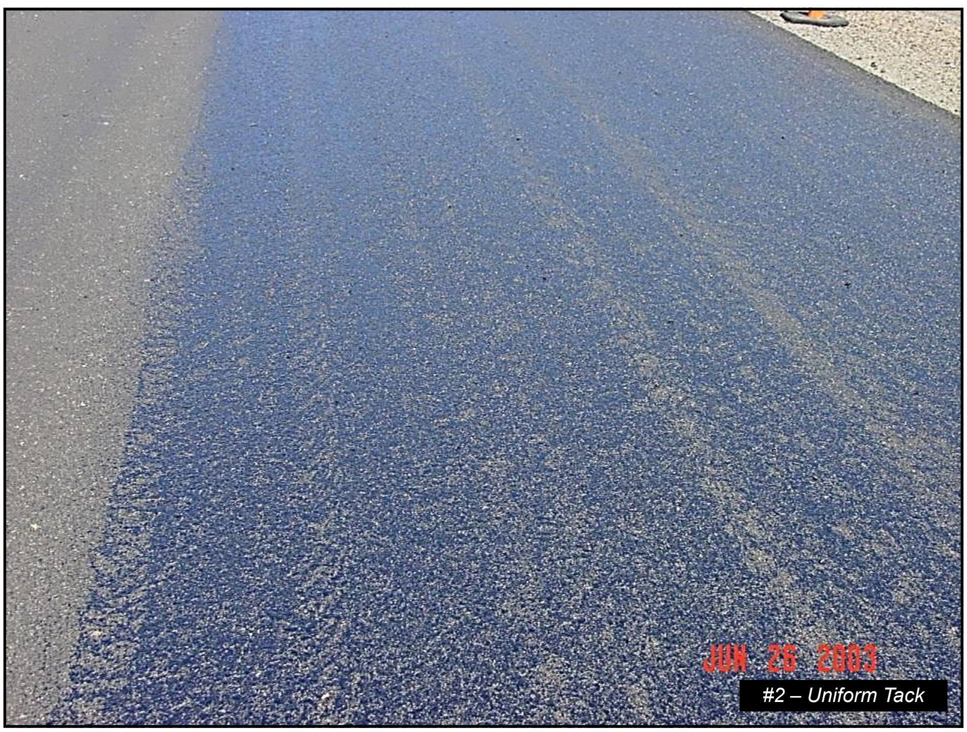

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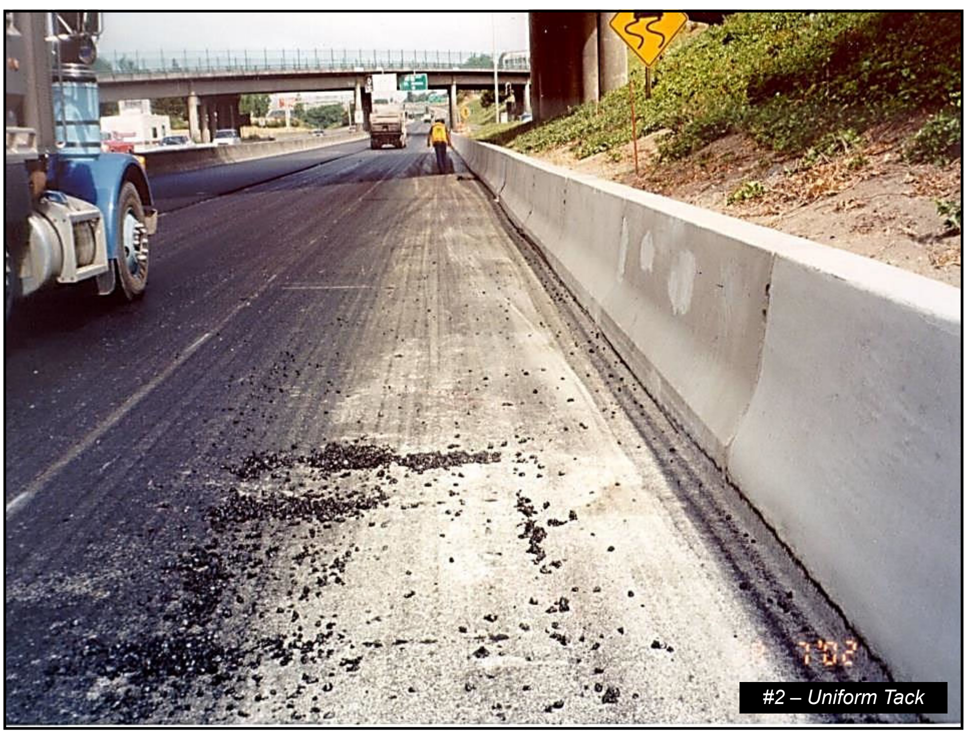

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19

#3
Continuous Paving

Module 5: Delivery &
Module 6: Pavers & Laydown

00745.46(a)
"Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine…"

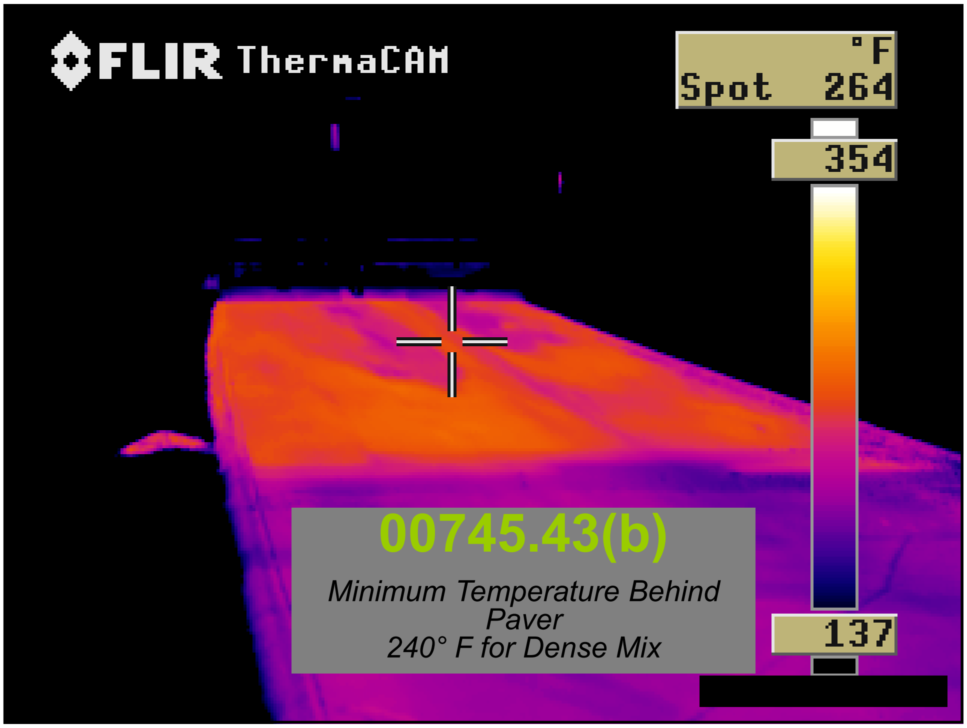
ODOT MATERIALS & INSPECTION

20


IF STOPPING IS "UNAVOIDABLE"...
PAVERS:
Rapid Stop – Rapid Start
ROLLERS:
- Stop at angle
- Leave vibration off
- Keep pneumatic moving – don't stop on the mat
SEP 25 2002
#3 – Continuous Paving

21

22


FLIR ThermaCAM
°F
Spot 264
354
137
00745.43(b)
Minimum Temperature Behind Paver
240° F for Dense Mix

23


#3 – Continuous Paving

24

#4
Segregation
Module 5: Delivery &
Module 6: Pavers & Laydown

00745.60(c)
"If segregation continues to occur, stop production..."

ODOT MATERIALS & INSPECTION

25

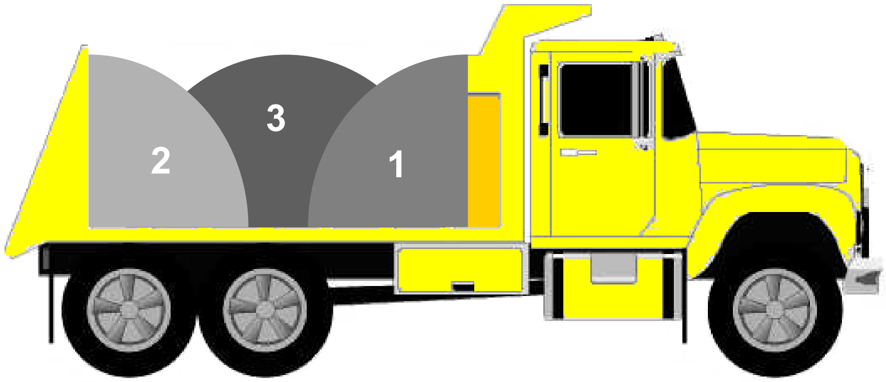
Segregation

1. Loadout
2. Truck Exchange
3. Paving
   - Angel Wings
   - Gate Tunnels
   - Gear Box

ODOT MATERIALS & INSPECTION

#4 - Segregation

26



LOADOUT!

#4 - Segregation

27

00745.46(b)

"Deposit ACP from the hauling vehicles so segregation is prevented"

TRUCK EXCHANGE!

#4 - Segregation

28

29

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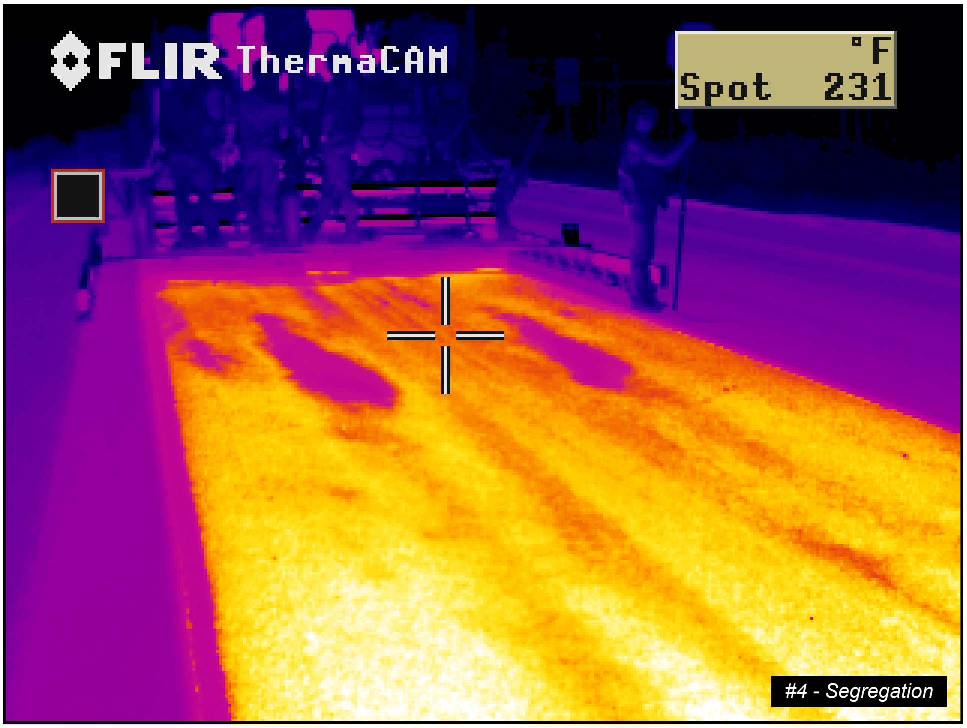
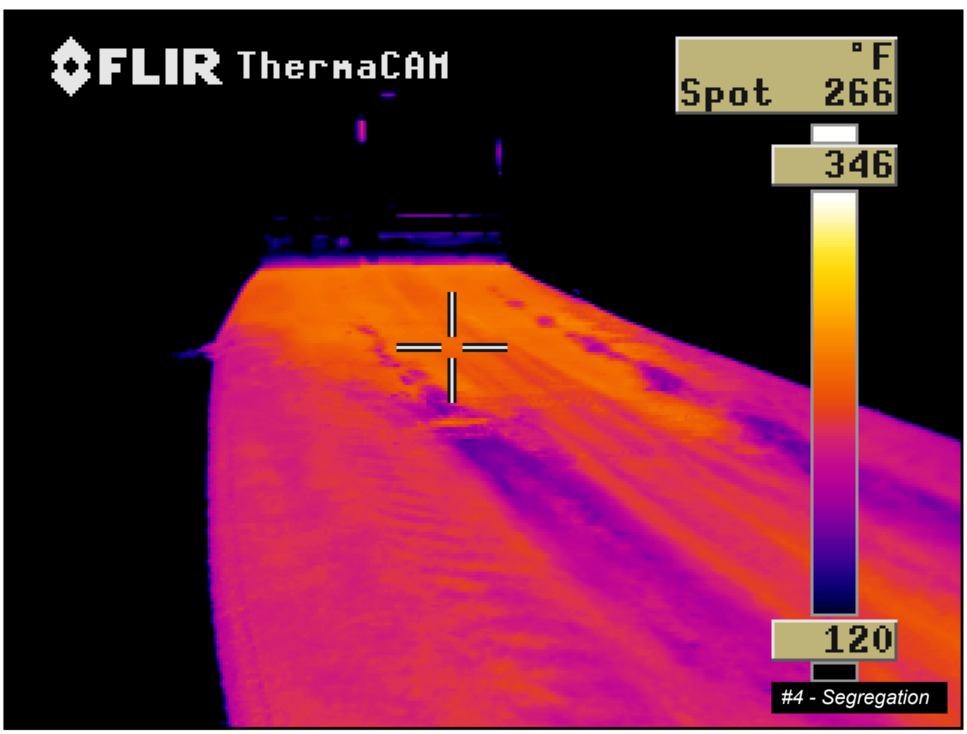

FLIR ThermaCAM
°F
Spot 231
#4 - Segregation

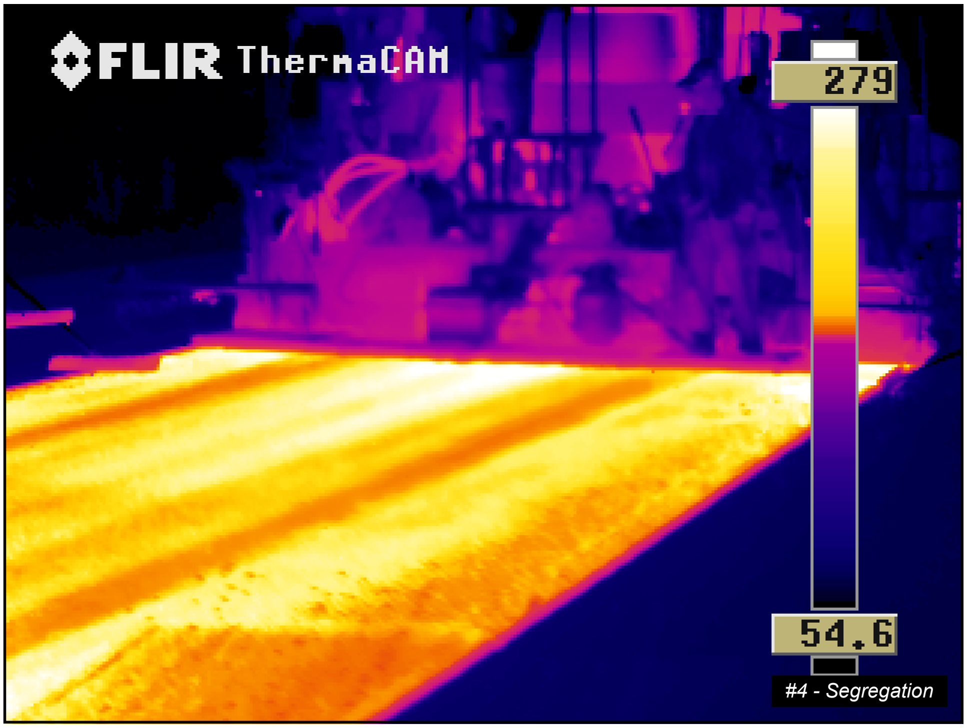
31


FLIR ThermaCAM
°F
Spot 266
346
120
#4 - Segregation

32

33

34


FLIR ThermaCAM
279
54.6
#4 - Segregation

35


MAY 29 2002
#4 - Segregation

36

#4 - Segregation

37

#5
Uniform Surface Texture
Module 5: Delivery &
Module 6: Pavers & Laydown

00745.60(b)

"Before the ACP cools replace boils, slicks, and oversized material with fresh mixture"

ODOT MATERIALS & INSPECTION

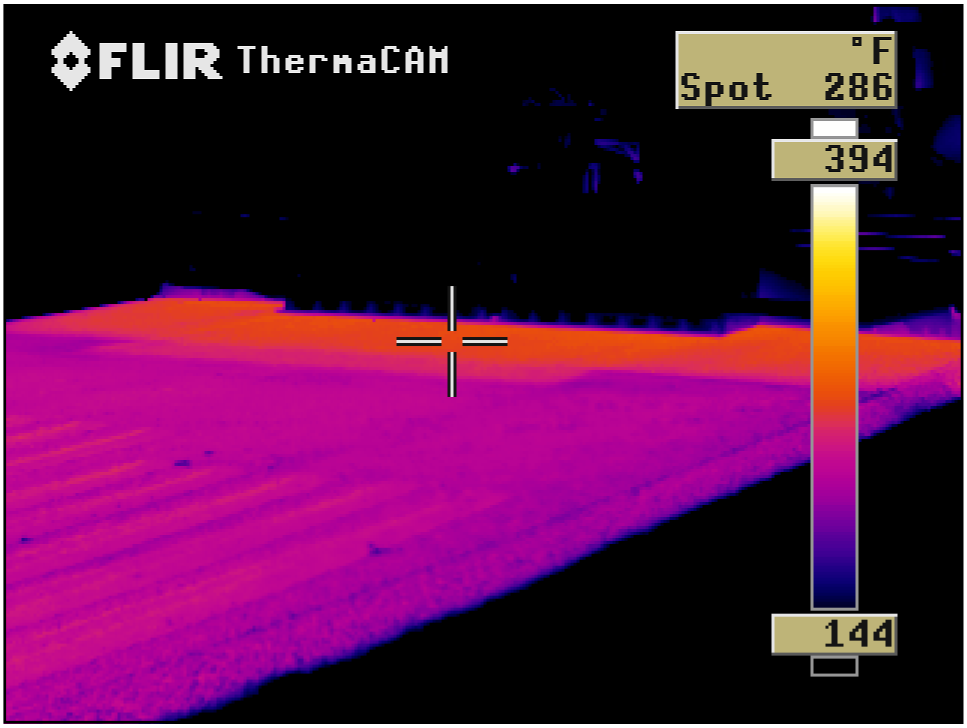
38


SEP 3 2002
#5 – Uniform Surface Texture

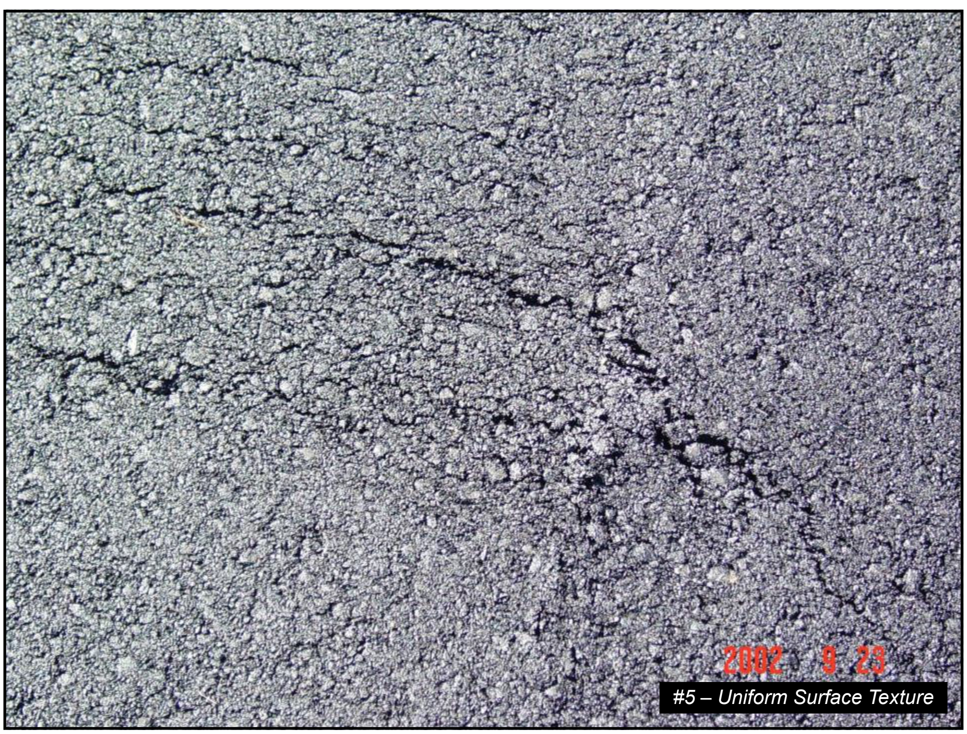
39


SEP 30 2002
#5 – Uniform Surface Texture

40


FLIR ThermaCAM
°F
Spot 286
394
144

41


2002 9 23
#5 – Uniform Surface Texture

42

43

44


#5 – Uniform Surface Texture

45


OCT 16 2002
#5 – Uniform Surface Texture

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#6
Compaction

Module 7: Compaction Fundamentals
Module 8: Compaction Equipment & Operations

"Compaction, Compaction, Compaction"

ODOT MATERIALS & INSPECTION

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6. Compaction

- Spec equipment
- Proper temperature
- Adequate compactive effort
- Achieve required density
- Monitor rolling pattern
- Proper compacted thickness

ODOT MATERIALS & INSPECTION

#6 - Compaction

48

6. Compaction

Spec Equipment

Static Steel-Wheeled Roller
Pneumatic – Rubber Tired Roller
Vibratory Roller
Oscillatory Roller

00745.24 - Compactors

ODOT MATERIALS & INSPECTION

#6 - Compaction

49

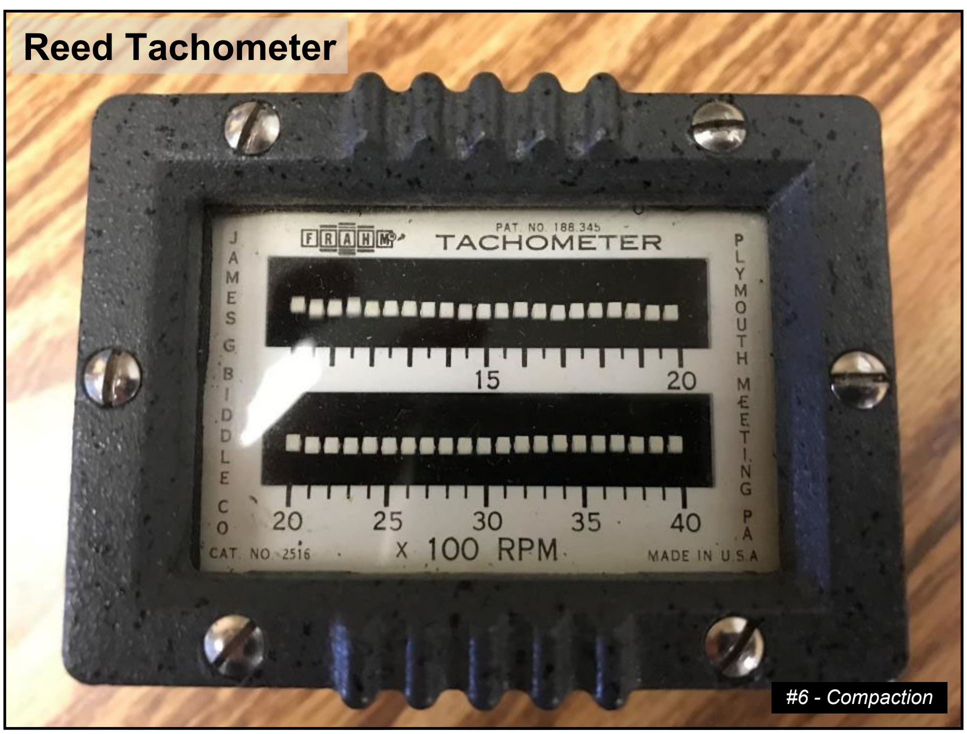
Static Steel-Wheeled Rollers (00745.24)

#6 - Compaction

50


DYN AC
221-31
2002 9 23
#6 - Compaction

51


Reed Tachometer
FRAHM
PAT. NO. 188,345
TACHOMETER
JAMES G BIDDLE CO
PLYMOUTH MEETING PA
15
20
20
25
30
35
40
CAT. NO. 2516
X 100 RPM
MADE IN U.S.A
#6 - Compaction

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6. Compaction

Proper Temperature

Surface Temperature
00745.40

Mix Temperature
Per JMF, 745.43, 745.49(a-1)

#6 - Compaction

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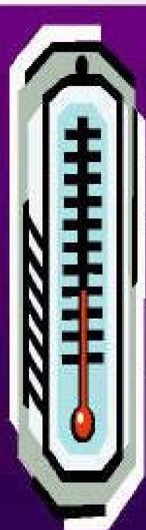
Mix Temperature



- 350F – Max. Production Temp.
- 320-275F – Breakdown Rolling
- 275-200F – Intermediate Rolling
- 200-150F – Finish Rolling
  (175F = Cessation Temperature)

55

6. Compaction

Adequate Compactive Effort

Review Control Strip - 8 to 12 passes?

ODOT MATERIALS & INSPECTION

#6 - Compaction

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6. Compaction

Achieve Required Density

#6 - Compaction

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Achieve Required Density

00745.49(b)(3)

92.0%

Exception – 91.0% if:
First ACP lift
& < 3" thick
& on agg base

NOT OR!

#6 - Compaction

58

Low Density

(high voids)

- *Cracking*
- *Stripping*
- *Too Permeable*

High Density

(low voids)

- *Rutting*
- *Shoving*
- *Flushing*

ODOT MATERIALS & INSPECTION

#6 - Compaction

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6. Compaction

Monitor Rolling Pattern

Consistent, Adequate Effort

ODOT MATERIALS & INSPECTION

#6 - Compaction

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6. Compaction

Proper Compacted Thickness

#6 - Compaction

64

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6. Compaction

- Spec equipment
- Proper temperature
- Adequate compactive effort
- Achieve required density
- Monitor rolling pattern
- Proper compacted thickness

ODOT MATERIALS & INSPECTION

#6 - Compaction

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#7
Smoothness

Module 9: Compaction Testing
Module 10: Smoothness Testing

Which Specification does your project use?
Black Book, 2021 Book, or Boiler Plate Specials?

ODOT MATERIALS & INSPECTION

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#8
Approaches & Utilities

Module 8: Compaction Equipment & Operations
Module 9: Compaction Testing

ODOT MATERIALS & INSPECTION

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OCT 28 2002
#8 – Approaches & Utilities

73


OCT 17 2002
#8 – Approaches & Utilities

74

75

#9
Joints

Module 11: Joints

ODOT MATERIALS & INSPECTION

76

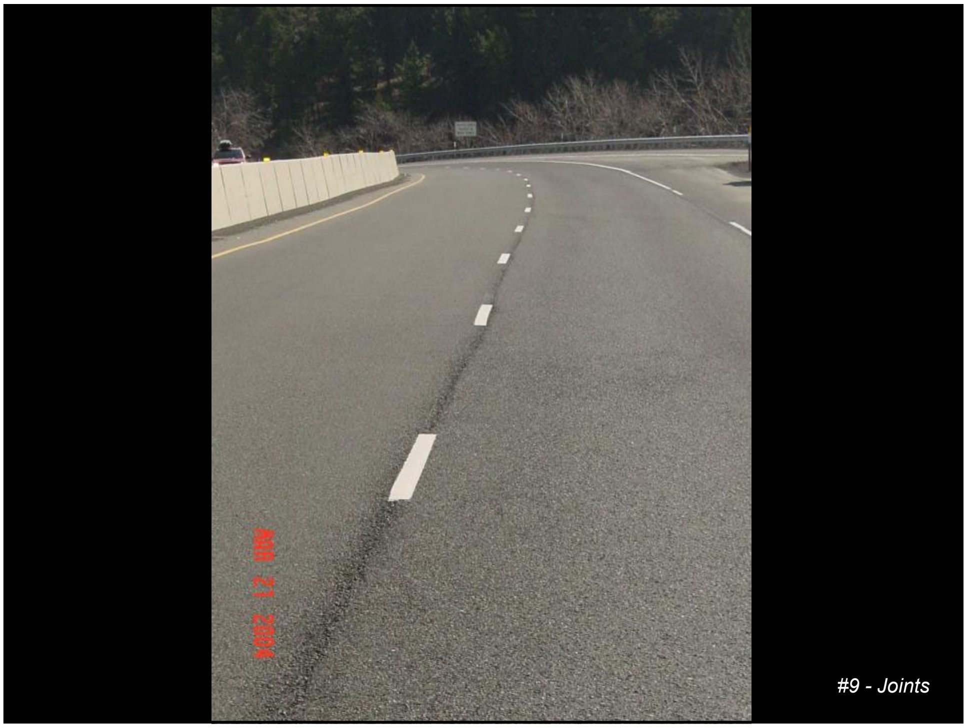
Longitudinal Joints!!!

Tight, Even, & Straight

#9 - Joints

77

78



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86

87

#10
Late Season Paving & Weather

Module 12: Miscellaneous Issues

00745.40

Season & Temperature Limitations

ODOT MATERIALS & INSPECTION

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Season & Temperature Limitations
00745.40

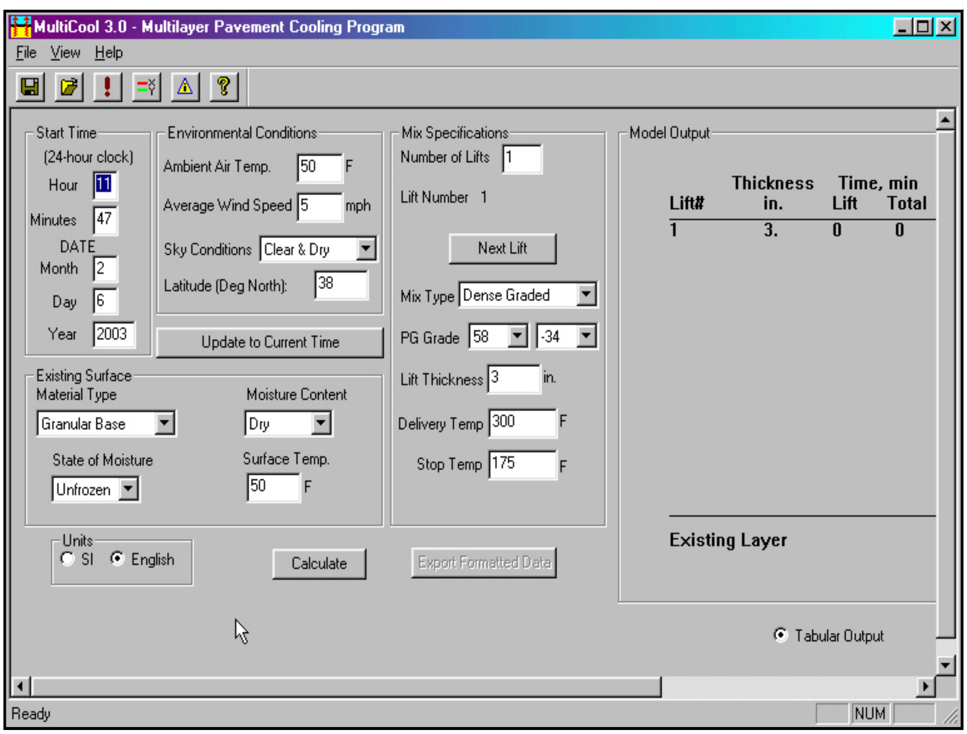
00745.40 Season and Temperature Limitations - Place ACP during the dates specified, and when the temperature of the surface that is to be paved is not less than the temperature specified:

Nominal Compacted Thickness of Individual Lifts and Courses as shown on the typical section of the Plans	All Levels	Level 1 and Level 2	Level 3 and Level 4	
		All Courses	Travel Lane Wearing Course	All Other Courses
	Surface Temperature*	From To Inclusive	From To Inclusive	From To Inclusive
Less than 2 inches	60 °F	All Year**	3/15 9/30	All Year**
2 inches - 2 1/2 inches	40 °F	All Year**	3/15 9/30	All Year**
Greater than 2 1/2 inches	40 °F	All Year**	3/15 9/30	All Year**
Temporary	40 °F	All Year**	All Year**	All Year**

* Do not use field burners or other devices to heat the Pavement surface to the specified minimum temperature unless approved.

** If placing ACP between March 15 and September 30, temperature requirement may be lowered 5 °F.

89



90

Rain = Moisture!!!

#10 – Late Season & Weather

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1) Don't leave open trenches
2) Don't leave exposed tack
Otherwise, STOP further mix delivery!
#10 – Late Season & Weather

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WE HAVE TO DO BETTER!!!!

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Critical Inspection Items

1. Milling & Clean Surface
2. Uniform Tack
3. Continuous Paving
4. Segregation
5. Uniform Surface Texture
6. **Compaction**
7. Smoothness
8. Approaches & Utilities
9. Joints – *tight, even, straight*
10. Late Season & Weather

4: SURFACE PREP

5 & 6 : DELIVERY, PAVERS & LAYDOWN

7, 8, 9 & 10: COMPACTION & SMOOTHNESS

11: JOINTS

12: MISC ISSUES

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Critical Inspection Items

6. Compaction

- Spec equipment
- Proper temperature
- Adequate compactive effort
- Achieve required density
- Monitor rolling pattern
- Proper compacted thickness

ODOT MATERIALS & INSPECTION

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The End!!

Thanks for Your Participation

ODOT MATERIALS & INSPECTION

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INSERT TAB

Specials
Section 00745

SECTION 00610 - RECONDITIONING EXISTING ROADWAY

Comply with Section 00610 of the Standard Specifications.

SECTION 00620 - COLD PLANE PAVEMENT REMOVAL

Comply with Section 00620 of the Standard Specifications modified as follows:

00620.43 Maintenance Under Traffic - Replace this subsection, except for the subsection number and title, with the following:

Traffic is not allowed on the cold planed surface. Before opening the area to traffic, pave the surface according to 00745.51.

SECTION 00640 - AGGREGATE BASE AND SHOULDERS

Comply with Section 00640 of the Standard Specifications.

SECTION 00730 - EMULSIFIED ASPHALT TACK COAT

Comply with Section 00730 of the Standard Specifications modified as follows:

00730.11 Emulsified Asphalt – Replace the sentence that begins “Furnish CSS-1, CSS-1h…” with the following sentence:

Furnish CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-1, CRS-2, HFRS-2, HFMS-2 or HPTC as selected by the Contractor.

00730.80 Measurement - Replace this subsection, except for the subsection number and title, with the following:

The quantities of Emulsified Asphalt used as tack will be measured on the weight basis.

SECTION 00738 - SAFETY EDGE

Comply with Section 00738 of the Standard Specifications.

SECTION 00745 - ASPHALT CONCRETE PAVEMENT - STATISTICAL ACCEPTANCE

Comply with Section 00745 of the Standard Specifications modified as follows:

00745.02 Definitions -

Replace the sentence that begins "**Sublot Size** - A sublot is…" with the following paragraphs:

Sublot Size - Except for compaction, a sublot is 1000 Tons. The final sublot for a JMF may be increased up to a maximum of 1,500 Tons, if the production total does not reach the random number for the sublot.

A compaction sublot is 200 Tons. The final compaction sublot for a JMF may be increased up to a maximum of 400 Tons, if the production total does not reach the random number for the sublot.

Add the following definition:

Localized Roughness - An area that exceeds 160.0 inches per mile in a continuous International Roughness Index (IRI) evaluation over a 25.0-foot base length.

Add the following definition:

Lot Size - A lot consists of up to 10,000 Tons of ACP, with a maximum of 20,000 Tons for the final lot per JMF. The following circumstances will require a different lot:

- A new JMF is used. A JMF adjusted according to 00745.16 is not considered a new JMF
- The method for measuring compaction is changed
- A new compaction specification limit is required according to 00745.49(b)(3)
- A change from one test procedure for measuring asphalt content to another test procedure for measuring asphalt content occurs.

00745.11(b) Asphalt Cement Additives – The bullet that begins with the words "Anti-stripping asphalt cement…" is deleted.

Add the following subsection:

00745.11(e) Liquid Anti-Stripping Additive – An asphalt cement liquid anti-stripping additive (LASA) may be used instead of lime treatment of aggregate.

(1) General - To be considered for use, the LASA must meet the following criteria:

- Be designated as an asphalt anti-strip, with test results posted on the Warm Mix Asphalt Technologies category of the National Transportation Product Evaluation Program (NTPEP). NTPEP test results must indicate an increase of 10% or greater in TSR (AASHTO T 283). The TSR results must be on durable aggregate, not limestone.

- Be approved for use in another State DOT as an anti-stripping additive.

If a product meets both criteria, it may be used in the JMF development according to the ODOT Contractor Mix Design Guidelines for Asphalt Concrete. The standard addition rate of LASA for the JMF is the rate the NTPEP testing was performed. If no rate is published, the minimum rate will be 0.5% of the virgin binder. For published rates of 0.5% to total binder or higher, the minimum rate may be reduced to 0.5% of the virgin binder.

Approval of the JMF is also dependent on Hamburg Wheel-track Testing results conducted at the ODOT Central Materials Laboratory. Minimum requirements according to AASHTO T 324 are:

Rut depth at 20,000 passes (Level 4 wearing Course) 7mm max.

Rut depth at 20,000 passes (All others) 10mm max.

Stripping inflection point at 20,000 passes none

The test is ran for 20,000 passes. The test temperature is 50° C.

(2) Addition to Asphalt Cement - Blend the LASA at the asphalt terminal prior to delivery to the Mixing Plant. Use LASA compatible with the asphalt cement. The blended product must comply with all asphalt cement requirements. Do not change the LASA addition rate without prior approval from the Engineer.

(3) Field Testing During Production - At the Agency's discretion, production mixture may be tested at the Central Materials Laboratory. Failure to meet the criteria listed above shall require a change in addition rate, a change of approved LASA, or may require lime-treatment of aggregate to continue production.

00745.14 Tolerances and Limits - Replace the line "**Asphalt Cement - AASHTO**… with the following line:

Asphalt Cement - AASHTO T 308 (Ignition)
and ODOT TM 323 JMF ± 0.35%

00745.46(b) Depositing - Replace the paragraph that begins "Deposit ACP from..." with the following paragraph:

Deposit ACP from the hauling vehicles so segregation is prevented. Do not deliver the ACP directly into the paving machine for wearing Courses where the continuous length of the Panel is greater than 500 feet. Deliver the ACP to the paving machine by either a windrow pick-up machine or an end-dump transfer machine.

00745.47(a)(2) Wearing Course - Replace this subsection, except for the subsection number and title, with the following:

Construct longitudinal joints six inches from permanent lane markings, or as shown or directed.

00745.48(c) Bridge Deck Overlays - Replace the paragraph that begins "Saw cut the wearing Course of Pavement …" with the following paragraph:

Sawcut the wearing or base Course of Pavement directly over the joints in bridge decks, bridge end joints and end Panel end joints as soon as practical but within 48 hours of paving each stage of the wearing or base Course, unless otherwise directed. Saw the cut 3/8 inch wide, ± 1/8 inch, by 1/2 inch less than the thickness of the Panel of Pavement depth or 1 1/2 inches deep, whichever is less.

00745.49(b)(1) General - Replace the paragraph that begins "Have the CDT notify the Engineer…" with the following paragraph:

Have the CDT notify the Engineer and CAT-II when a density test is less than 90.0 percent or exceeds 95.9 percent of MAMD. Initiate an investigation to determine if the results indicate that a problem with the mix is developing. Electronically submit the results and recommendations of the CAT-II's investigation to the Engineer within two shifts of the density test. An adjustment to the JMF will not be allowed unless MDV testing supports a required change.

00745.49(b)(2) Random Testing - Replace the paragraph that begins "Determine the density of each sublot by averaging…" with the following paragraphs:

Correspond lots and compaction sublots with those defined in 00745.02. Provide one density test location for each compaction sublot. Notify the Engineer when rolling operations are completed in a compaction sublot and it is ready for test location identification. The Engineer will use stratified random numbers to locate the QC tests according to ODOT TM 400 Annex. ODOT TM 400 Annex is available from the Engineer. The Engineer will mark where the QC tests are to be performed.

Allow 30 minutes for the Engineer to locate the final test locations after completion of finish rolling and any additional time required for testing, prior to opening the travel lane to traffic. Have the CDT locate and document the test locations not identified within this time frame.

00745.49(b)(2)(b) Core Correlation of Nuclear Gauge Readings - Replace this subsection, except for the subsection number and title, with the following:

For each Lift on the Project that contains more than 2,500 Tons of ACP, correlate each nuclear gauge that will be used on that Lift. Perform core correlations and determine core correlation factors according to AASHTO T 355 and ODOT TM 327. Provide bulk specific gravity values to the Engineer within 24 hours of coring. If an Aggregate source or the asphalt cement source changes, new core correlations are required.

Apply correlation factors to all nuclear gauge readings for the Lift on which the core correlation was performed.

Both the Engineer and the Contractor may request additional core correlation of nuclear gauge readings. Core correlations requested by the Contractor or that are required due to a change in Aggregate or asphalt cement source will be at no additional cost to the Agency.

00745.49(b)(4) Test Results - In the paragraph that begins "Provide density results…" replace the word "sublots" with the words "compaction sublots".

Add the following subsection:

00745.51 Opening Sections to Traffic - Schedule Work so that, during the same shift, the surfaces being paved are paved full width and length through the top Base Course before opening to traffic. Traffic will be allowed on the top Base Course up to 30 Calendar Days.

Before beginning wearing Course paving operations, make repairs to the existing surface as directed. Payment for the repairs will be made according to 00195.20.

00745.70 Pavement Smoothness - Replace this subsection, except for the subsection number and title, with the following:

Construct the Pavement wearing surface of Traffic Lanes to a profile that does not deviate from longitudinal and transverse smoothness more than the specified limits of 00745.73.

Perform profiling and straightedge testing under the supervision of the Engineer with Equipment furnished and operated by the Contractor at no additional cost to the Agency, according to ODOT TM 772. Complete all required smoothness testing no later than 14 Calendar Days following final completion of all Traffic Lane paving on the Project, or by October 15 of each calendar year for multiple year projects, whichever is earlier. The Contractor accepts the risk that the smoothness may be affected by exposure to traffic between the date the Traffic Lanes are paved and the date the smoothness testing is completed. If the Contractor elects to perform smoothness measurements on a Day other than the Day the Pavement is placed, additional traffic control required for smoothness measurement, and not required for other Work, will be at no additional cost to the Agency.

Add the following subsection:

00745.72 Smoothness Testing Equipment - Furnish all Equipment and supplies for determining smoothness.

(a) Straightedge - Provide one 12 foot straightedge.

(b) Profiler - Provide a profiling device meeting the requirements of ODOT TM 772 and certified according to ODOT TM 769.

Provide competent and experienced operator(s) for the Equipment, certified with the profiler according to ODOT TM 769. The profiler operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of smoothness measurement on the Project.

Add the following subsection:

00745.73 Smoothness Testing and Surface Tolerances - Test according to the following:

(a) General - Test the Base Course with a 12 foot straightedge as directed. Test the wearing Course with the profiler meeting the requirements of 00745.72(b). Compute the

IRI from the profile data according to the procedures described in ODOT TM 772. Price adjustment for smoothness will be made according to 00745.96.

Before performing any smoothness measurements on the Project, verify calibration of the profiler according to the manufacturer's recommendations and ODOT TM 772.

(b) Surface Test:

(1) Transverse - Test the Base Course with the 12-foot straightedge perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(2) Longitudinal - Test all Base or wearing Course sections of Pavement that are not required to be profiled according to 00745.73(c) with the 12-foot straightedge parallel to the centerline and lane dividers, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(c) Wearing Course Surface Test:

(1) Transverse - Test with the 12-foot straightedge perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(2) Longitudinal - Perform testing as follows:

a. Quality Control - Run the profiling device over each Traffic Lane for the full length of the Project.

In the presence of the Engineer and according to ODOT TM 772, obtain profiles on the Pavement surface in the right and left wheel path of the Traffic Lane along a line parallel to permanent longitudinal Pavement markings, at 3-foot and 9-foot offsets from the left edge of the Traffic Lane. Take the profile on transition areas of entrance and exit ramps, as close to the right and left wheel path of the through Traffic Lane as practical. Submit data files to the Engineer at the completion of each shift in which profiling has taken place. For the Pavement sections tested, provide the raw data files and provide electronic copies of the profile data in PPF and manufacturer proprietary formats, as required by the Engineer.

Analyze profiles according to 00745.73(d), and give the results to the Engineer no later than 24 hours following completion of required smoothness. The results shall consist of a table showing areas of Localized Roughness in each wheel path, and the left wheel path IRI, right wheel path IRI, and mean IRI (average of left and right wheel path IRI) at 0.10 mile intervals.

b. Quality Assurance - At the discretion of the Engineer, the Agency may perform Quality Assurance of Profiles on projects according to ODOT TM 772.

(3) Transverse Joints - Test with the 12-foot straightedge parallel to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(d) Determination of the International Roughness Index:

(1) General - Determine the IRI in 0.10 mile segments and partial segments of the wearing Course. Begin segments 50 feet into the Project and run consecutively in the direction of travel. A segment ends as a partial segment and a new segment begins when the segment sequence is interrupted by stage construction or by profiled areas excluded from the smoothness requirements. Minimize the number of partial segments.

The following areas of Pavement are excluded from IRI smoothness requirements and are not profiled:

- Profiles extending beyond the Project ends.
- Bridge decks, Bridge end panels, and Pavement within 50 feet of Bridge end panels.
- First and last 50 feet of the ACP paving limits of the Project.
- The 50 feet before and after No Work Areas within the Project limits.
- Ramps and auxiliary lanes that are less than 2500 feet in length.
- First 800 feet of entry ramps and the last 800 feet of exit ramps.
- The 25 feet before and after Utility appurtenances in the Traffic Lane.
- Continuous portions of Traffic Lanes with less than 0.05 mile between excluded areas.
- Portions of the Project with posted speed limits less than 45 mph.

Locate ACP IRI profiling excluded areas prior to smoothness measurement. Areas excluded from longitudinal profile measurement shall meet the straightedge requirements of 00745.73(b)(2).

(2) Method of Analysis - Determine the IRI for each wheel path and areas of Localized Roughness for each wheel path according to ODOT TM 772. Submit the results to the Engineer for review.

(e) Shoulders and Paved Medians - Test the Base and wearing Course with the 12-foot straightedge parallel to and perpendicular to the centerline for Shoulders and paved Medians, as directed by the Engineer. The Pavement surface shall not vary by more than 1/4 inch.

00745.75 Correction of Pavement Roughness - Replace this subsection, except for the subsection number and title, with the following:

If testing described in 00745.73 shows that the Pavement does not conform to the prescribed limits, the following applies:

(a) General - The Contractor is responsible for locating areas that require corrective work.

(b) Base Course - If the requirements of 00745.73(b) are not met, correct according to one of the following and retest:

(1) Cold Plane Removal - Profile grind with Equipment meeting the requirements of 00620.20 to a maximum depth of 0.4 inch.

(2) Grinder - Profile grind with abrasive grinder(s), equipped with a cutting head comprised of multiple diamond blades to a maximum depth of 0.4 inch.

(c) Wearing Course - After locating each area of Localized Roughness and the 0.10 mile segments that have an average IRI value greater than 95.0 inches per mile, meet with the Engineer at a mutually agreed upon time and drive the Project together. During the drive-through, evaluate each area of Localized Roughness between 160.0 and 189.9 inches per mile and partial segments with an average IRI value greater than 95.0 inches per mile to determine if corrective Work is required. All 0.10 mile segments with an IRI value more than 95.0 inches per mile and all areas of Localized Roughness equal to or greater than 190.0 inches per mile require corrective action. Disagreements will be resolved by the Engineer.

Correct all areas of Localized Roughness, segments and partial segments identified for corrective work, and any transverse joint and excluded areas that exceed the requirements of 00745.73, by one of the methods listed below and to the specified limits:

(1) Remove and Replace - Remove and replace the wearing surface lift.

(2) Grind - Profile grind with abrasive grinder(s) equipped with a cutting head comprised of multiple diamond blades to a maximum depth of 0.3 inch and apply an emulsion fog seal according to Section 00705, or as directed. Half or full lane width corrective grinding is required for areas requiring correction in one or both wheel paths as shown by the Localized Roughness, respectively. Perform corrective grinding in such a manner that the shedding of water is not interrupted across the travel lanes due to the grinding.

Following corrective work, the Engineer will re-evaluate all corrected areas for acceptance. The Engineer may require retesting per ODOT TM 772 and 00745.73. Further corrective Work may be required. Perform all corrective Work and retesting, including traffic control, at no additional cost to the Agency.

(d) Time Limit - Complete correction of all surface roughness prior to application of permanent Pavement markings within 14 Calendar Days following notification, unless otherwise directed.

00745.80 Measurement - Add the following paragraph to the beginning of this subsection:

The quantities of ACP shown in the Contract Schedule of Items were computed on the basis of Aggregates having a specific gravity of 2.75.

Add the following paragraph to the end of this subsection:

The quantities of core correlation of nuclear gauge readings will be measured on the unit basis for each core correlation test that is completed and accepted according to ODOT TM 327. Core correlations that are requested by the Contractor or that are required due to a change in Aggregate or asphalt cement source will not be measured.

00745.90 Payment -

Add the following Pay Item to the Pay Item list:

(c) Core Correlation of Nuclear Gauge Readings……………..Each

Add the following paragraph after the paragraph that begins "In item (b)…":

Item (c) includes developing core correlation factors for all gauges to be correlated for the lift on which the core correlation was performed, according to the procedure in ODOT TM 327.

In the paragraph that begins "No separate or additional payment…", add the following bullet to the end of the bullet list:

• liquid anti-stripping asphalt cement additives

00745.95 Price Adjustments - Add the following two paragraphs after the bullet that begins "The adjusted target…"

If the Pay Factor (PF) for compaction is 1.00 or greater as calculated in 00165.40, use that compaction PF for the lot. If the PF for compaction is below 1.00, re-calculate the PF for compaction using a lower specification limit (LSL) of 91.5. The compaction PF re-calculated using a LSL of 91.5 will not exceed 1.00. The minimum PF of 1.00 described in 00165.40(d)(8) does not apply when re-calculating the compaction PF.

A completed lot with a CPF of between 0.95 and 1.00 will be accepted, subject to a price adjustment according to 00150.25. The basis of adjustment will be the CPF as calculated in 00165.40.

Add the following subsection:

00745.96 Smoothness Price Adjustment - No separate or additional payment will be made for smoothness testing.

(a) General - A price adjustment based on the results of the IRI will be made for each 0.10 mile segment or partial segment of Traffic Lane ACP requiring IRI measurement according to 00745.73. The price adjustment will be based on the IRI values determined according to ODOT TM 772 for each 0.10 mile segment and partial segment. Partial segments less than 0.10 mile in length shall be evaluated with the IRI price adjustment value multiplied by the ratio of the partial segment length to 0.10 mile.

A smoothness price adjustment will be made for all segments, or partial segments based on the average IRI value and the following equations:

Schedule 1

Averaged IRI (inches/mile)	Equation
≤ 35.00	Y = $500.00
35.01 - 60.00	Y = (– $20.00 × X) + $1,200.00
60.01 - 65.00	Y = $0.00

65.01 - 95.00	Y = (– \$20.00 × X) + \$1,300.00
> 95.00	Corrective Action
Y = The price adjustment for the segment or partial segment X = The averaged IRI value for the segment or partial segment	

Any positive smoothness price adjustment due to the Contractor will be made on the next monthly progress estimate following the satisfactory completion of all corrective Work and the submission of all test data for all Traffic Lane paving on the Project.

00745.96(b) applies when corrective action is taken by the Contractor, or the Engineer elects to not correct identified Areas of Localized Roughness according to 00745.45(c).

(b) Adjustments for Sections Requiring Corrective Work or with Areas of Localized Roughness - Segments or partial segments in which corrective Work is performed according to 00745.75(c) are subject to the price adjustments described in 00745.96(a) except that no positive price adjustment (bonus) will be due to the Contractor If a segment or partial segment containing corrective Work is retested according to ODOT TM 772 and 00745.73, the retested average IRI value will be used for payment, except that no positive price adjustment will be made for a segment or partial segment containing corrective work.

No segment or partial segment containing an area of Localized Roughness with a value of 160.0 inches per mile or greater will be eligible for positive price adjustment, even if corrective action is not required by the Engineer.

Segments or partial segments containing corrective Work with an IRI value of more than 95.0 inches per mile are subject to additional corrective action and retesting according to 00745.75(c). The Engineer may waive corrective action in partial segments with the application of a smoothness price adjustment based on an IRI value of 95.0 inches per mile.

SECTION 00748 - ASPHALT CONCRETE PAVEMENT REPAIR

Comply with Section 00748 of the Standard Specifications.

SECTION 00810 - METAL GUARDRAIL

Comply with Section 00810 of the Standard Specifications.

SECTION 00812 - ADJUSTING AND REPAIRING GUARDRAIL

Comply with Section 00812 of the Standard Specifications.