ENSURING A GOOD BOND

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Flexible Pavements of Ohio
What's wrong here?
OVERVIEW

Why is Tack so Important
Materials
Surface Prep
Mean of Measure
Insurance vs Performance
WHY DO WE TACK??

• To bond paving layers in order to create a monolithic pavement structure

• Failure to achieve a Monolithic Layer??
  • Flexural strength is reduced
  • Structural design is invalid
  • **Premature failure**
STRUCTURAL IMPORTANCE

½” Deflection, 60lb Load

¼” Deflection, 160lb Load

Unbonded

Fully Bonded

Up to 5 sheets (layers)
48” x 4” x 11/32”
STRUCTURAL IMPORTANCE

Courtesy of NCAT
TELLTALE SIGNS OF A BOND FAILURE?

- Layers slipping under traffic load

Days later!

Courtesy of WVDOT
TELLTALE SIGNS?

- Longitudinal Cracking along the wheel path
- Layer Delamination

Courtesy of WVDOT
TOP TWO BONDING MECHANISMS

Surface Texture

Bonding Agent (Tack coat)
SURFACE TEXTURE

• A rough, open texture, milled surface promotes mechanical interlock

• Finer graded material placed on a coarser surface promotes mechanical interlock

• Coarse stone mix on a smooth surface could act as a slip plane
DELAMINATION POTENTIAL
TACK COAT

- ODOT Item 407 - Tack Coat

Provides requirements for preparing the surface and treating the surface with an application of asphaltic material.
ENSURING THE BEST TACK COAT

• Surface Preparation
• The Right Material
• The Right Way
• The Right Time
SURFACE PREPARATION

407.05  PREPARATION OF SURFACE

• Ensure that the surface is thoroughly clean and dry when the asphalt material is applied. Remove material cleaned from the surface and dispose of it as the Engineer directs.
What is “CLEAN AND DRY”? 

Clean…
• **Remove anything that would interfere with adhesion or with placement operations, e.g. dust, loose aggregate, soil, leaves, pieces or lumps of foreign material, etc.**

Dry…
• Emulsions may be placed on “damp” surfaces
• Pavement should not be wet
• No visible, flowing water on the pavement surface
THE RIGHT MATERIAL

407.02

702.04
RS-1, SS-1, SS-1h, CRS-1, CSS-1, CSS-1h

702.12; Non-Tracking Asphalt Emulsion
- May be used anytime, required when specified

702.13; SBR Asphalt Emulsion
Required when paving over concrete or brick (407.06)
PROTECTING THE TACK MATERIAL

- Avoid overheating - typically <180°F
- Protect from freezing
- Do Not Heat And Cool Repeatedly
- Do NOT mix anionic and cationic emulsions
- Be sure to use the Reclamation Tank on the Distributor and remove all fuel prior to pumping into distributor

• **Consult with the Supplier for any unique handling needs for their product(s)!**
NON-TRACKING TACK COAT

• Shorter break and set time vs standard tack
  • 10-15 minutes vs 20-30 minutes

• Typically harder base binder
  • Does harder mean Stronger??

• Quick curing keeps tack on roadway where it is needed
  • accelerates paving operations
  • Improves aesthetics by avoiding tracking onto local roadways

• Night paving

• Any project where conditions do not allow for adequate cure time for standard tack coat
  • Urban & suburban areas with numerous driveways, intersections and high traffic volume
  • Any project where tracking onto local roads is unacceptable
APPLICATION OF ASPHALT MATERIAL

407.06

- Determining your Application Rate **Table 407.06-1**
  - Existing surface (asphalt vs concrete)
  - Aged of the existing surface? (oxidized, fresh, ...)
  - Pavement texture (milled, fine-milled, rough, smooth, ...)
  - On concrete (or brick) use SBR asphalt emulsion, 702.13

- For ODOT projects... obtain the Engineer’s approval and apply tack coat within ranges specified in **Table 407.06-1**
THE TACK COAT DISTRIBUTOR

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

NOZZLE ANGLE SETTING: 15 TO 30 DEGREES

SPRAY BAR AXIS

~12"

Triple Lap Coverage
NOZZLE SELECTION

ONE SIZE DOES NOT FIT ALL!!!!!!!!!!!!!
Nozzles are clogged, but triple overlap covering the gap.

Note: not a tack coat, but principle applies.
EMULSION BREAKING VS SETTING

• Emulsions are asphalt droplets suspended in water
• Breaking
  • Contact with surface changes pH; reducing charge
  • Color change… brown to black
• Setting
  • Evaporation leads to coalescence
  • Original asphalt characteristics return
TRACKING AND PICKUP
NON-TRACKING TACKS FIX THE PROBLEM, RIGHT?

• If you don’t let it break material choice doesn’t matter
Is this application acceptable?

Is it uniform?

Is this complete coverage?

No, No and No.
Acceptable?

Uniform?

Complete Coverage?

No
Acceptable?

Uniform?

Complete Coverage?

Yes
MEASURE AND PAYMENT
407.07 & 407.08

• Determine gallons to be paid from weight tickets and weighed partial loads using S1060 and CA-FP-6 (Excel File)

• S 1060 contains procedures for converting weights to volume at a standard temperature using factors given in Table A.

<table>
<thead>
<tr>
<th>Item</th>
<th>Material</th>
<th>Specific Gravity (77°F)</th>
<th>T (F)</th>
<th>C</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>702.04</td>
<td>Asphalt Emulsions</td>
<td>0.9622</td>
<td>100.0</td>
<td>0.00035</td>
<td>8.368</td>
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</tbody>
</table>
INSURANCE VS PERFORMANCE

• Insurance
  • Calibration of the Distributor
  • Application Rate verification

• Performance
  • Destructive testing (Shear/Torsion/Tension/etc)
DIRECT MEASUREMENT
ASTM D2995

• Field Measurement of Application Rate
  • Longitudinally
  • Transversely
• Units of Gallons/Yard$^2$ (Liters/Meter$^2$)
Photo courtesy of Dr. Louay Mohammad
DIRECT MEASUREMENT
ASTM D2995

• Method B—Volume-Based Calculations
  • Spray tack coat into containers for a set time period
  • Determine volume collected for each nozzle
  • Calculate transverse uniformity
  • Calculate longitudinal rate incorporating truck’s velocity
PERFORMANCE TESTING

• Three main types of bond strength testing devices

1. Tension Device
2. Direct Shear Device
3. Torsion Device
CONCLUSIONS

• Lack of a tack leads to Problems and **Premature failure**
  • 10% bond loss = 50% less fatigue life (May & King)
  • 10% bond loss = 70% loss of life (Brown & Brunton)

• Surface Prep
  • CLEAN AND DRY

• Application
  • Uniform, complete coverage
  • Triple Overlap
  • WAIT FOR THE TACK TO BREAK before putting construction Equipment on the road!!!!!!

• Verify the application
  • Application rate or Performance Testing