Tack Coat Best Practices

Indiana Workshop

Wayne Jones – Asphalt Institute
Jason Dietz – FHWA Resource Center

U.S. Department of Transportation
Federal Highway Administration

ASPHALT INSTITUTE®

Federal Highway Administration
RESOURCE CENTER

Opening Remarks

- Instructor introductions
- Course materials / Forms and handouts
- Questions and interaction
- Coffee breaks
- Classroom etiquette *(Cell phones, Talking)*
- ***All applications are in terms of residual asphalt.***

Today's Participants

- Instructors Introductions
- Audience Makeup?
  - DOT
  - Local Agency
  - Contractor
  - Supplier
  - Consultant
- Years in Industry?
  - 0-5
  - 5-10
  - 10-20
  - 20+

Any preliminary Tack Coat questions?

Overall Purpose

… to **improve** the overall **bonding** of pavement layers;

to **decrease distresses** associated with poor bond;

and to **improve overall pavement performance**.

Key Factors for Tack Coat Success

- Condition of Existing Pavement
- Tack Coat Application Rate
- Residual Binder Content
- Proper Distributor Operation
- Emulsion Break and Set Times

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

III. • Tack Coat Specifications & Manuals

IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

Workshop Format

- Guided instruction/discussion
- Protocol:
  - Informal
  - Questions are encouraged
  - Class participation is essential

Learning Objectives

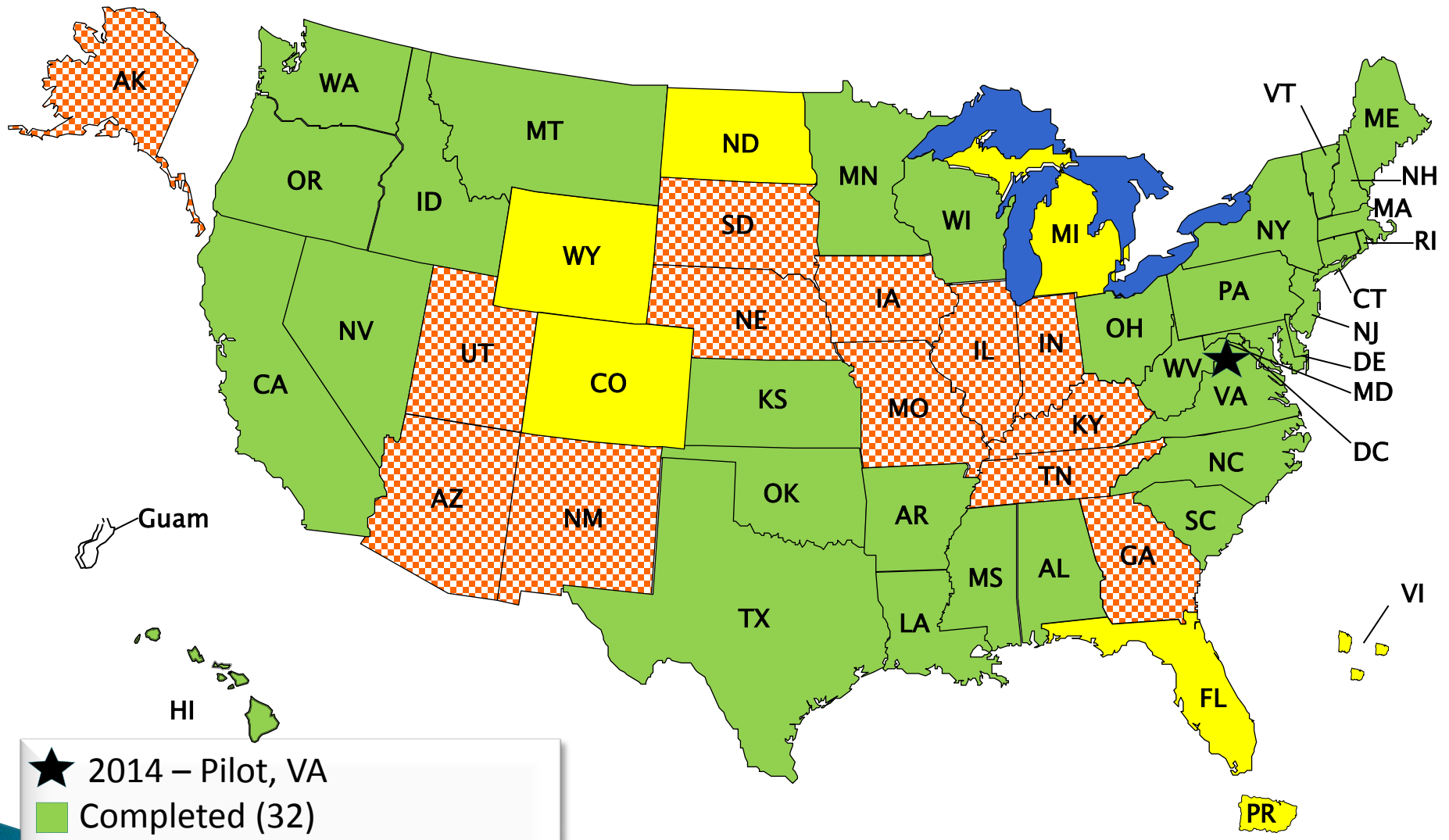
Upon completion of this workshop, you will be able to:

1. Recognize the importance of layer bonding.
2. Describe the proper handling, storage, and testing of tack coat materials.

Learning Objectives (continued)

3. Explain the type of field tests used to measure residual application rates.
4. Identify construction best practices that need to be met in order to have a successful tack coat application.

Tack Coat Workshops



★ 2014 – Pilot, VA
Completed (32)
Scheduled (13)
Requested (7)
Have not Requested (1)

Outcomes From 25 Workshops

- FHWA Best Practices Tech Brief (Dec. 2015)
- AASHTO SOM Specification Was Submitted
- Increasing Application Rates
- DOTs Specification Revisions
- Going to Stiffer Base Asphalts
- Verifying Calibration of Distributor
- Treat Tack as Separate Pay Item vs. Incidental Item

Successful Tack Coat

The Ultimate Goal:
Uniform, complete, and adequate coverage

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

III. • Tack Coat Specifications & Manuals

IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

I. Importance of Tack Coats

Why do we use Tack Coats?

I. Importance of Tack Coats

- **To promote the bond between pavement layers.**
  - To prevent slippage between pavement layers.
  - Vital for structural performance of the pavement.
  - All layers working together.
  - Apply along all transverse and longitudinal vertical surfaces.

Consequences of Poor Bonding

- Poor pavement performance
  - Slippage cracks
  - Shoving
  - Early fatigue cracking
    - Bottom up
    - Top down
- Costly pavement repairs
  - Repair of isolated area relatively inexpensive
  - Removal and replacement of a portion or the entire pavement structure is very expensive
  - Shorter than expected pavement life can be devastating for agency budgets

Definition

Tack Coat—sprayed application of asphalt cement upon an existing asphalt or Portland cement concrete pavement which may or may not have been milled before an overlay, or between layers of fresh asphalt concrete.

Everyone MUST be on the same page

What we are talking about:

- ***Original Emulsion***—an undiluted emulsion which primarily consists of a paving grade binder, water, and an emulsifying agent.

- ***Diluted Emulsion***—an emulsion that has been diluted with <u>additional</u> water.
  - Critical to control
  - 1:1 typical (Original Emulsion: Added Water)

- ***Residual Asphalt***—the remaining asphalt after an emulsion has set typically 57-70 percent.

What's wrong (if anything) with the following specification regarding application rate?:

"Apply the tack coat at a rate of 0.05 gallons/yd^2"

What difference does it make?

If the example spec *intended* 0.05 *gal/yd²* of residual asphalt:

Original emulsion *applied at* ***0.05 gal/yd²*** *using an emulsion with 60% residual asphalt, leaves* ***0.03 gal/yd²*** *on the roadway?*

40% less than intended

What difference does it make?

If the example spec *intended* 0.05 *gal/yd²* of residual asphalt:

Diluted Emulsion using the same emulsion diluted 1:1 with water and applied at ***0.05 gal/yd²*** leaves ***0.015 gal/yd²*** *on the roadway?*

70% less than intended

What difference does it make?

If the example spec *intended* 0.05 *gal/yd²* of residual asphalt:

*To receive **Residual Asphalt** at **0.05 gal/yd²** using an emulsion with 60% residual asphalt, the contractor would need to apply:*

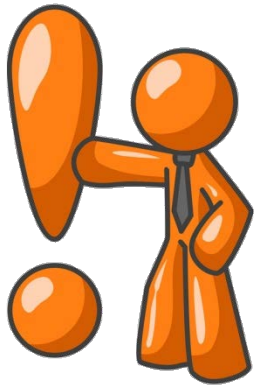
***0.083 gal/yd²** of **Original Emulsion** or*
0.167 gal/yd²** of **1:1 Diluted Emulsion

More Terminology

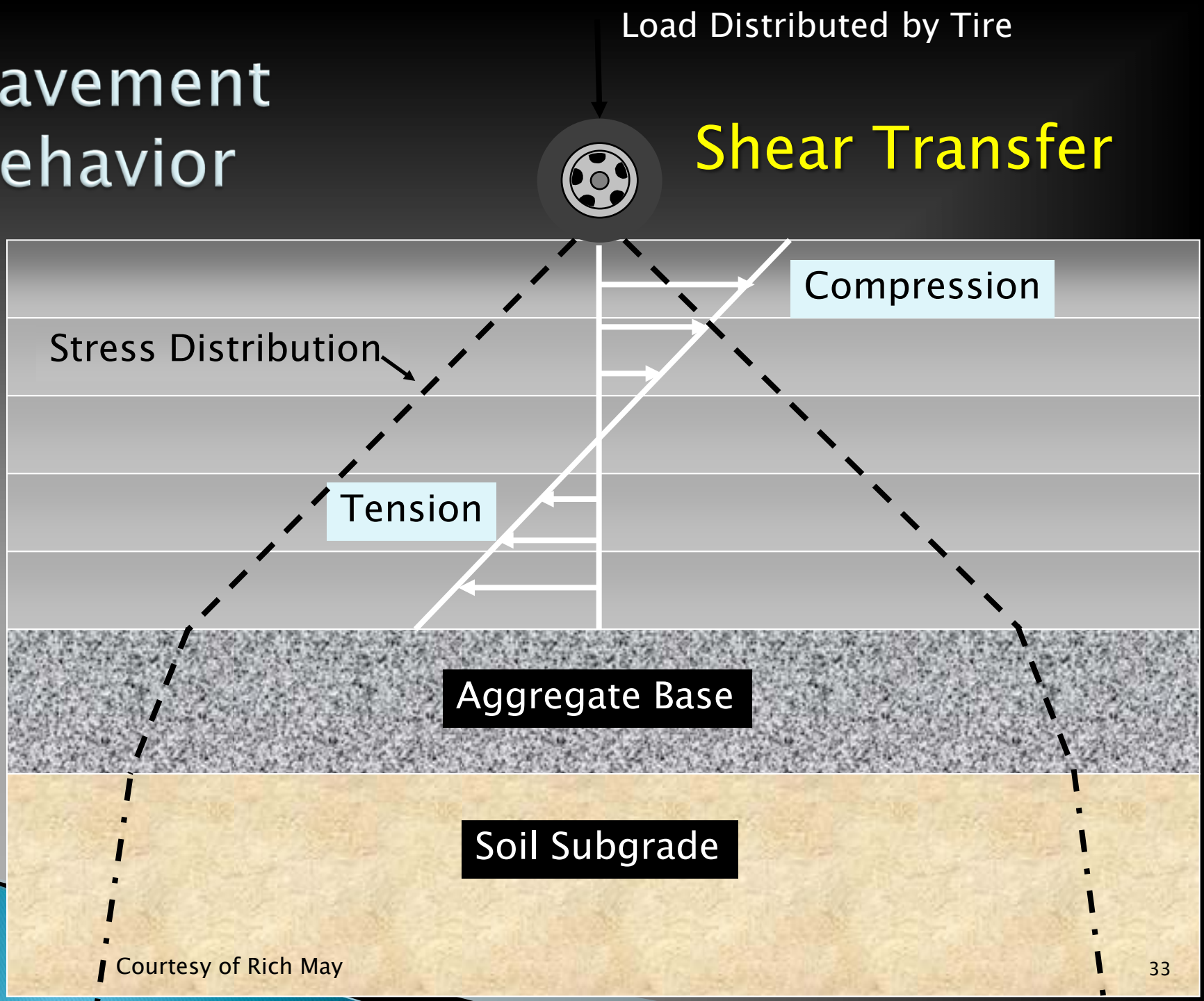
- *Tack Coat Break*—the moment when water separates enough from the asphalt showing a color change from brown to black.
- *Tack Coat Set*—when all the water has evaporated, leaving only the residual asphalt. Some refer to this as completely broke.

So who was listening?

- T/F A **Broken Emulsion** is the remaining asphalt after an emulsion has set.

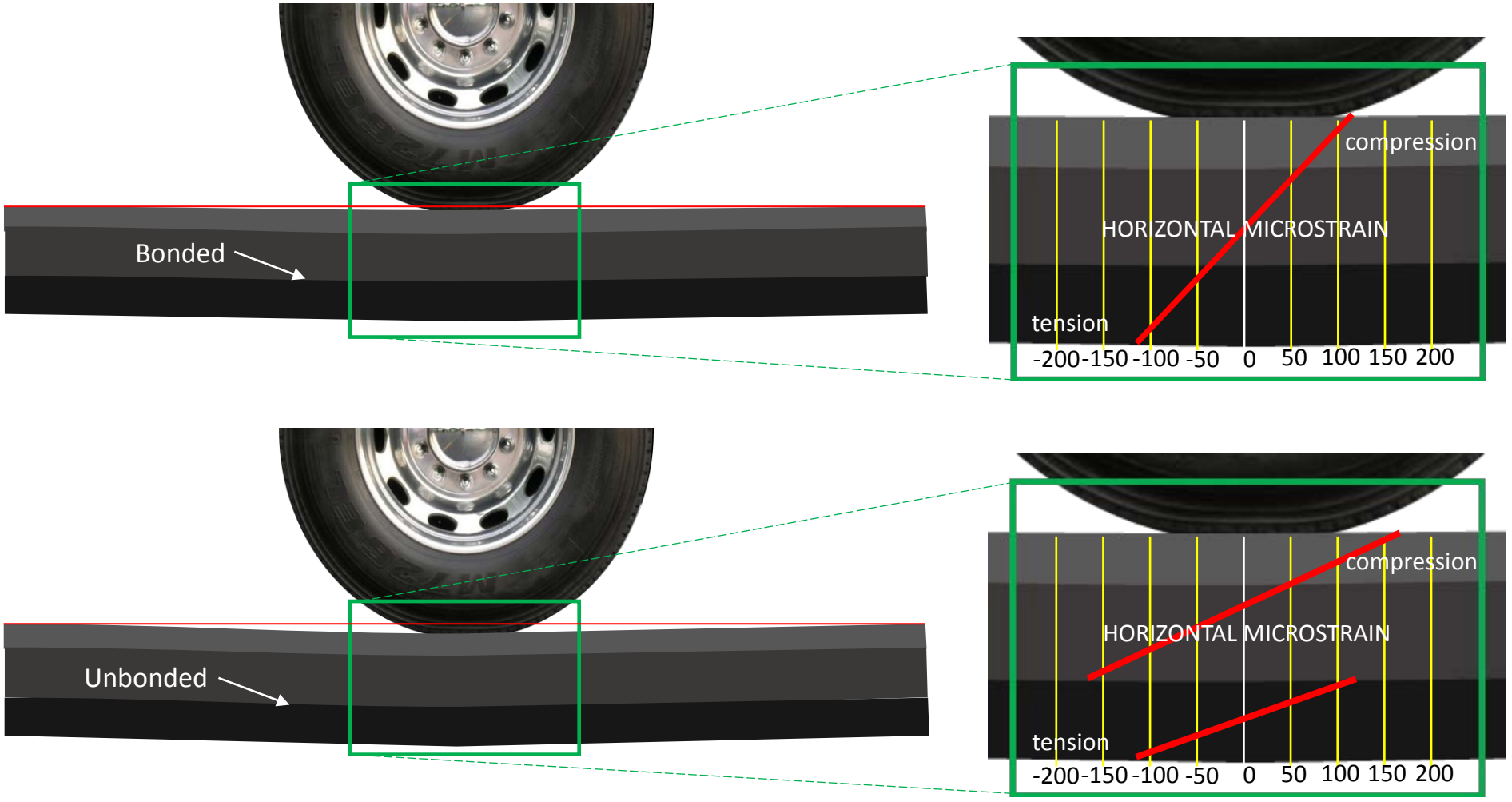


Pavement Behavior



Courtesy of Rich May

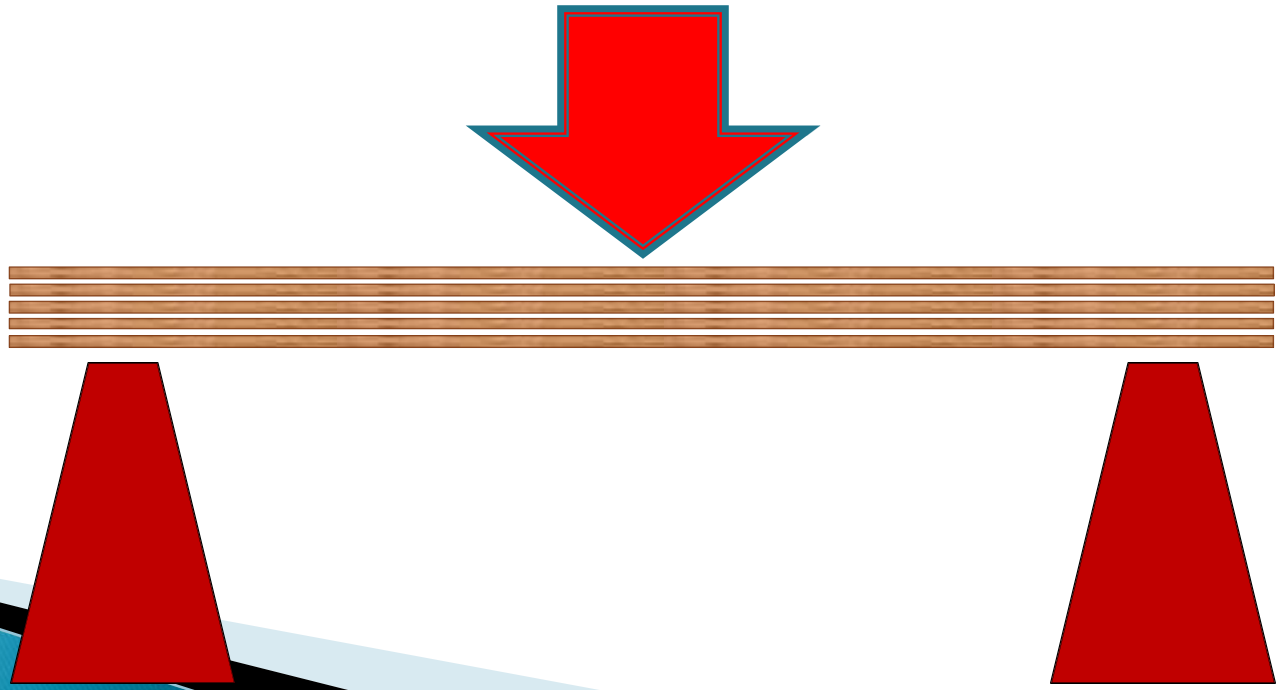
Consequences of Debonding



Courtesy of NCAT

Bonded Demonstration

- Up to 5 sheets (layers)
- 48” x 4” x 11/32”
- 60, 100, or 160 pound loadings
- Various Bonding Configurations

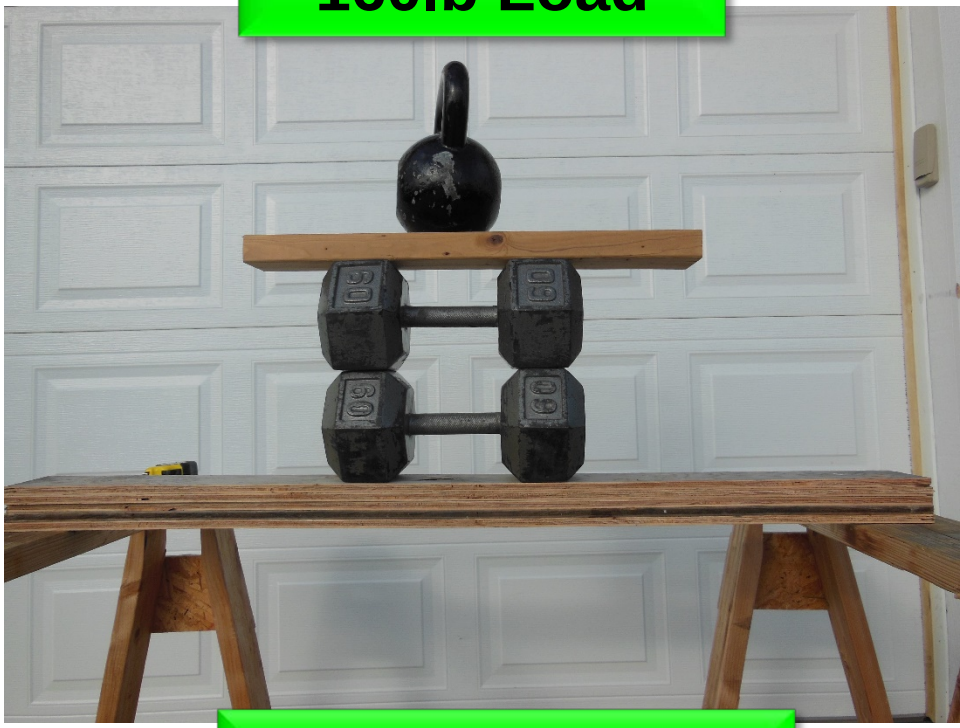


Bonded Demonstration

½” Deflection,
60lb Load

Unbonded

¼” Deflection,
160lb Load



Fully Bonded

Bonded Demonstration Highlights

- 2 bonded layers had less deflection than 5 unbonded with the same loading (60#).

- 5 unbonded layers deflected 4x more than 5 bonded with the same loading (60#).

- ***5 bonded layer with over 2½x the load deflected half as much as 5 unbonded.***

TACK

What is going on and why?

- Layer independence
  - Reduced fatigue life
  - Increased rutting
  - Slippage
  - Shoving
- Compaction difficulty

Direction of traffic?

Slippage Failure

Types of Tack Coat Failures

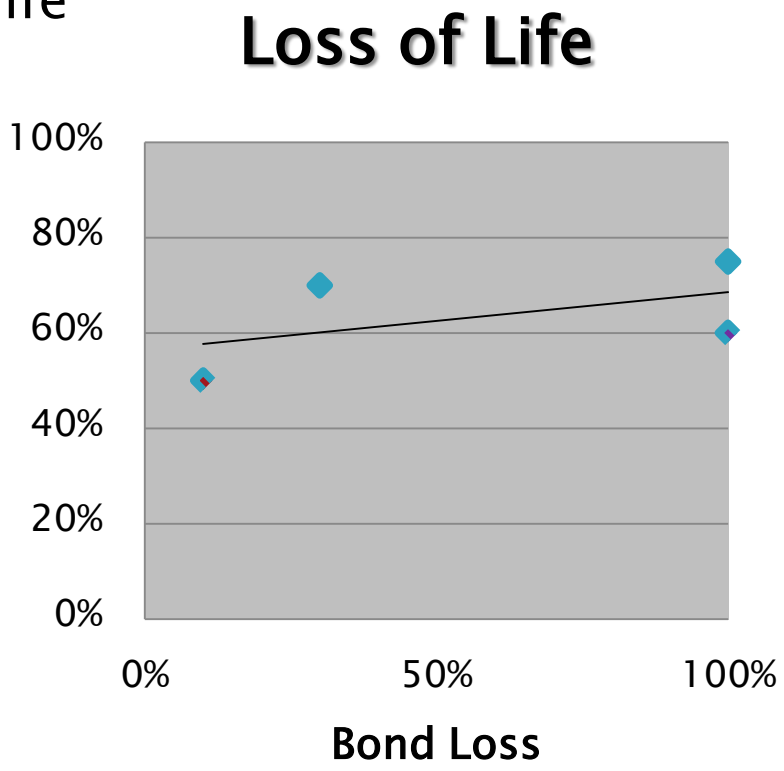
Delamination of overlay from underlying pavement

Days later!

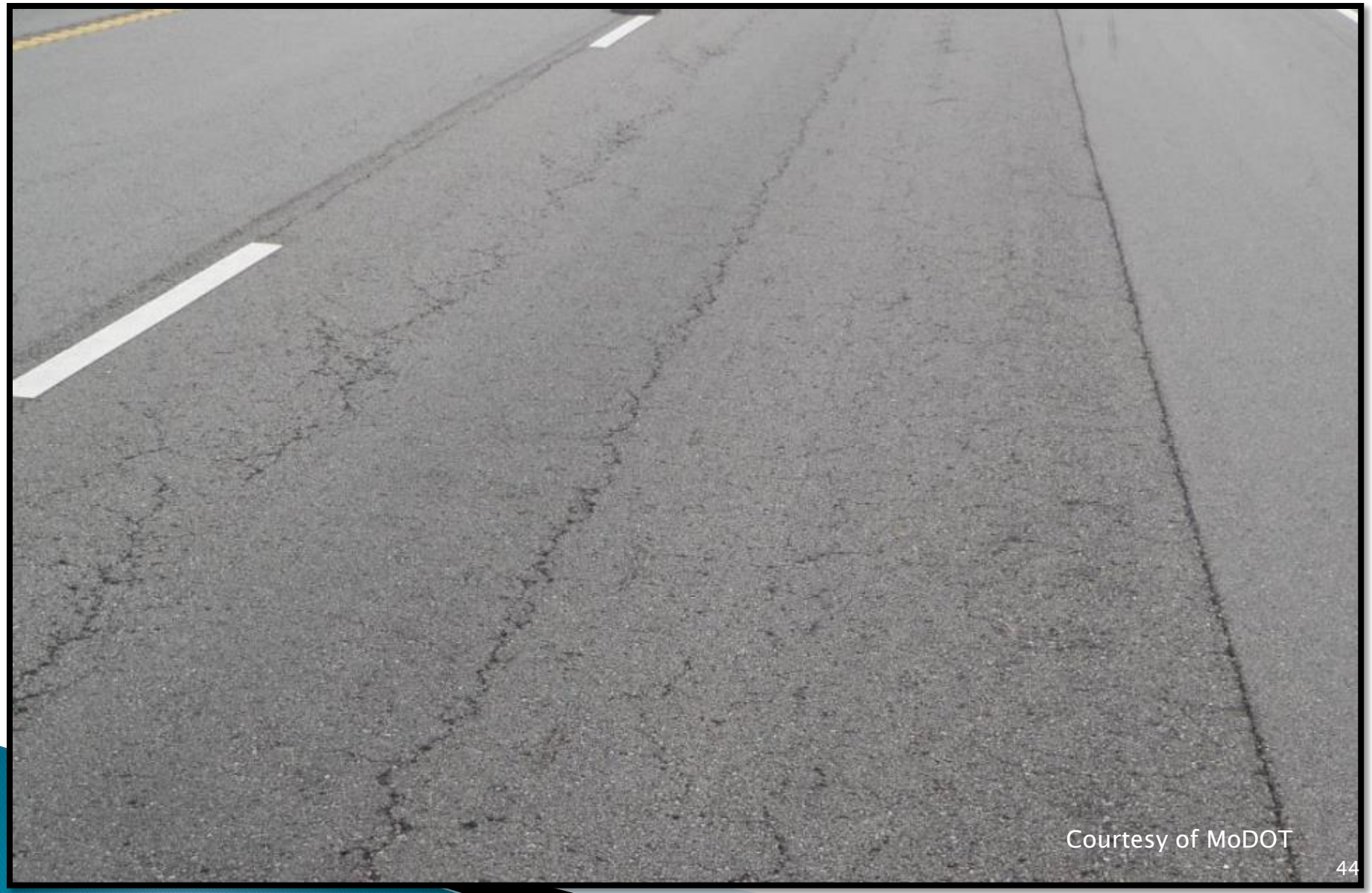
Courtesy of Road Science™

Loss of Fatigue Life Examples

- May & King:
  - 10% bond loss = 50% less fatigue life
- Roffe & Chaignon
  - No bond = 60% loss of life
- Brown & Brunton
  - No Bond = 75% loss of life
  - 30% bond loss = 70% loss of life



8-10 years est. Interstate Pavement



Cores Showing Debonding

Courtesy of MoDOT

So is it worth it to apply a tack coat?

Cost of Tack Coat

- New or Reconstruction
  - About 0.1–0.2% of Project Total
  - About 1.0–1.5% of Pavement Total Cost

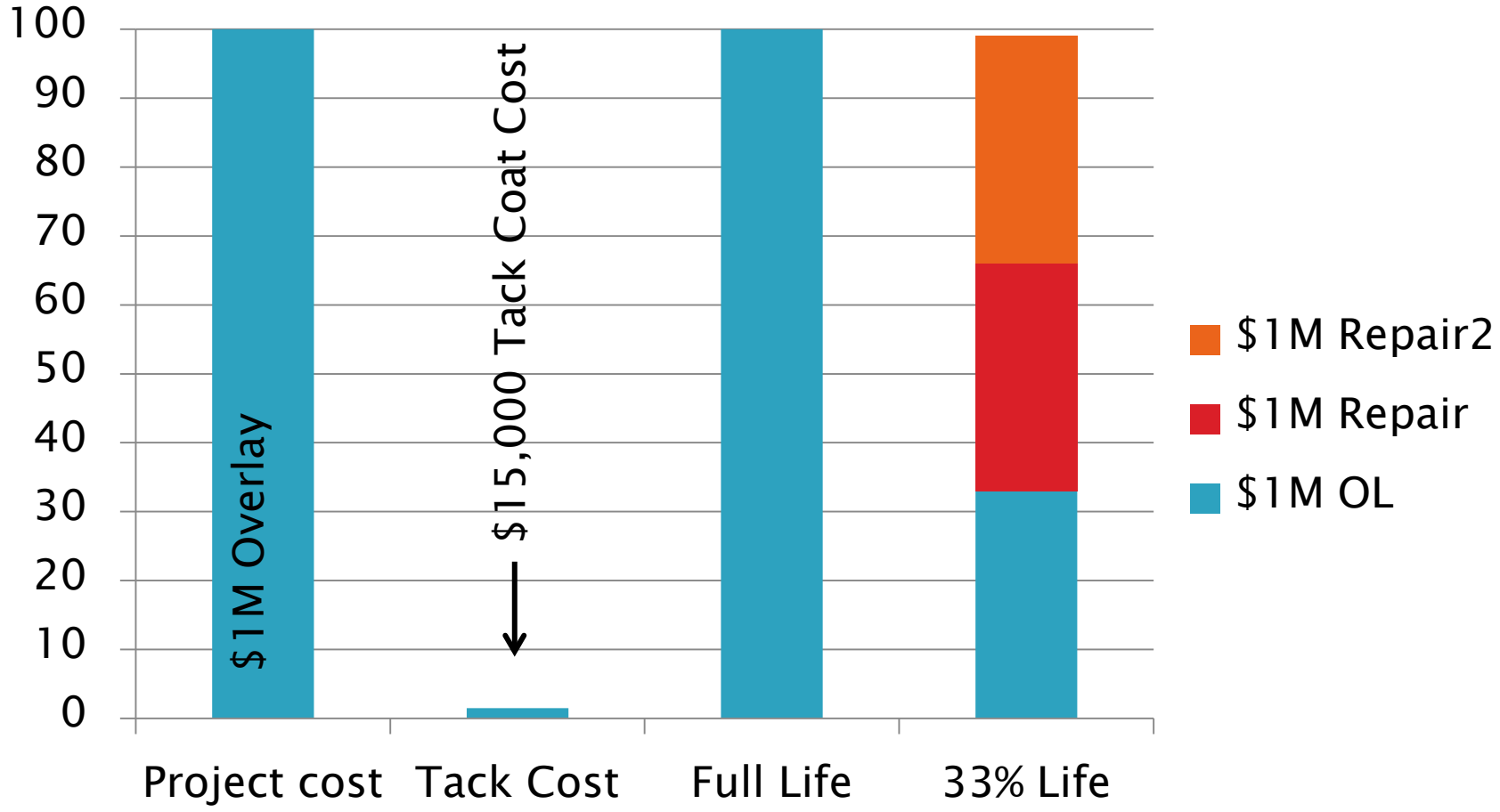
- Mill and Overlay
  - About 1.0–2.0% of Project Total
  - About 1.0–2.5% of Pavement Total Cost

Estimated Cost of Bond Failure in Only the Top Lift

- Assume no inflation for materials
- Estimated traffic control
- Used project plans for thicknesses
- Used bid tabs for:
  - Milling
  - Material costs
  - Replaced pavement markings

30–100% of Original Pavement Costs

What is the Risk?



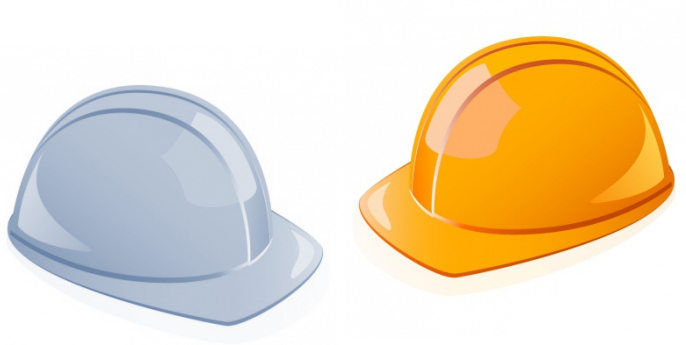
$15,000 now or $2 M later?

What are the Other Obstacles In Getting a Good Tack?

- Working in short construction windows
- Cold weather
- Night time paving
- Residential areas
- Proper surface cleaning

Tack Coat Challenges

- Contractor
  - Application Rate
  - Consistency of Application
  - Tack Coat Pickup or Tracking By Vehicles
  - Traction for Construction Equipment
  - Breaking/Setting Time
- Agency
  - Acceptance
  - Dilution?
  - Application Measurement
  - Bond Quality
  - Tort Claims



Successful Application

Proper storing and handling these materials can help ensure proper application and better bonding.

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

III. • Tack Coat Specifications & Manuals

IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

II. Tack Coat Materials Selection & Handling

- Emulsified Asphalts
  - Most common options
    - **SS-1, SS-1H**
    - **CSS-1, CSS-1H**
    - RS-1, RS-1H, RS-2
    - CRS-1, CRS-2
    - HFMS-2
    - PMAE
    - Reduced Tracking

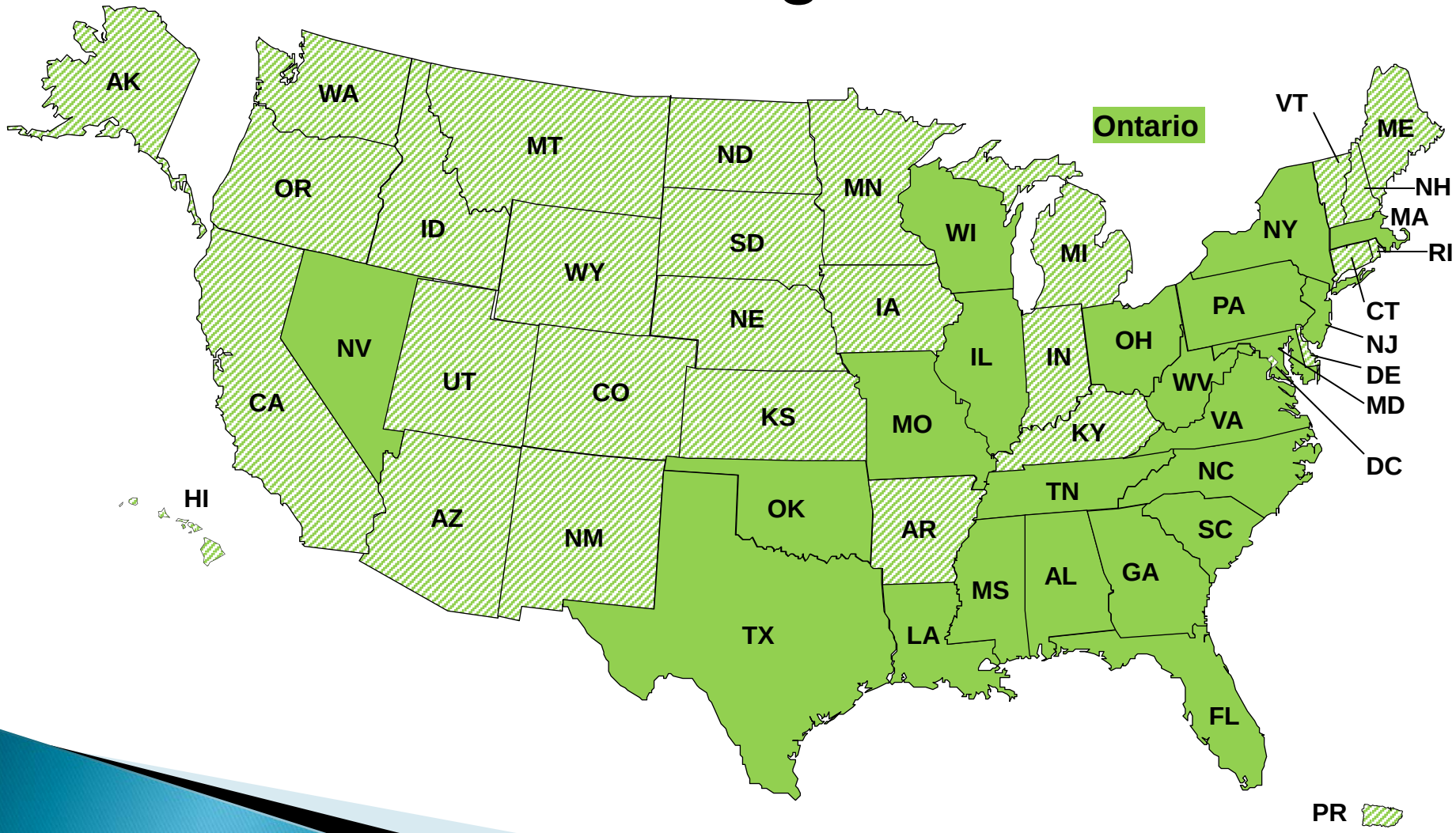
II. Tack Coat Materials Selection & Handing (cont.)

- PG Graded Binders
  - Most common Neat Binders
    - PG 58-28
    - PG 64-22
    - PG 67-22
  - Polymer Modified
- Cutback Asphalt (minimal use)
  - Rapid Cure Cutbacks
  - Produce Lower Bond Strengths

Newer Materials

- Materials that have been brought to market in recent years.
- These are primarily reduced tracking emulsion formulations or additives.
- Currently known reduced tracking options found in your handouts.

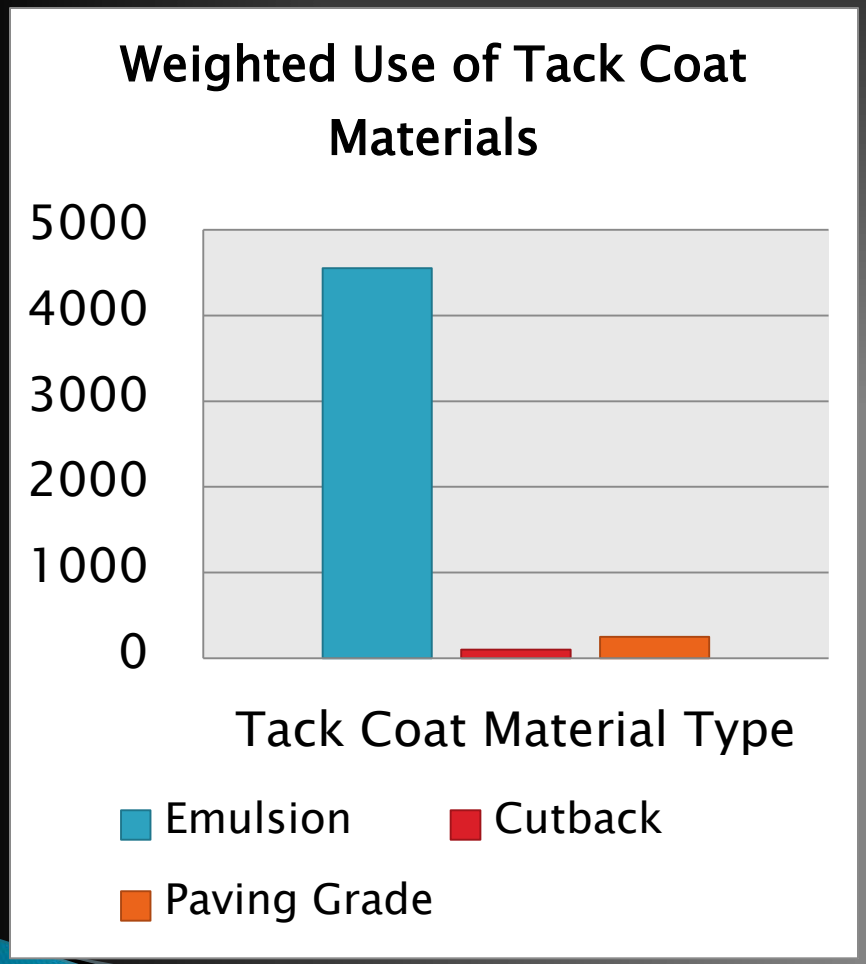
22 States Known to Allow Reduced Tracking Tack Materials

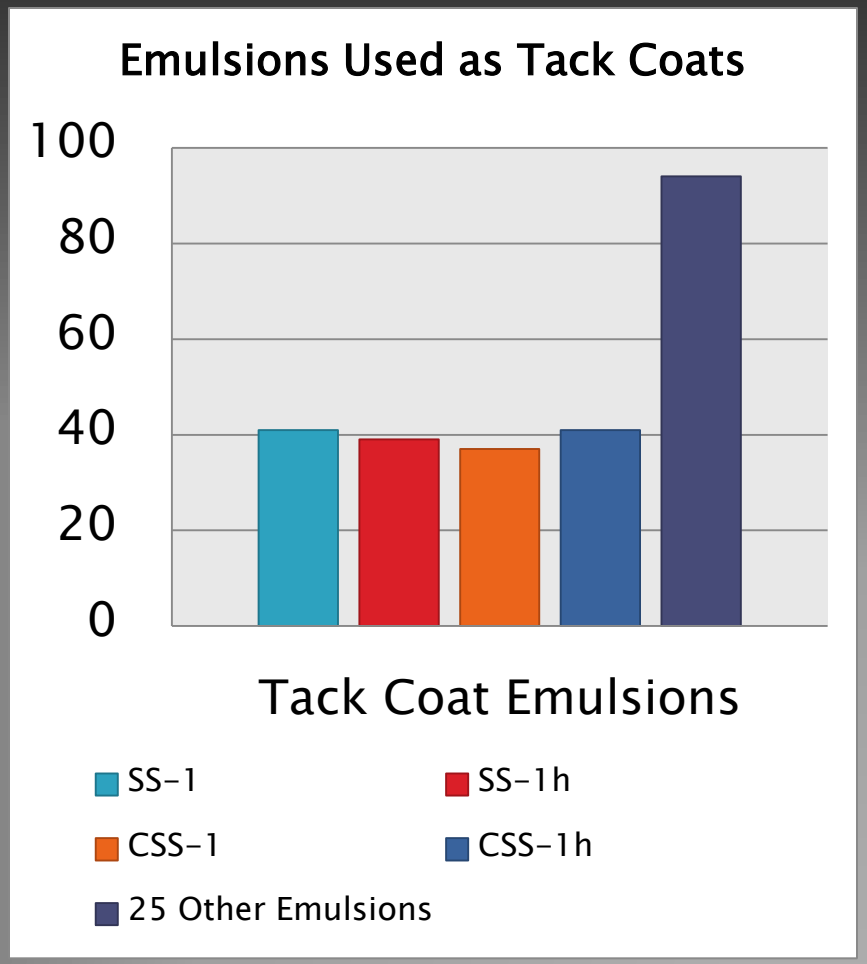


Material Selection

- State approved products lists
  - Online at most DOT websites
  - Asphalt Institute State Emulsion Data Base
    - http://www.asphaltinstitute.org/public/engineering/state_binder_specs/emusion-spec-database.dot
- Material availability
- Local experience
- Dynamic area

Common Tack Coat Materials (NCHRP Report 712)





Handling of Emulsions

- Do NOT mix anionic and cationic emulsions.
- Vertical tanks preferred—skin formation.
- Protect from freezing.
- Avoid overheating—typically <180°F.
- Minimal low-shear pumping.

Consult with the Supplier for any unique handling needs for their product(s)!

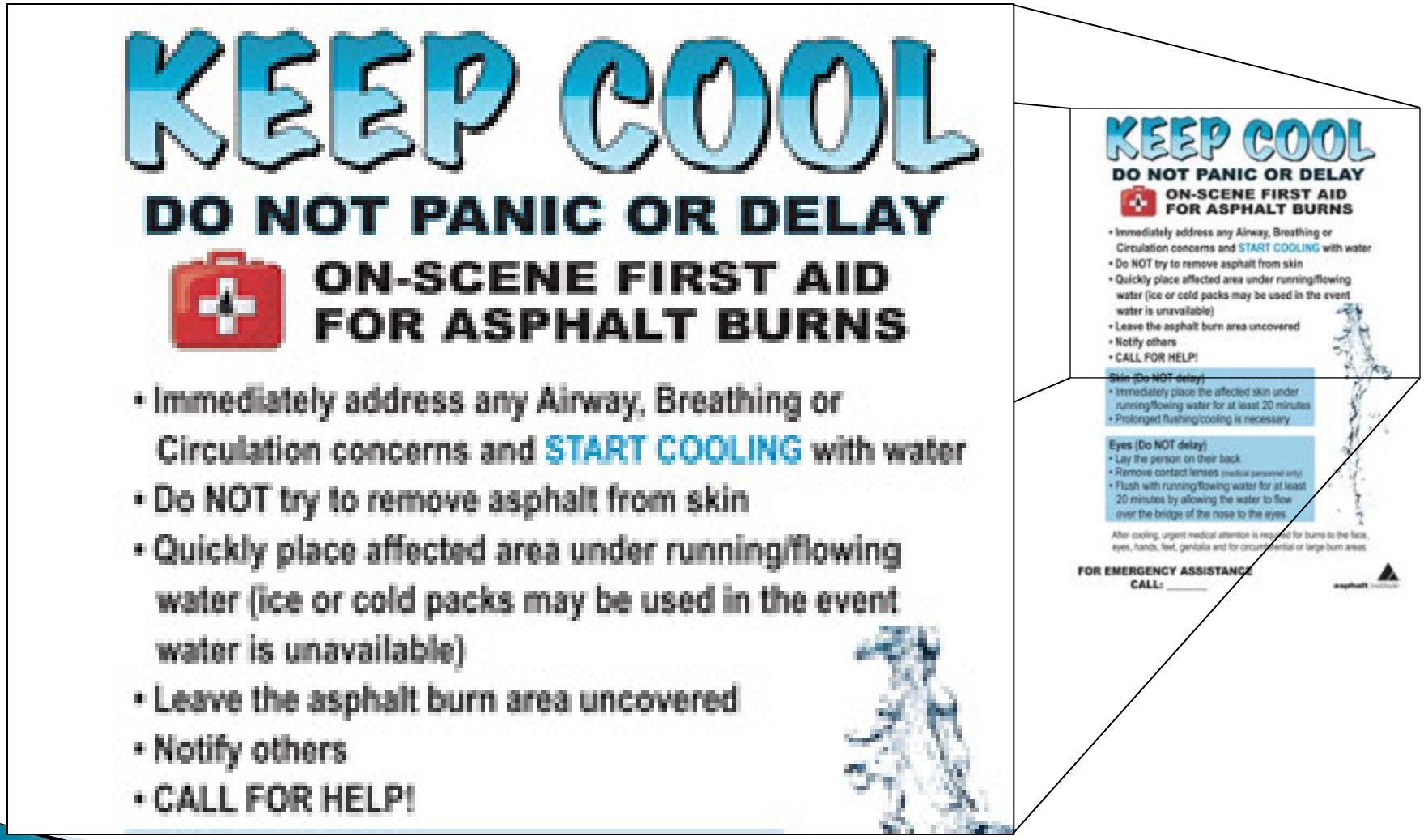
Handling of Emulsions

- Dilution
  - Verify if it is allowed.
  - If allowed, where?
    - Supplier only?
    - Contractor?
  - Control amount of water added.
    - 1:1 most common (Original Emulsion: Added Water)
  - Use acceptable/approved water.
  - Terminal added or field diluted.
  - Always add water to emulsion.

Handling of Hot AC

- Proper personal protective equipment.
- Proper protection of hot elements.
- Ensure a water-free distributor.

Asphalt Institute Burn Information



Storage Options

- Tank—long-term storage
- Tanker—short-term storage
- Distributor Truck—short-term storage

Storage Tanks

- Long-term storage.
- Vertical generally preferred.
- Heated.
  - Store toward lowest pump-able temperature
- Agitation.
  - Low-shear
  - Minimize frequency
- Hoses.
  - Keep clean

Tanker Storage

- Short-term storage.
- Generally not heated.
- Generally can not agitate.

Distributor Storage

- Short-term storage
- Heated
- Pump circulation

Time for a quick Break?

15 Minute Break

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

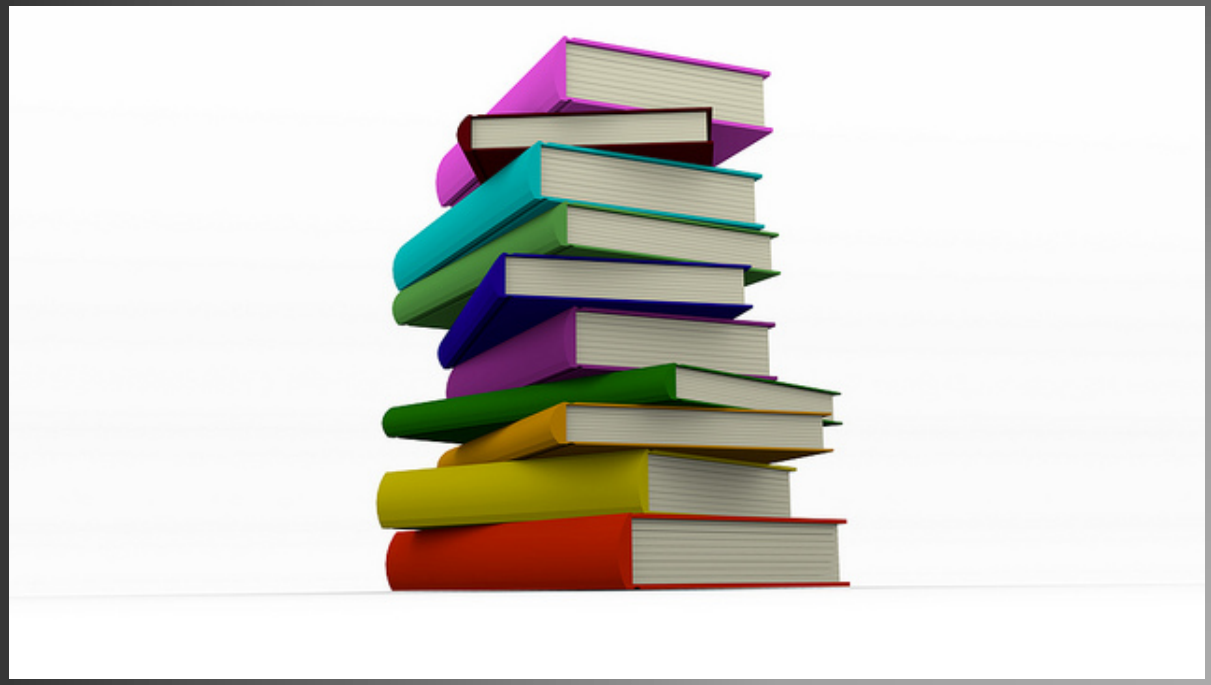
III. • Tack Coat Specifications & Manuals

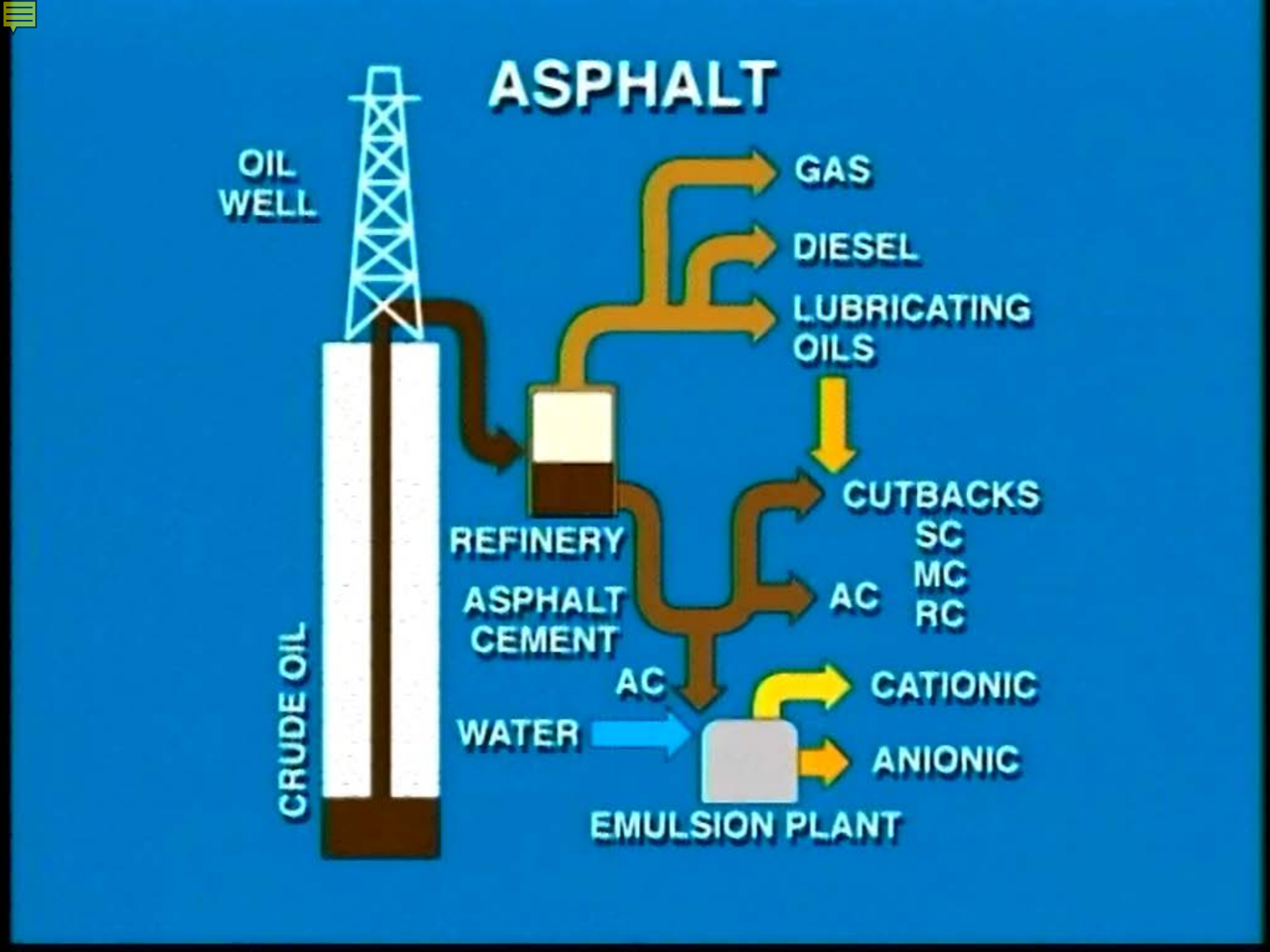
IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

III. Tack Coat Specifications & Manuals




ASPHALT
OIL WELL
GAS
DIESEL
LUBRICATING OILS
CUTBACKS
SC
MC
RC
REFINERY
ASPHALT CEMENT
AC
AC
CATIONIC
WATER
ANIONIC
CRUDE OIL
EMULSION PLANT

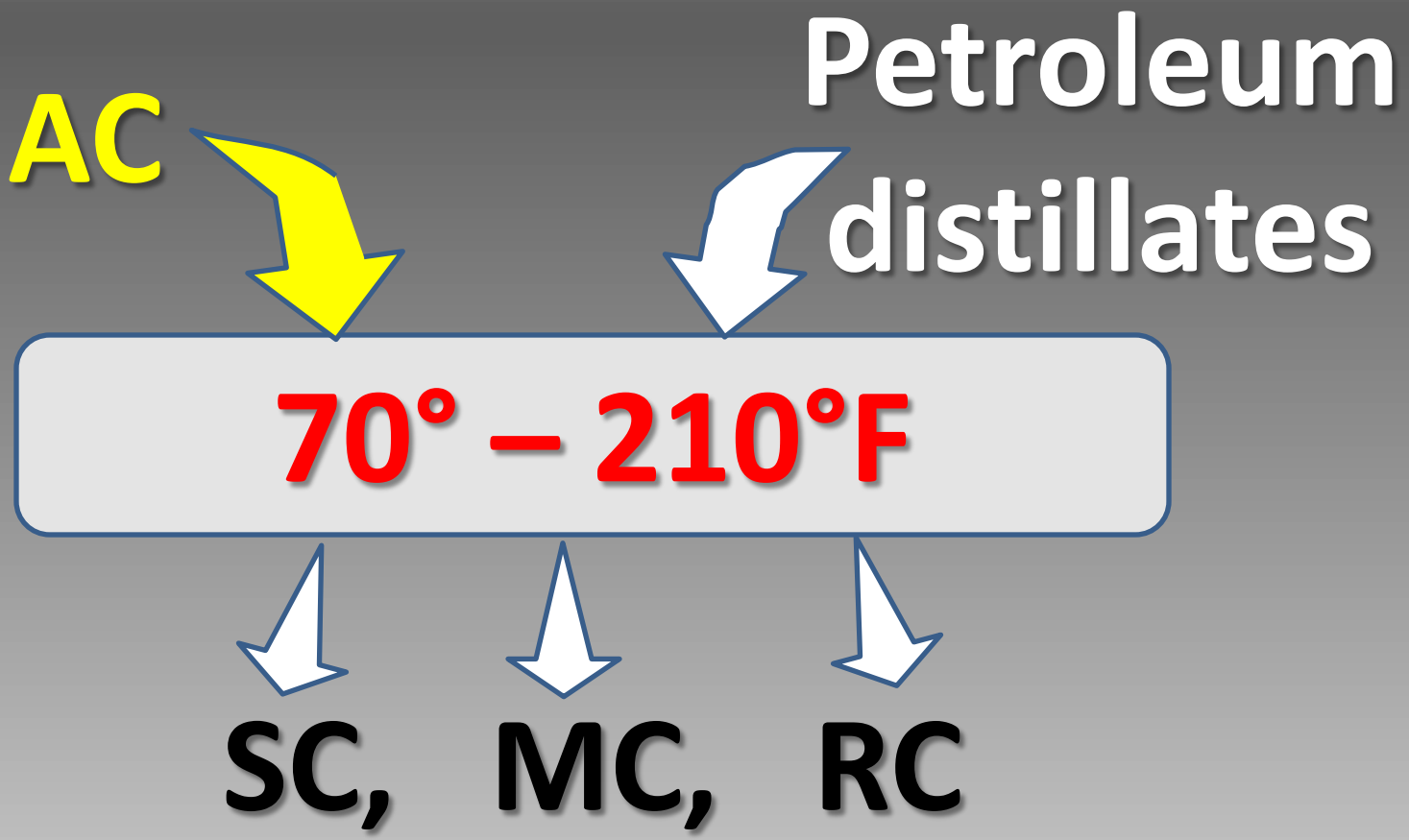
ASPHALT CEMENT

AC

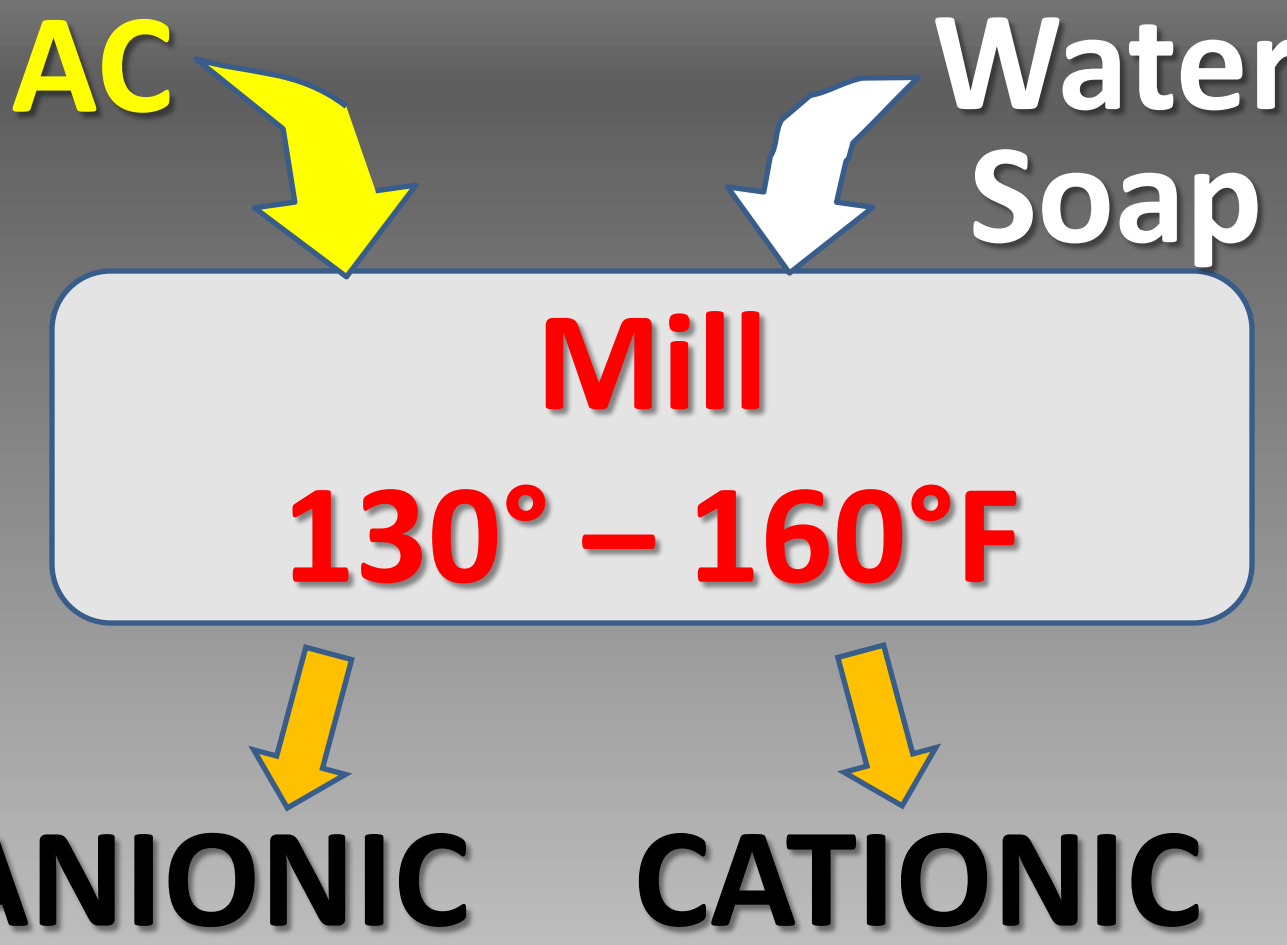
300° – 350°F

Multiple Grades

CUT BACKS



EMULSIONS



Negatively- Charged Emulsions are classified into 3 main types

RS (Rapid Setting)

MS (Medium Setting)

SS (Slow Setting)

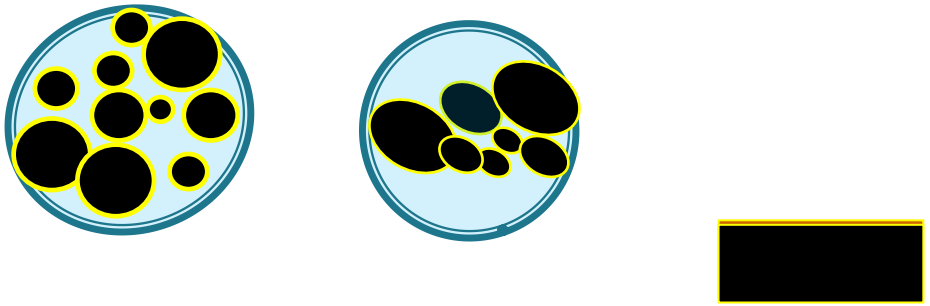
Positively- Charged Emulsions are also classified into 3 main types

CRS (Rapid Setting)

CMS (Medium Setting)

CSS (Slow Setting)

Emulsion Breaking & Setting



Emulsions are asphalt droplets suspended in water

- Breaking
  - Contact with surface changes pH; reducing charge
- Setting
  - Evaporation leads to coalescence
  - Original asphalt characteristics return

Additional Nomenclature

QS = Quick Set HF = High Float

1 = Binder residue = 60% Min. (Low Viscosity Emulsion)

2 = Binder Residue = 65% Min. (High Viscosity Emulsion)

H = Hard Pen Asphalt Base

S = Soft Pen Asphalt Base or sometimes Solvent

L and/or P = Latex and/or Polymer

Standard Emulsion Specifications

- Anionic Emulsion Specifications
  - AASHTO M 140-08
  - ASTM D 977-05

Pen Values 100-200 +				Pen Values 40 - 90	
RS-1	RS-2	HFRS-2		MS-2h	HFMS-2h
MS-1	MS-2	HFMS-1		SS-1h	QS-1h
HFMS-1	HFMS-2	HFMS-2S			
SS-1					

Standard Emulsion Specifications

- Cationic Emulsion Specifications
  - AASHTO M 208-01
  - ASTM D 2397-02

Pen 100-250		Pen 40-90
CRS-1		CMS-1h
CRS-2		CSS-1h
CMS-2		CQS-1h
CSS-1		

Cutback Asphalt Specifications

AASHTO M 81 & 82
ASTM D 2027

Rapid Cure Characteristics	Grades			
Rapid Curing Liquid Asphalt Specs	RC-70	RC-250	RC-800	RC- 3000
Residue after Distillation	55 +	65 +	75 +	80 +
Penetration, 77°F, 100 g, 5s	80 – 120	80 – 120	80 – 120	80 – 120
Medium Cure Characteristics	**Grades**			
Medium Curing Liquid Asphalt Specs	MC-70	MC-250	MC-800	MC- 3000
Residue after Distillation	55 +	67 +	75 +	80 +
Penetration, 77°F, 100 g, 5s	120-250	120-250	120-250	120-250

INDOT Specification

Section 406 – Tack Coat

406.02 Materials

- The **type** and **grade** of asphalt material shall be in accordance with the following:
  - Asphalt Emulsion, AE-T, AE-PMT, SS-1h, AE-NT…**902.01(b)**
  - PG Asphalt Binder, PG 64-22…**902.01(a)**

409.03(a) Distributor

- The distributor shall be equipped, maintained, and operated to provide **uniform** heating and **application rates** as specified. The distributor shall have a **volume measuring device** and a **thermometer** to monitor the asphalt material.
- Distributors shall also be equipped with a **power unit** for the pump and with a **full circulation spray bar** with vertical controls.

406.04 Preparation of Surface

- The existing surface to be treated shall be **free of foreign materials** deemed detrimental by the Engineer.

406.05 Application of Asphalt Material

- The asphalt material shall be **uniformly** applied at the rate of from **0.05 to 0.10 gal/sq yd**, or as otherwise specified or directed.
- Tack coat shall not be applied to a **wet** surface.
- The rate of application, temperature, and areas to be treated shall be **approved** prior to application.
- **Excessive** tack coat shall be corrected to obtain an even distribution.

406.06 Method of Measurement

- Asphalt for tack coat will be measured by the **ton** or by the **square yard**.

406.07 Basis of Payment

- The accepted quantities of tack coat will be paid for at the contract unit price per **ton**, or per **square yard** for asphalt for tack coat, complete in place.

INDIANA DEPARTMENT OF TRANSPORTATION

TYPE A CERTIFICATE OF COMPLIANCE

Lab Certification # 81815

CONTRACT NUMBER: R-29741
PROJECT NUMBER:

CONTRACTOR'S NAME: E & B PAVING
MANUFACTURER'S NAME: K-Tech Specialty Coatings
LOCATION SOURCE CODE 7229
B/L OR INVOICE NUMBER: 12721
MATERIAL DESTINATION: FLUTTER RD.

Tank # 201

This is to certify that for the contract described above, the material supplied are as follows:

MATERIAL NAME	GALLONS
AE-NT	1,176

The material listed above comply with the following Test Methods and are within the acceptable limits of said test method.*

TEST	AASHTO TEST METHOD	LIMITS OF TEST VALUE	ACTUAL TEST RESULTS
Viscosity, SSF, 25°C	T 59	15-100	25.00 sfs
Sieve Test,%, max	T 59	0.3	0.00 %
Penetration, 100g, 5s,	T 49	40 dmm,max	18.00 dmm
Solubility, organic sol	T 44	97.5%	98.76 %
Residue by Dist.	T 59	50% min	51.53 %
Oil Distillate	T 59	4.0% max	0.25 %
Settlement %,max	T 59	5.0% max	4.00 %

August 4, 2015
Date

K-Tech Specialty Coatings
Company of Manufacture

Signature of Company Official/Title

STRAIGHT BILL OF LADING

VKSBRG - Vicksburg
2611 Haining Rd Vicksburg, MS 39183

601-830-8343

BOL/Certificate #: 1483111
Revision Number: 0
Folio Number: 20150916

Start Time: 9/16/2015 4:17:14AM
End Time: 9/16/2015 5:38:45AM

Shipper: ERGON ASPHALT & EMULSIONS, INC.
Customer Number: 841100
Billed To: T.L. WALLACE CONSTRUCTION CO INC
4025 HWY 35 NORTH
COLUMBIA, MS 39429

Reference Number: PS84
Destination: WAYNE COUNTY, MS

Truck-Trailer: 7210
Order Number : A483111
PO#: 211038

Contract Number : N/A
Project Number : WAYNE COUNTY
Residue : 63.6

Tank Code	Certification Number	Specific Gravity
T-315	1592102218	1.0090

				WEIGHT			VOLUME
Product Name	API	Temp	LBS/GAL	Gross	Tare	Net	Net
CSS-1HP	8.0	120.00	8.4470	78840.000	32880.000	45960.000	5441.000

TOTAL	KG	35761.222	14914.117	20847.105
	TONS	39.420	16.440	22.980
	MG (MT)	35.761	14.914	20.847
	BRLS			129.548
	LTRS			20596.426

Emergency Contact - CHEMTREC 1-800-424-9300 Ergon, Inc Contract # 7956

Placard Messages - Emulsified Asphalt Label Codes - None PLACARDS NOT REQUIRED UOM Temp. Corrected to 60F

Certification Messages - This is to certify that the materials provided under this bill of lading shall meet the standards of and were pretested in accord with the Quality Control Plan that Ergon or its affiliates provided to the State and thereby conforms to the Mississippi Department of Transportation specifications. The transport or railroad car was inspected prior to loading and found to contain no contaminating material. The densities and Specific Gravity denoted are typical results. Product densities can vary through the processes of manufacturing, shipping and

Silicone: Yes ☐ No ☐

Last Product Hauled: _____

Received: _____

Driver: Karl

Carrier: EGNT - ERGON TRUCKING

Certified by ERGON REFINING, INC.
Authorized Signature: Amanda Gay

A=Acceptance I=Investigative

LABORATORY NO. _____ Date Rcv'd @ Lab. / /

Name of Pay Item PAVER PLACED SURFACE TREATMENT, TYPE C Pay Item No. 900 . 675

Material Name CRS-1P EMULSION Type ● Mat. Spec. No. 762 . 04

Quantity Rep. 3000 Gallons = 24,000 LBS = 12,329 SY Line Item No. 0180 Date Sampled 09 / 24 / 14

Sample Type: A = [X] = [ ] Where Sampled OUT OF HAUL UNIT (In-Place, Stockpile, Pit, Truck, etc.) — Tank Time 1:56 PM

Sample Source MM 48.33 LT (Location on Project, Plant Name etc.)

Material Source NEW ENGLAND EMULSIONS CORP (Supplier, Producer, Manufacturer etc.)

Project Name BERLIN - MONTPELIER No. IM 89RF(45)

Ident. No. LOT # 143616 (Release, Lot, Cert.) Comparison Sample? [ ] X-Ref No. _____

Sampled by (Print Name) SCHMITT / HARDING

Comments FOR USE ON 13A6316 ONLY (Rebar, Hot-Mix, Admixtures, and/or any other pertinent information)

TA 178A Rev. 5M (04/00)

State Non-Tracking Specifications

- State specifications tend to mirror manufacturer's specifications.
- States generally have an approval process for new products.
- Need to be on Approved Products List.
- Example Virginia:
  - Six approved products
  - Each product's specifications from supplier

Manuals of Practice

- Asphalt Institute
  - MS-4 *The Asphalt Manual, 7th Edition* (2007)
  - MS-16 *Asphalt Pavement Preservation and Maintenance, 4th Edition* (2009)
  - MS-19 *Basic Asphalt Emulsion Manual, 4th Edition* (2008)
  - MS-22 *Construction of Hot Mix Asphalt Pavements, 2nd Edition*
- Comments
  - AI has a long history of promoting the proper use of tack coats.

Manuals of Practice

- QIP-128, *Tack Coat Best Practices*, NAPA (2013)
- *Hot-Mix Asphalt Paving*, US Army Corp of Engineers (2000)
- *Airfield Asphalt Pavement Construction Best Practice Manual*, NCAT (2008)
- *Tack Coat Guidelines,* Caltrans (2009)
- *Tack Coats: How and what to apply!* Colorado Asphalt Pavement Association (CAPA) (2011)
- *Guide for Using Prime and Tack Coats, C*FLHD (2005)
- *Best Practices for Applying Undiluted Emulsified Asphalt Tack Coats,* CAPA (2013)
- ***Tack Coat Best Practices Field Guide 2012*, NCDOT (2012)**

Current Research

- NCHRP 9-40a
- SHRP2
- Arkansas
- Colorado
- Illinois
- Louisiana
- NCAT
- Texas
- Wisconsin
- Oregon
- MnRoads
- International

NCHRP Report 712

- Looked at numerous test methods (shear, tension, torsion)
- Many tack materials
- Four application rates (gsy residual)
  - 0.00
  - 0.031
  - 0.062
  - 0.155
- International survey
- Variety of surfaces both AC and PCC
  - New
  - Old
  - Milled
  - Un-milled
  - Dry
  - Wet
  - Clean
  - Dirty
- Eight test temps.
  - -10—60°C

NCHRP Report 712 Conclusions

- Recommends Shear Testing
- Stiffer based asphalts performed better
- 0.155 gal/yd^2 (application rate) best results for all materials
- Current common rates may be too light
- Milled surfaces performed better
- Very good training appendix
- Application rate recommendations for different surfaces

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

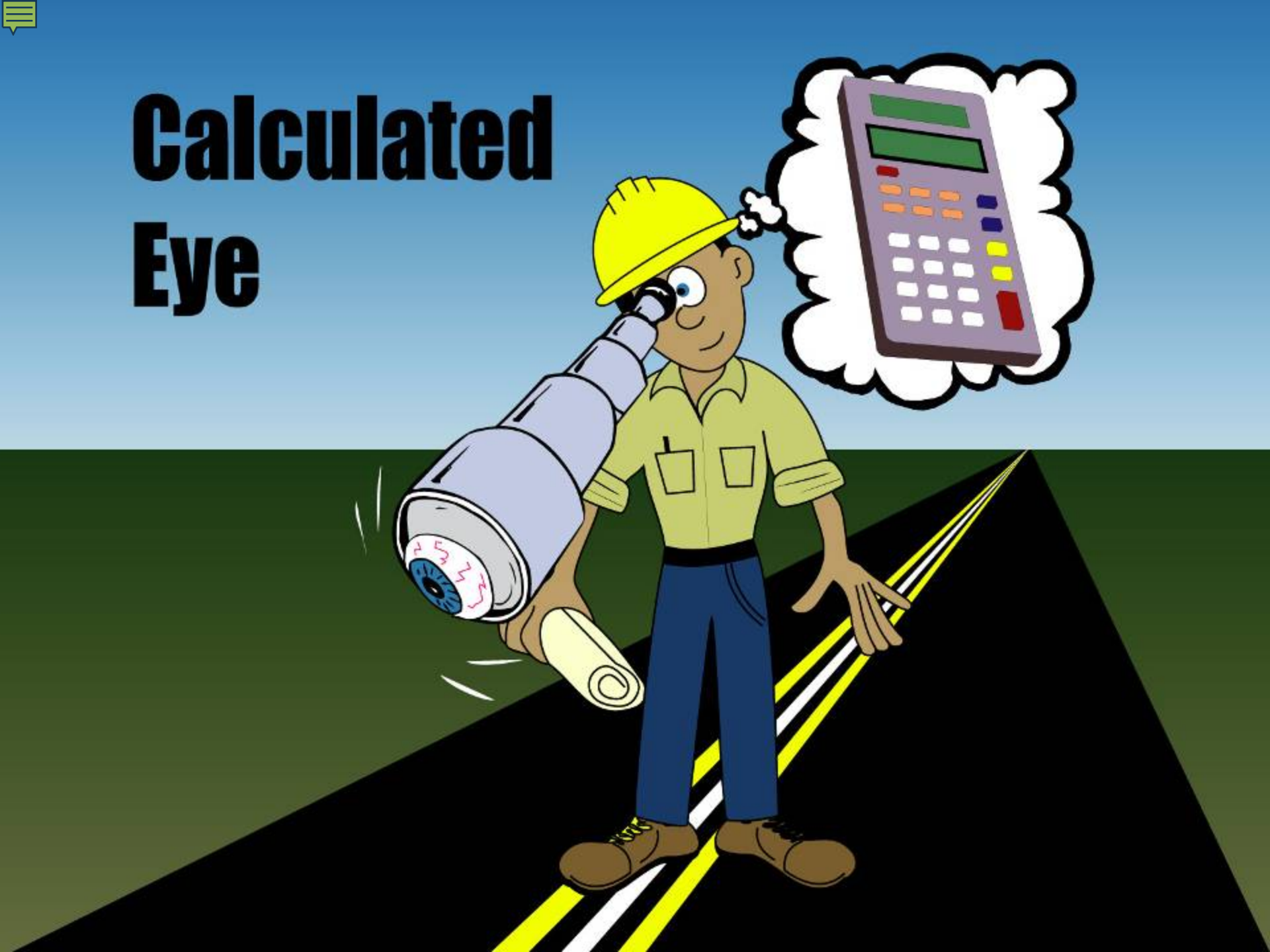
III. • Tack Coat Specifications & Manuals

IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

Application Rate & Temperature


Calculated
Eye

Uniformity of the Tack Coat Application

Non-uniform Application

Proper Application

Residual Asphalt Binder in Emulsion

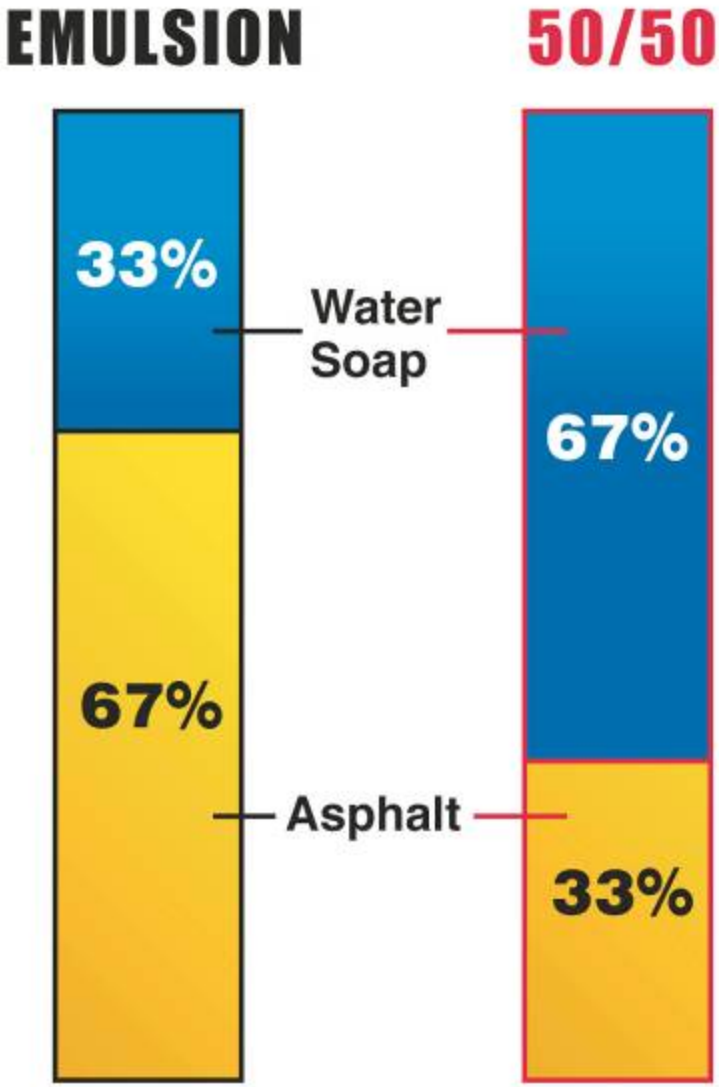
- Slow set tack coat – 67% asphalt + 33% water
- Generally, use this ratio to estimate residual asphalt.
- Residual asphalt is critical: It is the amount of actual asphalt that remains on the pavement after water and solvents have evaporated

Calculation of Application Rate for Emulsion

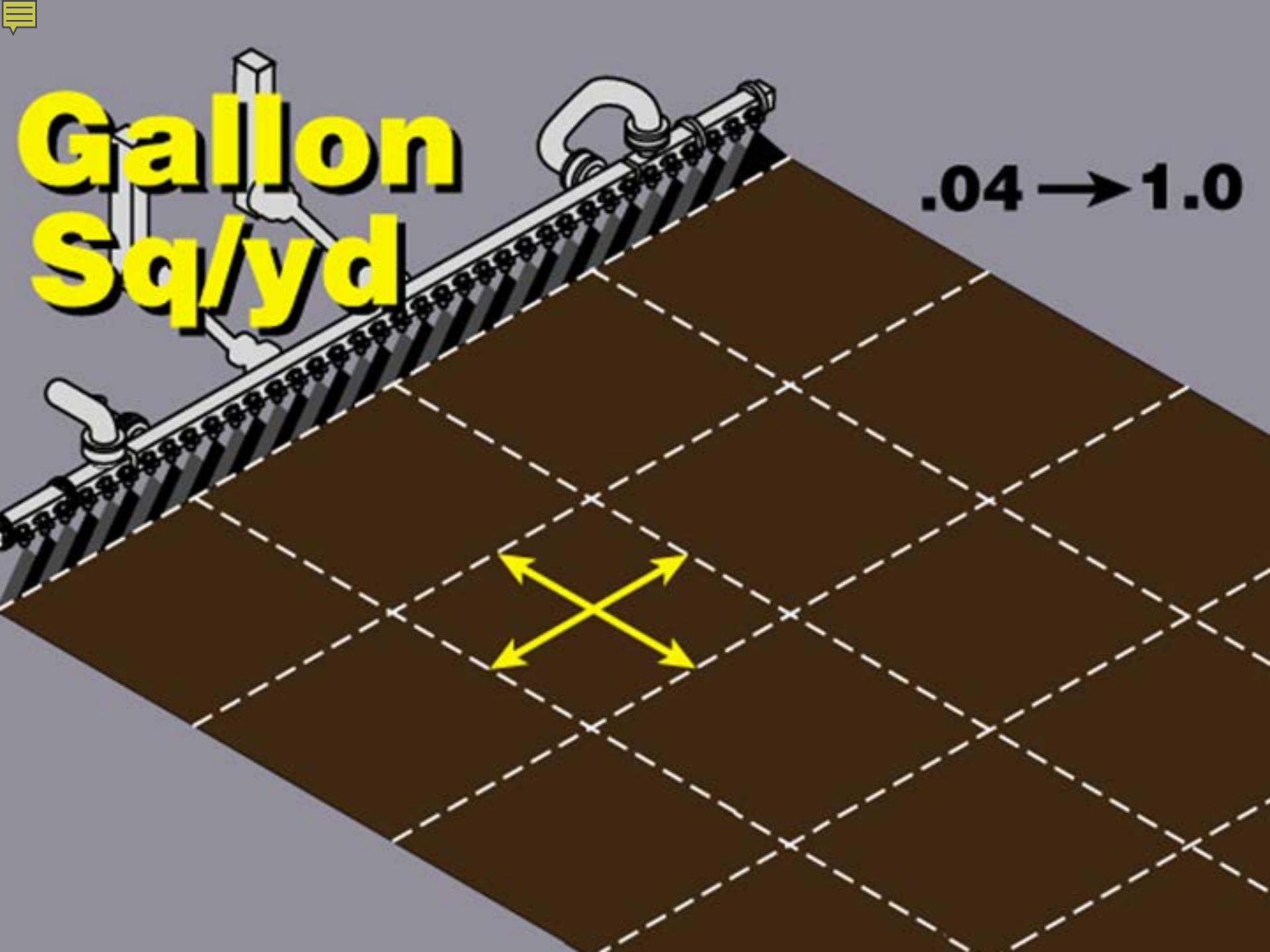
- Based on a ratio of 2/3 asphalt and 1/3 water, the required application amount of asphalt binder in an asphalt emulsion will be 1.5 times greater than the residual amount.
- Application Rate = 1.5 x Desire Residual Asphalt

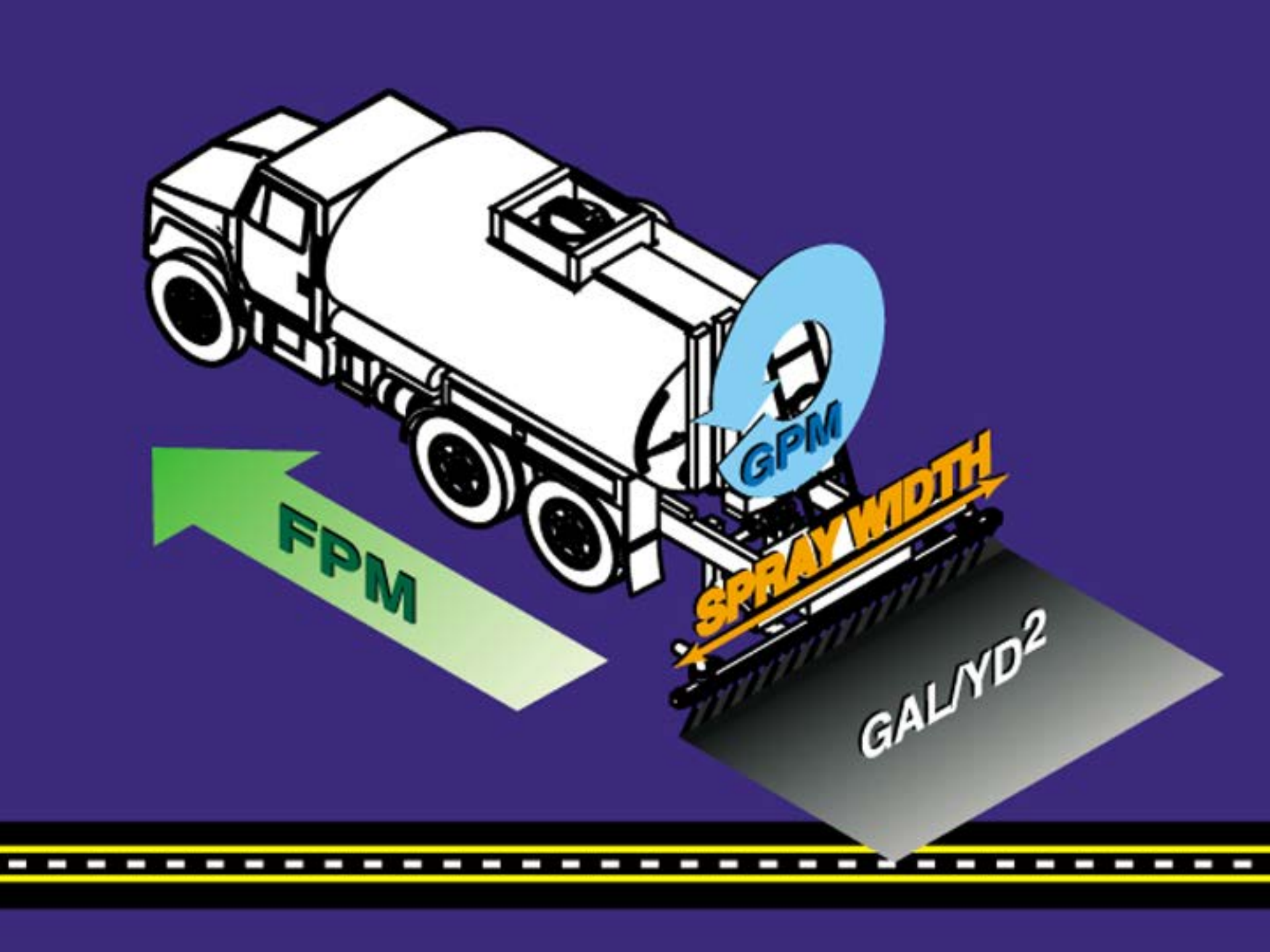
Application Rate for Diluted Emulsion

- Based on a ratio of 1 part asphalt emulsion and 1 part additional water, a diluted asphalt emulsion will have a residual binder content of only 1/3 of the weight of the emulsion
- So, you must apply three times (3x) more diluted emulsion than the desired residual tack coat rate



SHOT RATE		RESIDUAL
0.05	=	0.034
0.075	=	0.05
0.05	=	0.017
0.15	=	0.05


Gallon
Sq/yd
.04 → 1.0

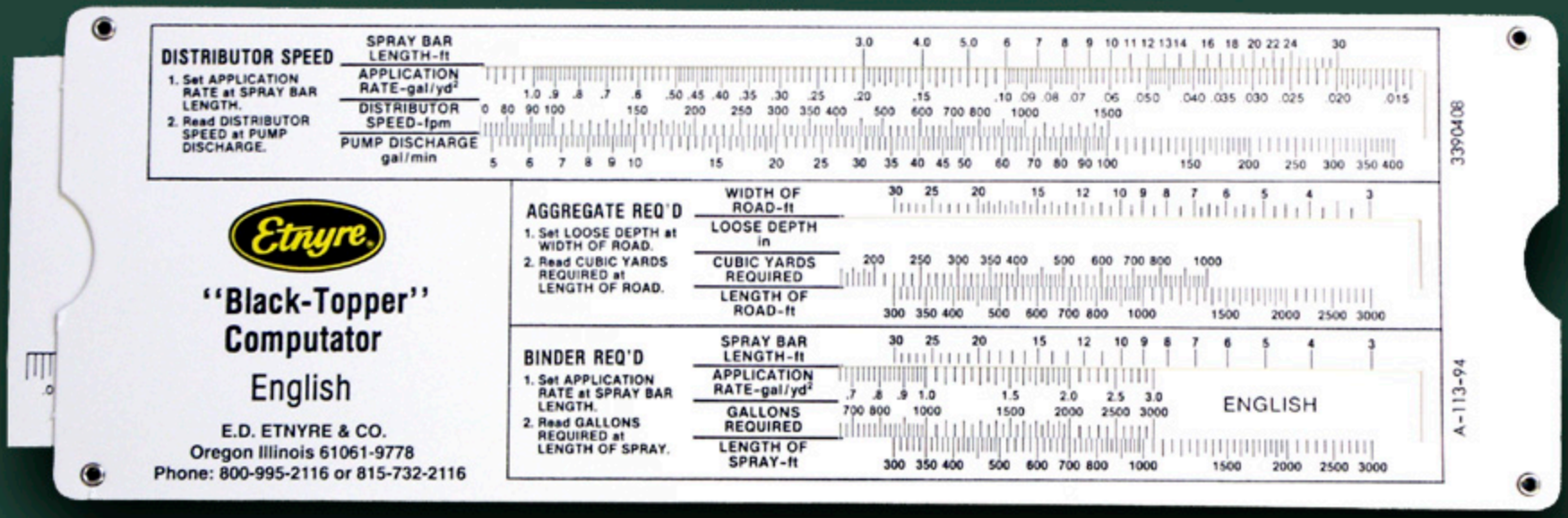

GPM
SPRAY WIDTH
FPM
GAL/YD2

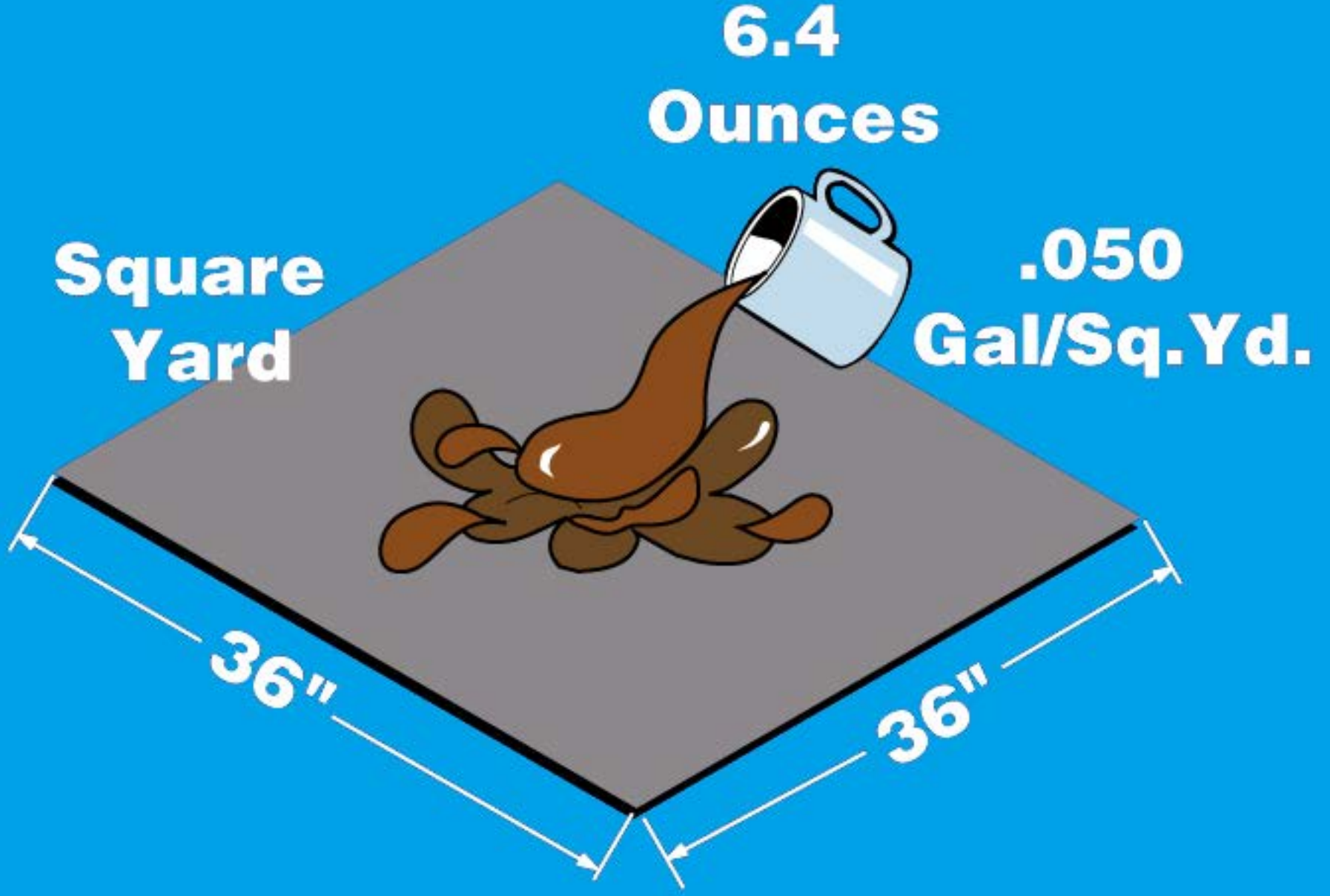

FPM
GPM

Critical Elements in Determining Residual Application Rates

- Dilution rates are critical in determining final **residual** application rates.
- Temperature is important in determining accurate volumetric calculated rates.
  - Higher than 60°F, need to spray more emulsion.
  - Lower than 60°F, need to spray less emulsion.
- Uniform application spreads in distributing tack on the surface of the road.
- Samples of emulsion from the spray bar are only good for estimating dilution rates and residual binder properties.


.300 GAL/YD2
300 FPM
120 GPM
SPRAYBAR
ON
OFF
POWER
ON
OFF
CIRCULATION RATE
CHANGE DISPLAY
MEMORY
1
2
3
4
5
RESET FEET METRES
RESET GALLONS LITRES
APPLICATION RATE
HYD OIL
TEMP
BAR
CENTERED
MAIN BAR
4 3 2 1 1 2 3 4
PTO
LOW TANK LEVEL
LEFT WING
RIGHT WING
MARKER
12 11 10 9 8 7 6 5 5 6 7 8 9 10 11 12
MARKER
WING FOLD
FRONT
REAR
SUCTION
LIFT
IN BAR
LOAD
SUCK BACK
OFF
BAR LATCH
SUCKBACK
LOW
HYD MOTOR

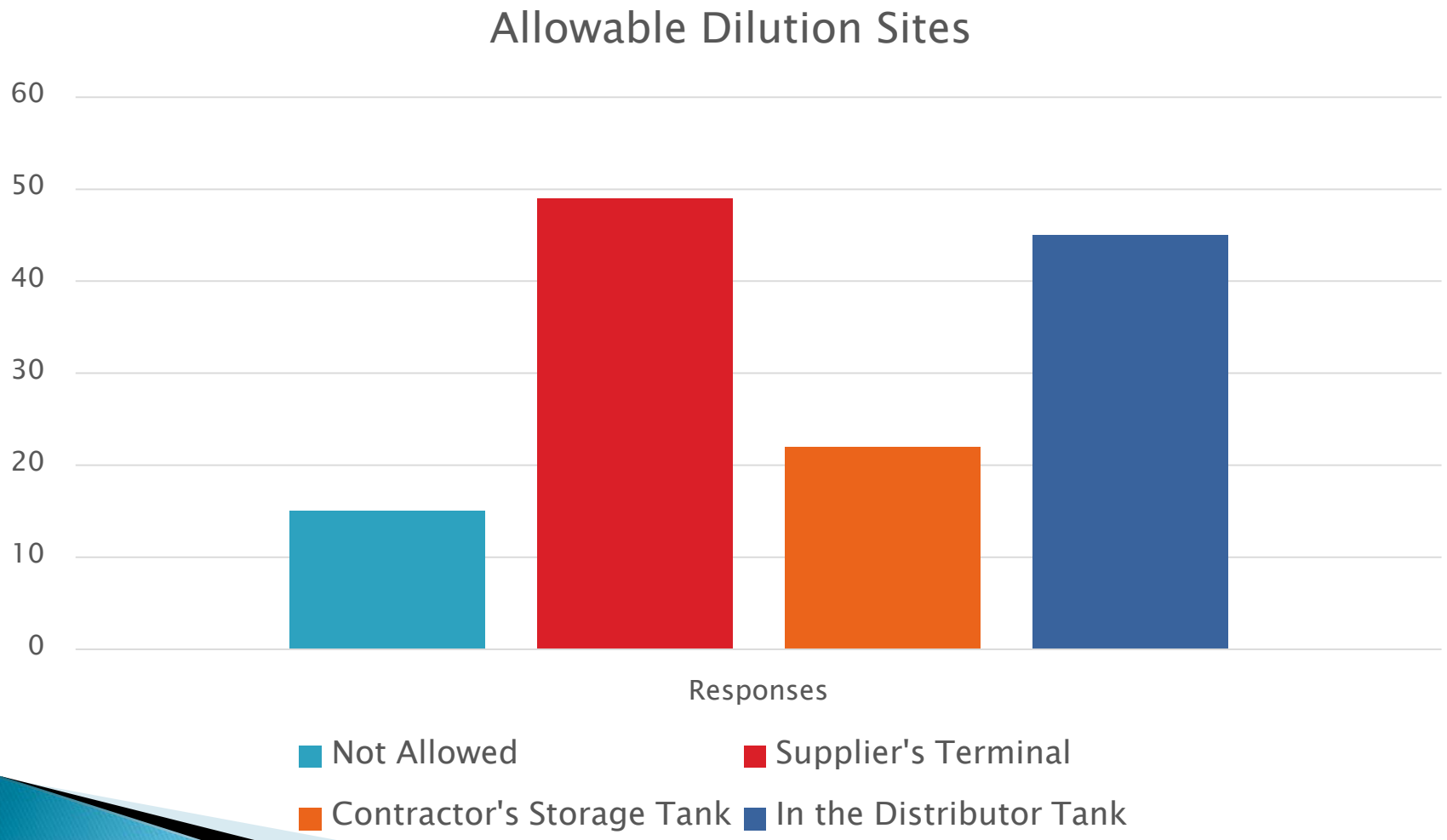

DISTRIBUTOR SPEED
1. Set APPLICATION RATE at SPRAY BAR LENGTH.
2. Read DISTRIBUTOR SPEED at PUMP DISCHARGE.
SPRAY BAR LENGTH-ft
APPLICATION RATE-gal/yd²
DISTRIBUTOR SPEED-fpm
PUMP DISCHARGE gal/min
AGGREGATE REQ'D
1. Set LOOSE DEPTH at WIDTH OF ROAD.
2. Read CUBIC YARDS REQUIRED at LENGTH OF ROAD.
WIDTH OF ROAD-ft
LOOSE DEPTH in
CUBIC YARDS REQUIRED
LENGTH OF ROAD-ft
BINDER REQ'D
1. Set APPLICATION RATE at SPRAY BAR LENGTH.
2. Read GALLONS REQUIRED at LENGTH OF SPRAY.
SPRAY BAR LENGTH-ft
APPLICATION RATE-gal/yd²
GALLONS REQUIRED
LENGTH OF SPRAY-ft
ENGLISH
3390408
A-113-94
Etnyre
"Black-Topper" Computator
English
E.D. ETNYRE & CO.
Oregon Illinois 61061-9778
Phone: 800-995-2116 or 815-732-2116


6.4
Ounces
Square
Yard
.050
Gal/Sq.Yd.
36"
36"

Application Calculations

- Workshop Exercises

Dilution Allowance Information (NCHRP Report 712)



Correcting for temperature

- Asphalt and water expands and contracts when temperatures deviate from 60°F.
- As temperatures rise above 60°F expansion occurs and the resulting density (#/gal.) decreases.
- As temperatures cool below 60°F contraction occurs and the density increases.
- A Temperature-Volume correction table for asphalt emulsion is available in MS-19, page 91.

Table 13. Temperature - volume corrections for asphalt emulsions [6].

°C	°F	M	°C	°F	M	°C	°F	M
10.0	50	1.0025	35.0	95	0.9912	60.0	140	0.9800
10.6	51	1.0022	35.6	96	0.9910	60.6	141	0.9797
11.1	52	1.0020	36.1	97	0.9907	61.1	142	0.9795
11.7	53	1.0017	36.7	98	0.9905	61.7	143	0.9792
12.2	54	1.0015	37.2	99	0.9902	62.2	144	0.9790
12.8	55	1.0012	37.8	100	0.9900	62.8	145	0.9787
13.3	56							0.9785
13.9	57							0.9782
14.4	58	1.0005	39.4	103	0.9892	64.4	148	0.9780
15.0	59							0.9777
15.6	60							0.9775
16.1	61	0.9997	41.1	106	0.9885	66.1	151	0.9772
16.7	62	0.9995	41.7	107	0.9882	66.7	152	0.9770
17.2	63	0.9992	42.2	108	0.9880	67.2	153	0.9767
17.8	64	0.9990	42.8	109	0.9877	67.8	154	0.9765
18.3	65	0.9987	43.3	110	0.9875	68.3	155	0.9762
18.9	66	0.9985	43.9	111	0.9872	68.9	156	0.9760
19.4	67	0.9982	44.4	112	0.9870	69.4	157	0.9757
20.0	68	0.9980	45.0	113	0.9867	70.0	158	0.9755
20.6	69	0.9977	45.6	114	0.9865	70.6	159	0.9752
21.1	70	0.9975	46.1	115	0.9862	71.1	160	0.9750

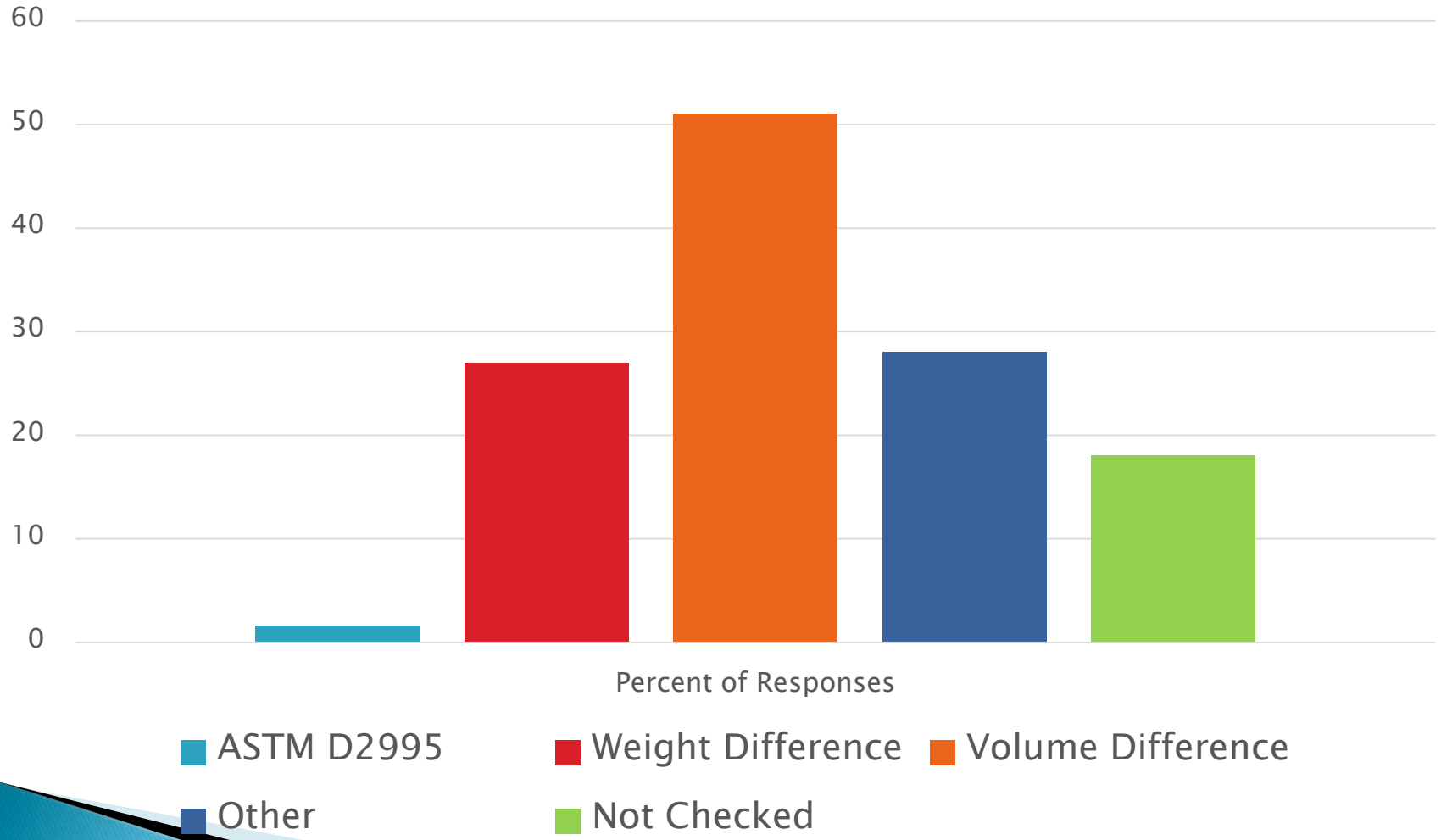
$$Volume_{@\,°\mathrm{F}} \times M_{value} = 60°\mathrm{F}\,Vol.$$

$$Volume_{@\,°\mathrm{C}} \times M_{value} = 15.6°\mathrm{C}\,Vol.$$

Calculating field application rates

- There are three primary methods of determining field application rates.
  - Determination by volume.
  - Determination by weight or mass.
  - Determination by direct measurement, ASTM D2995

Application Verification (NCHRP Report 712)



Calculating rates by Volume

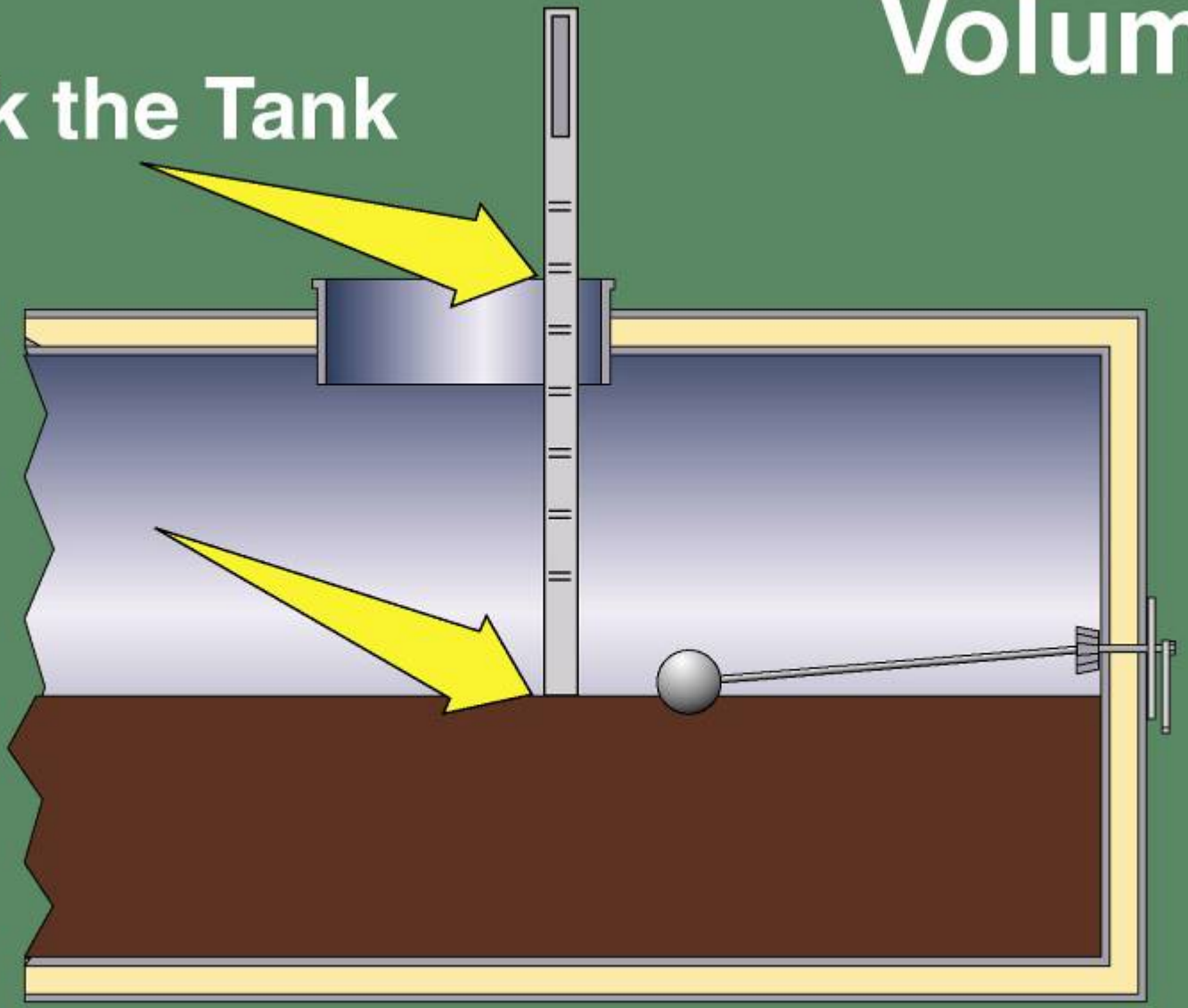
- The rate of material applied is calculated by determining the volume of material distributed. Either by:
  - By observation and recordation of an onboard volume meter or gauge.
  - Or, Using a tank stick method where the depth of material is measured in the tank and the volume is calculated or by the use of a pre-calibrated stick.

Dipstick Method

- Measure Asphalt Volume in Truck
- Record Asphalt Temperature
- Spray Tack Coat Over a Known Area
- Measure Asphalt Volume in Truck
- Correct Volume for Temperature Variation from 60°F

Volume

Stick the Tank



Before checking your volume by sticking the tank , make sure Distributor is level

Dipstick Equation:

$$\frac{9 \times Gallons\ App}{\underset{\text{(feet)}}{Width} \times \underset{\text{(feet)}}{Leng}}$$

Note: 9 to convert from square feet to square yards. Use as required.

Calculating rates by Volume

- When using a tank volume method for determining the quantity of material distributed, the temperature **must** be determined and the volume of material corrected to 60°F.

- Lets work an

Example Problem

Determining Residual Application Rates

- For the following examples we will assume we are using SS-1h or CSS-1h which have a minimum AASHTO (M140 and M 208 resp.) specified minimum residual asphalt content of 57%.
- Specifying a 60°F undiluted emulsion rate, will yield the following in-place residual asphalt content in gallons per square yard (gsy).

Exercise: Calculating rates by Volume

- Volume at start of Application 1875 gal.
- Volume at end of run 1250 gal.
- Temperature of material 160°F
- Temperature Correction Factor 0.97500
- Beginning Station 35+00
- Ending Station 56+00
- Distributor width 14 Ft.
- SS-1h Emulsion is diluted 1:1

Calculate the residual application rate

Calculating rates by Volume Solution

- Distance travelled:
- Area sprayed:
- Hot Gallons sprayed:
- Temp. Correction factor from Chart:
- 60°F gallons:

Calculating rates by Volume Solution

- 609 diluted gallons!
- Diluted 1:1 the actual emulsion is:
  609 gal / 2 =
- Final rate: 304.5 gal/ 3267 sq. yd. =
- SS-1h Residual rate: 0.0938 gsy x 0.57 =

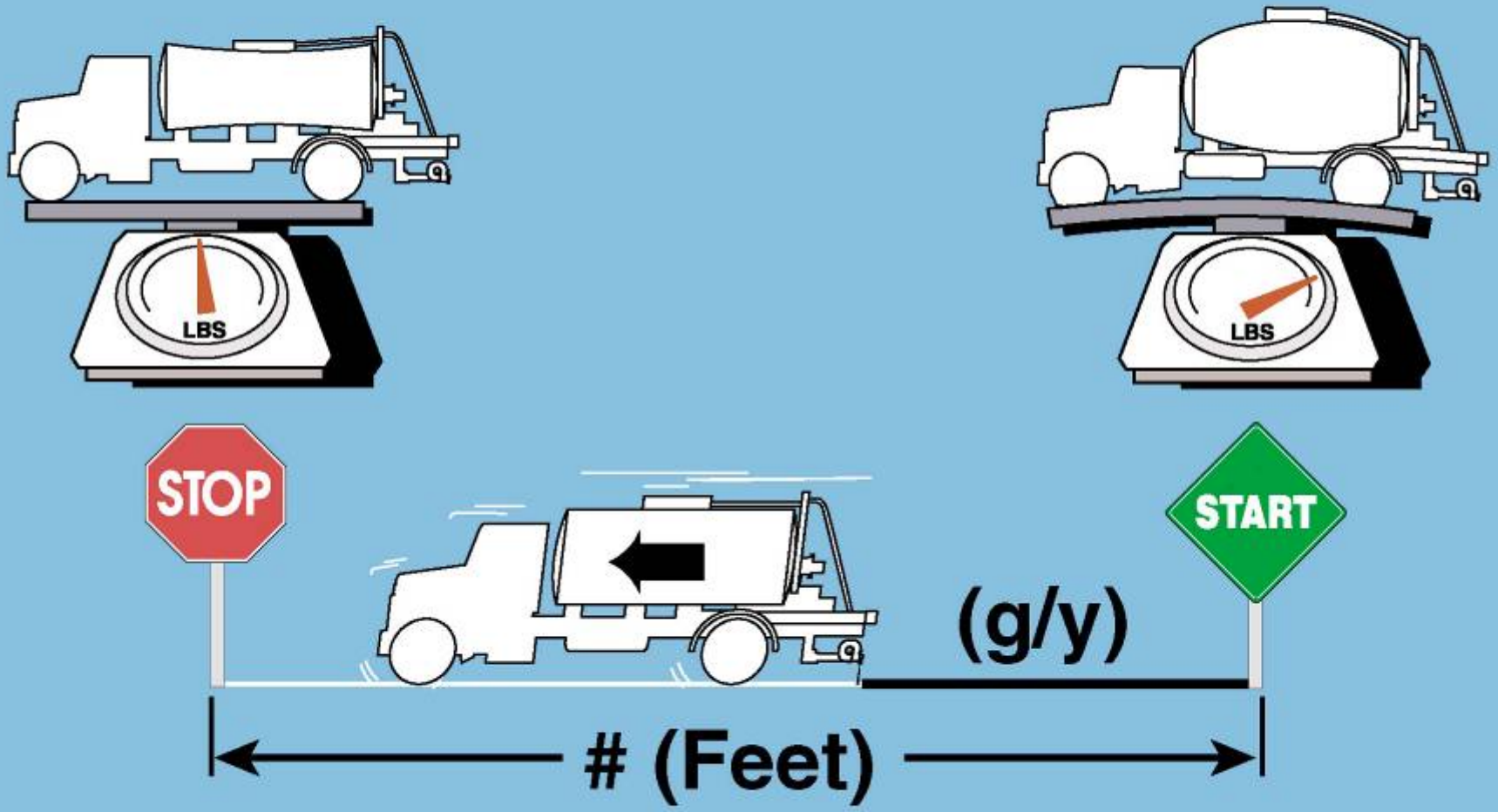
Comments on Calculating by Volume

- Pros:
  - Quick
  - Simple
  - Accuracy improves with larger areas
- Cons:
  - Volume requires
    - Dip Stick, or
    - Volumeter
  - Dilution rate vital
  - Temperature correction required
  - Inaccurate on small areas

Calculating rates by Weight (Mass)

- Calculating an application rate by weight is the most accurate method.
- Bill of lading from the supplier should contain a 60°F wt. per gallon.
- Weight measurements are not affected by temperature.
- However constant weighing after each shot can be complicated.
- Recommend using this method for full load applications, calibration, etc.

Weight



Exercise: Calculating rates by Weight (Mass)

- Plans specify CSS-1h (57% residue)
- Tare Weight of empty distributor = 26,000 lbs.
- Loaded weight of distributor (1:1) = 54,000 lbs.
- Bill of lading shows a 60°F density of 8.350 #/gal
- Application width = 15 feet
- Application length = 3 miles

Calculate the residual application rate in lbs/yd^2

Calculating rates by Weight (Mass) Solution

- Step 1: Determine pounds of diluted emulsion applied. Beginning weight – ending weight

  54,000# – 26,000# =

- Step 2: Account for dilution if present. For our problem, 1:1 dilution of Original Emulsion and Water

  ∴ 28,000#/2 =

- Step 3: Calculate residual asphalt weight. 57% residue in Original Emulsion

  14,000# X 0.57 =

Calculating rates by Weight (Mass) Solution

- Step 4: Calculate application area. Length X Width

  (3 mi. X 5,280 ft./mi.) X 15 ft. =

- Step 5: Convert to square yards.

  237,600 $ft.^2$ ÷ 9 $ft.^2/yd.^2$ =

- Step 6: Calculate Residual Asphalt application rate.
  Mass Applied ÷ Area Applied

  7,980# ÷ 26,400 $yd.^2$ =

Calculating rates by Weight (Mass) Solution

NOTE: If one wanted to know the residual application in gal./yd.^{2} use 8.350 #/gal from the Bill of Lading.

- 0.30 #/yd.^{2} ÷ 8.350 #/gal =

Comments on Calculating by Mass

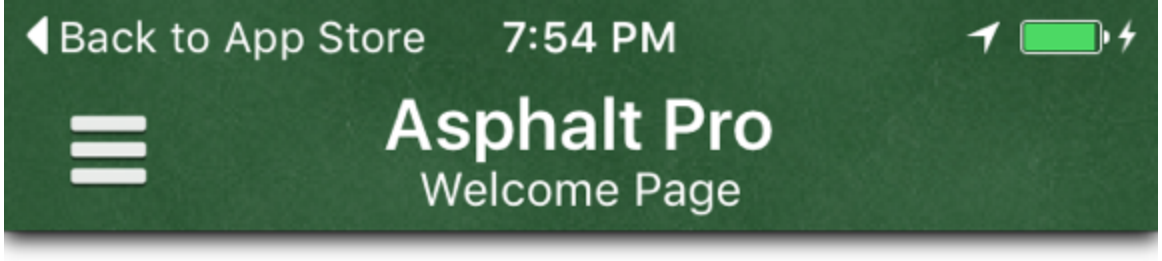
- Pros:
  - Quick
  - Simple
  - Temperature correction not needed
  - Accuracy improves with larger areas
- Cons:
  - Dilution rate vital
  - Inaccurate on small and irregular areas

v 0.3 **OKLAHOMA DEPARTMENT OF TRANSPORTATION**

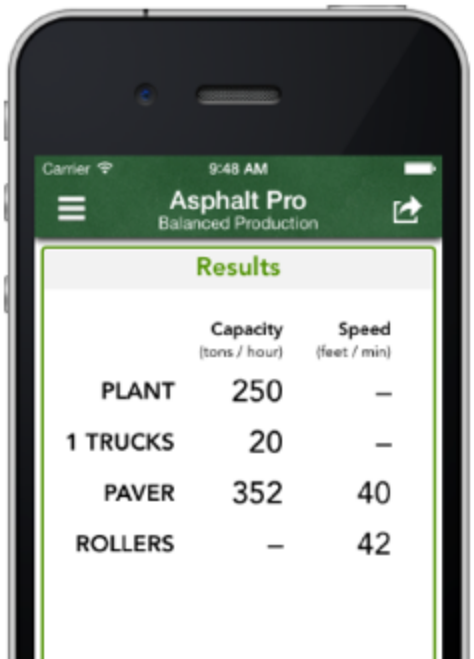
Shot Record

Lab	Lab					%Shot	50.0%
Project No.	876555	J.P. No.	123	%Residual	60.9%	Binder Tpe	Emulsion
Contractor	Dietz	Contract	90000	Specific Gravity	1.0091	Use Type	Tack Coat
P/S Name	Ergon @ Ardmore	P/S code	SS-1 (P/S m00324)	Spec. Rate Gal/SY	0.150	Spec. Type	Raw/Original

DATE	BEGINNING STATION	ENDING STATION	Ft. LENGTH	Ft. WIDTH	SQUARE YARDS	GAL. START	GAL. STOP	GAL. SHOT	OIL (F) TEMP	TEMP. CORR.	CORR. GAL.	GAL. @ 50%	RESIDUAL GAL.	ACC. GAL.	Diluted Gal/SY	Raw Gal/SY	Residual Gal/SY	Lane or Comments
3/12/2015	**35+00.00**	**56+00.00**	2100.00	**14**	3,266.67	**1875**	**1250**	625.00	**160**	**0.97500**	609.38	304.69	185.56	304.69	0.187	0.093	0.057	
2/22/2015	144+75.00	118+50.00	2625.00	12	3,500.00	1319	850	469.00	160	0.97500	457.28	228.64	139.24	228.64	0.131	0.065	0.040	Lt.
2/22/2015	144+75.00	118+50.00	2625.00	12	3,500.00	1319	778	541.00	160	0.97500	527.48	263.74	160.62	492.38	0.151	0.075	0.046	Rt.
3/9/2015	12+25.00	10+60.00	165.00	14.33	262.72	1350	1320	30.00	160	0.97500	29.25	14.63	8.91	507.01	0.111	0.056	0.034	CL
3/9/2015	10+60.00	60+67.00	5007.00	8	4,450.67	1500	900	600.00	160	0.97500	585.00	292.50	178.13	799.51	0.131	0.066	0.040	Lt. Shldr.



Asphalt Pro includes calculators specifically designed to match your workflow in the field



- Mix Yield
- Balanced Production
- Tack
- Seal
- Project Docs
- Cost Estimator

Direct Measurement using ASTM D2995

- Standard Practice for Estimating Application Rate of Bituminous Distributors

Direct Measurement using 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 using ASTM D2995

- Method A—Weighing Pads
  - Pre-weigh pads
  - Secure pads to surface
  - Apply tack coat
  - Reweigh pads
  - Calculate application rate

Photo courtesy of
Dr. Louay Mohammad

Photo courtesy of
Dr. Louay Mohammad

Direct Measurement using 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

Photo courtesy of TxDOT, Maintenance Division

Inconsistent Application

Location	Application Rate	Residual Rate
Left Wheel Path	0.075	0.051
Center of Lane	0.047	0.032

Photo courtesy of MoDOT

Comments on Calculating by ASTM D2995

- Pros:
  - Quick
  - Simple
  - Temperature correction not needed
  - Allows for randomized testing
  - Measures across the bar
- Cons:
  - Dilution rate vital
  - More labor intensive than other options
  - Potential evaporation between application of emulsion and reweighing of pads

Time for a quick Break?

15 Minute Break

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

III. • Tack Coat Specifications & Manuals

IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

V. Testing & Best Practices

- Materials
  - Emulsion
  - Paving grade asphalt
- Calibration of Distributor Truck
- Field/Laboratory Bond Testing
  - Shear Testing
  - Torsion Testing
  - Pull-Off Testing (tension)
  - Cyclic

Typical Emulsion Tests

- Viscosity, Saybolt Furol @ 77°F
- Sieve Test, %
- Storage Stability, 24 hrs, %
- Unit Weight @ 77°F, lbs/gal
- Residue by distillation to XX°F (Note: states commonly choose 300-400°F)
- Pen @ 77°F on Residue, 0.1 mm
- Ductility @ 77°F on Residue, cm
- Solubility on Residue, %

Truck Calibration

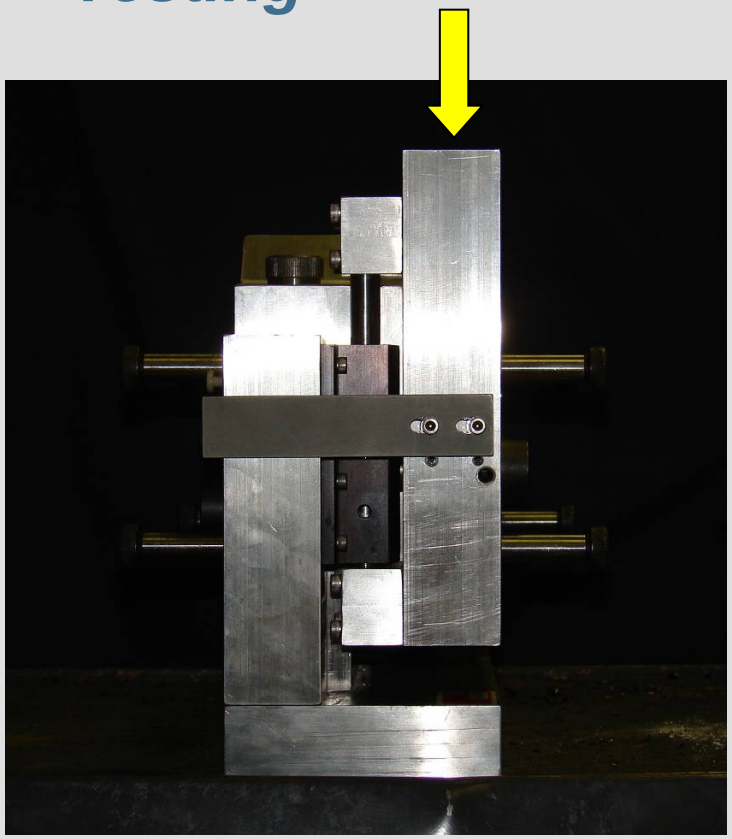
- Compare computer value to measured value.
  - Volume
  - Mass
  - ASTM D2995

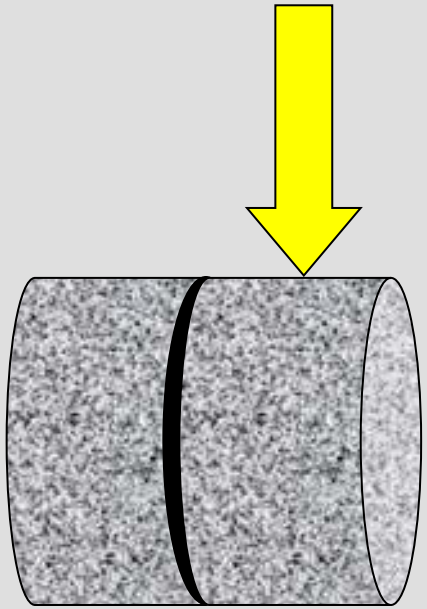
Shear Testing

- Common for Product Approval
- Various State Methods
- AASHTO TP 114-15:
  - Louisiana Interlayer Shear Strength Tester (LISST)
  - 4 or 6-inch (100 or 150 mm) cores or lab specimens
  - 0.1 in/min. (2.54 mm/min) vertical movement
  - 77°F (25°C) test temperature
  - Optional 30 psi (206.84 kPa) normal pressure
  - Record peak load (P_{ult})
  - Interlayer Shear Strength (ISS) in psi or Pa

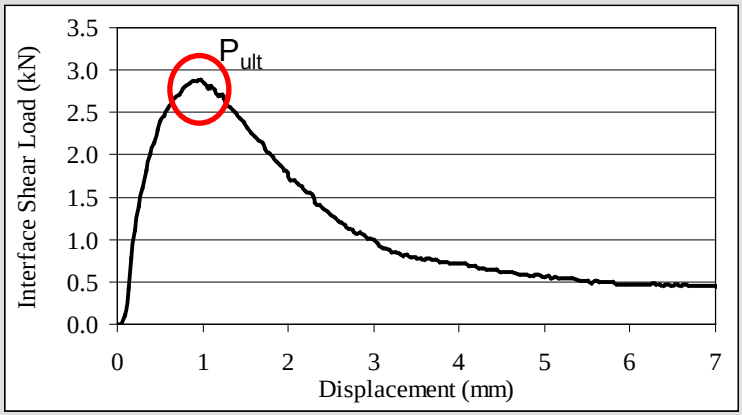
$$ISS = \frac{P_{ult}}{Area}$$

Louisiana Interlayer Shear Strength Tester (LISST) Testing



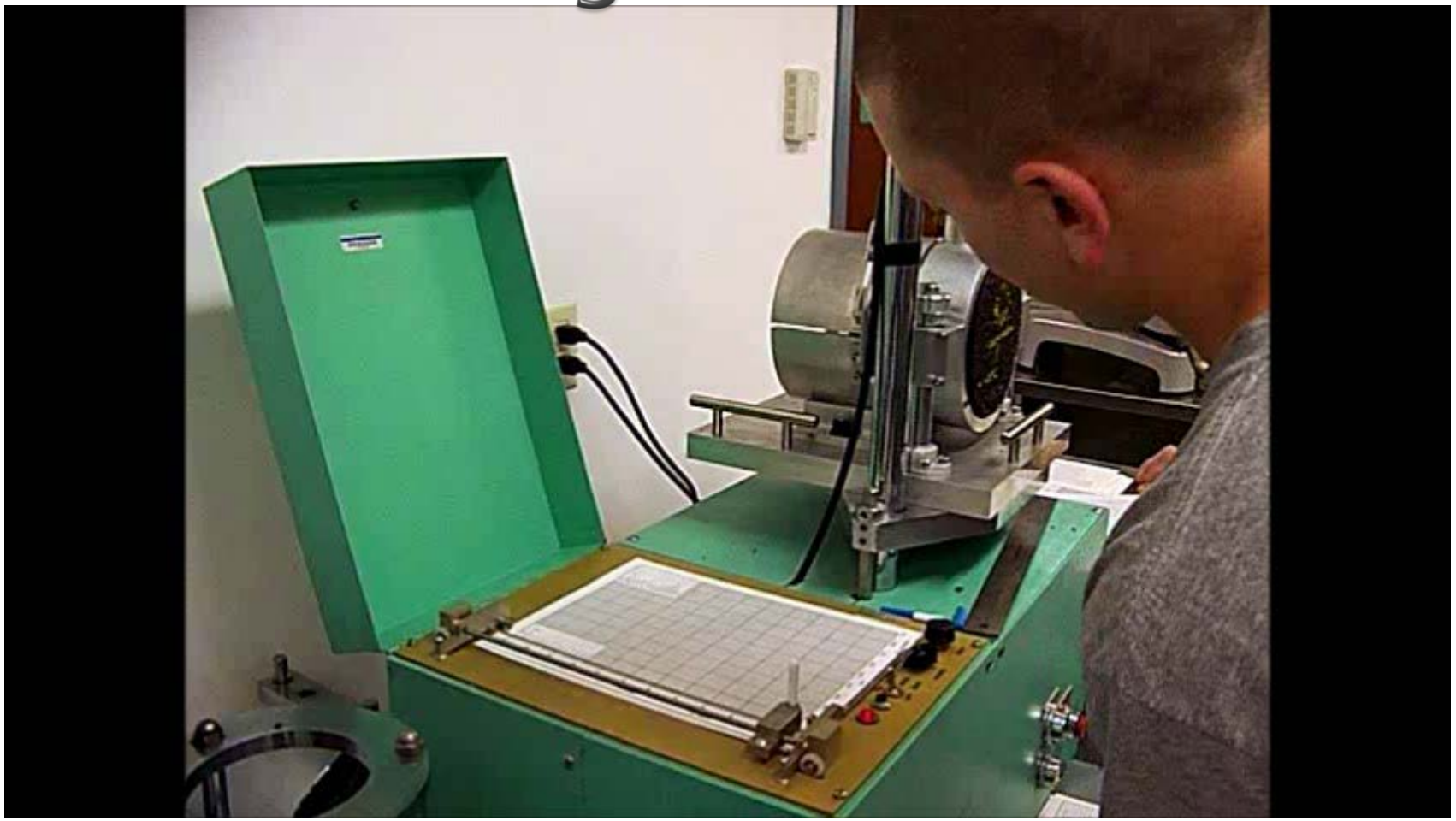


- **Loading rate**
  2.54 mm (0.1 in.) per minute.
- **Interface Shear Strength**
  - **–ISS**
  - **–% CV < 15%**



Courtesy of Dr. Louay Mohammad

Shear Testing



WVDOT Video

Torsion Example

- Developed in Sweden
- Commonly used in the United Kingdom
- Known as the “Torque Bond Test”
- Manual and automated versions
- Is being used for product approval in US
- Field or laboratory test
- Various configurations

Tension Testing

- Most typically a field test
- May be a modified ACI-503R or
- Direct Tensile Bond Test: ASTM C-1583
- Procedures identified in Texas, Kansas, and Virginia
- AASHTO TP 115-15
  - Quality of Tack Coat Adhesion to the Surface of an Asphalt Pavement in the Field or Laboratory

Kansas devise

Tension Testing

- AASHTO 115 Example:
  - Lab or Field Test
  - Louisiana Tack Coat Quality Tester
  - 6-inch Specimen (Lab) or Area (Field)
  - 3-minute 20# (89 N) compressive load.
  - Pull rate of 0.008 in/sec (0.02 mm/sec)
  - Record Ultimate Tensile Load (P_{ult})
  - Tack Coat Adhesion Quality (TCQ) in psi or Pa

$$TCQ = \frac{P_{ult}}{Area}$$

Characterization of Tack Coat Quality -- AASHTO TP 115
Louisiana Tack Coat Quality Tester -- LTCQT

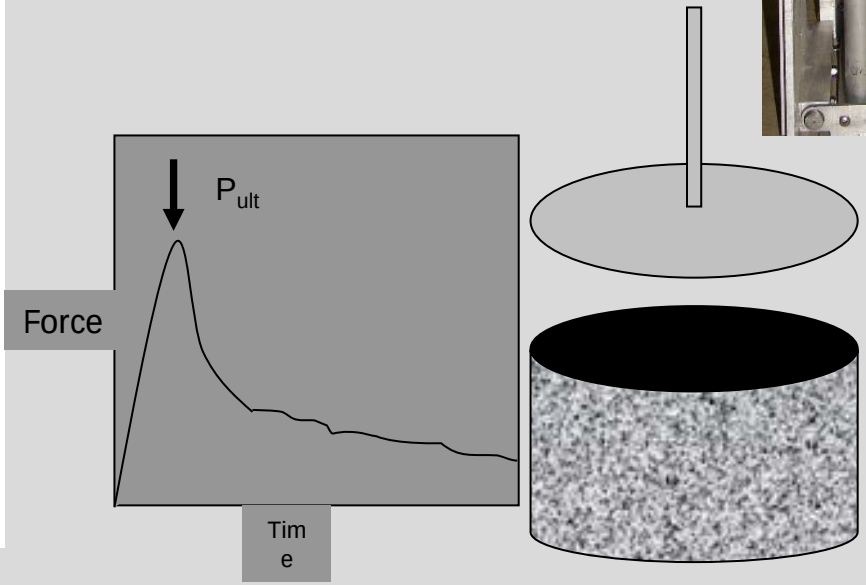
Proposed Standard Method of Test for

DETERMINING THE TACK COAT QUALITY OF ASPHALT PAVEMENT IN THE FIELD OR LABORATORY

AASHTO Designation: **TP 115`**

Proposed test method under review before submitting to AASHTO Subcommittee on Materials

American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001



Courtesy of Dr. Louay Mohammad

Cyclic Loading Testing

- Repeated Load Test
- Shear, Tension, and Torsion Options
- Example: Composite Specimen Interface Cracking (CSIC) Test
  - Developed in Florida
  - Tension Test
  - Monotonic or Cyclic Procedures

CSIC

- Cyclic Methodology
  - Prepare Specimens
  - One Second Cycles
    - Load to chosen peak load
    - Remove load
    - Rest
    - Repeat
  - Calculate Cycles to Failure
  - Calculate Crack Propagation Rate

Comments on Testing Options

- Shear Testing
  - Lab test
  - Quick
  - Repeatable
  - Most widely promoted
  - Uses common lab equipment
  - Cleanly ranks materials
- Torsional Testing
  - Lab or field test
  - Quick
  - Poorer repeatability (manually ran)
- Tension Testing
  - Lab or field test
  - Quick
  - Repeatable
  - Cleanly ranks materials
  - Used in Texas, Kansas, and Virginia
- Cyclic Testing
  - Lab test
  - More time consuming
  - Repeatable
  - Cleanly ranks materials

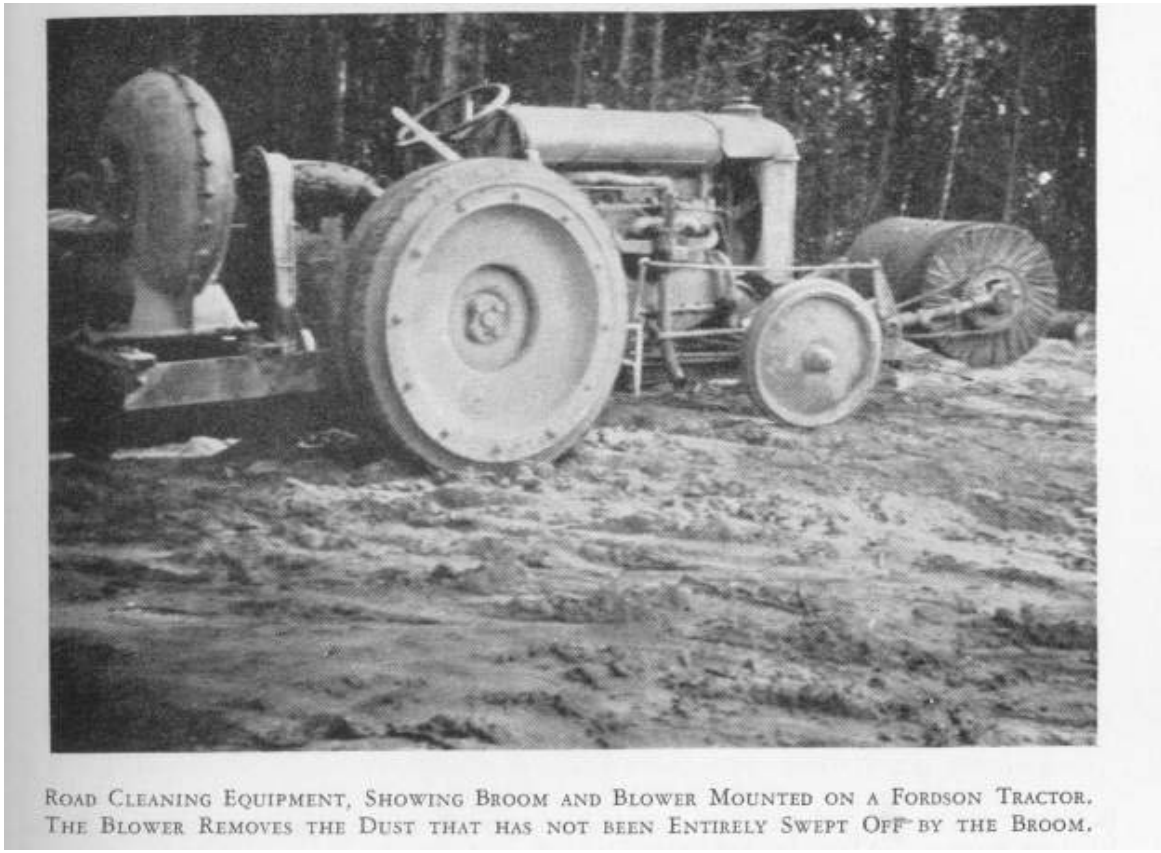
Comments on Testing Options

- Testing Method has a Huge Effect on Rankings
  - Shear/Torsion vs. Tension/Cyclic
  - Stiffer vs. Softer Materials

Confused?

Best Practices

- Surfaces need to be clean and dry
- Uniform application
- Tack all surfaces
  - Horizontal
  - Vertical



Road Cleaning Equipment, Showing Broom and Blower Mounted on a Fordson Tractor. The Blower Removes the Dust that has not been Entirely Swept Off by the Broom.

Surface Preparation

- Milling
  - Improves profile
  - Typically improves bonding characteristics
  - Increases cleaning effort
  - Adds cost
- Surface Sweeping
- Visually Verify Moisture Free

Delamination on Milled Surface

Best Practices

- Match application to conditions.
  - Materials
  - Residual rate
- Verify application rate.
- Resist tacking too far ahead of paver.


ROSCO
Maximizer 3
Light Application
Dirty Surface
No Tack
Longitudinal Joint Tacked

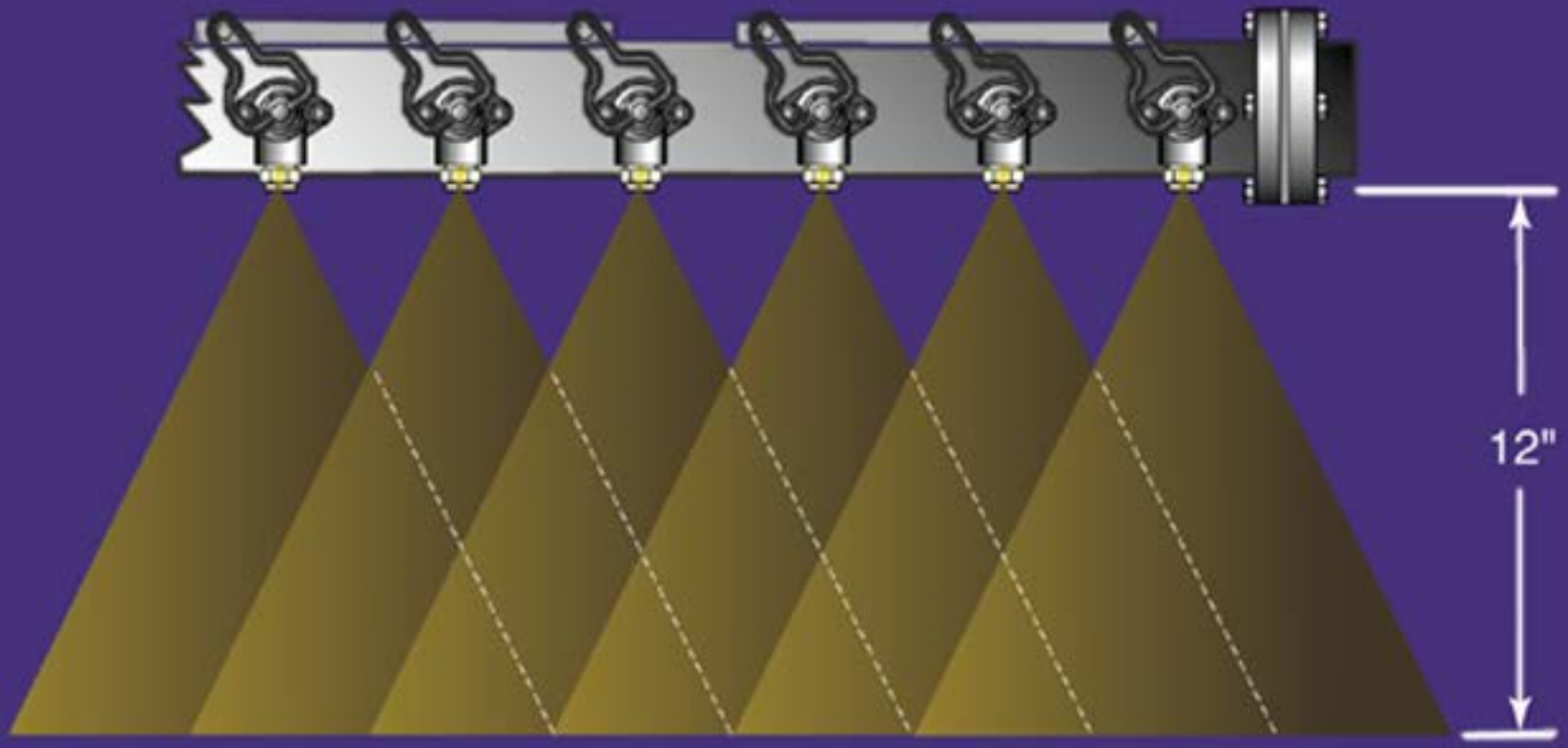
Distributor Truck Setup

Distributor Truck Setup

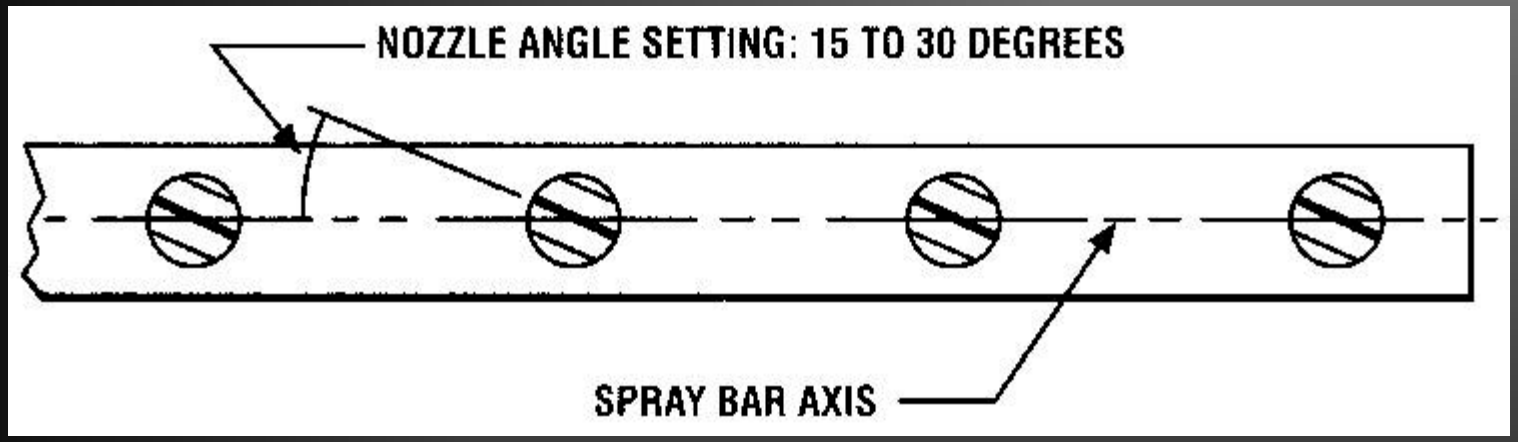
- Liquid temperature
  - Monitor and Match to material
- Calibrate distributor truck
  - Spray bar height
  - Spray bar pressure
  - Nozzle angle
  - Nozzle selection
  - Thermometers
  - Volumeter


SPRAY BAR

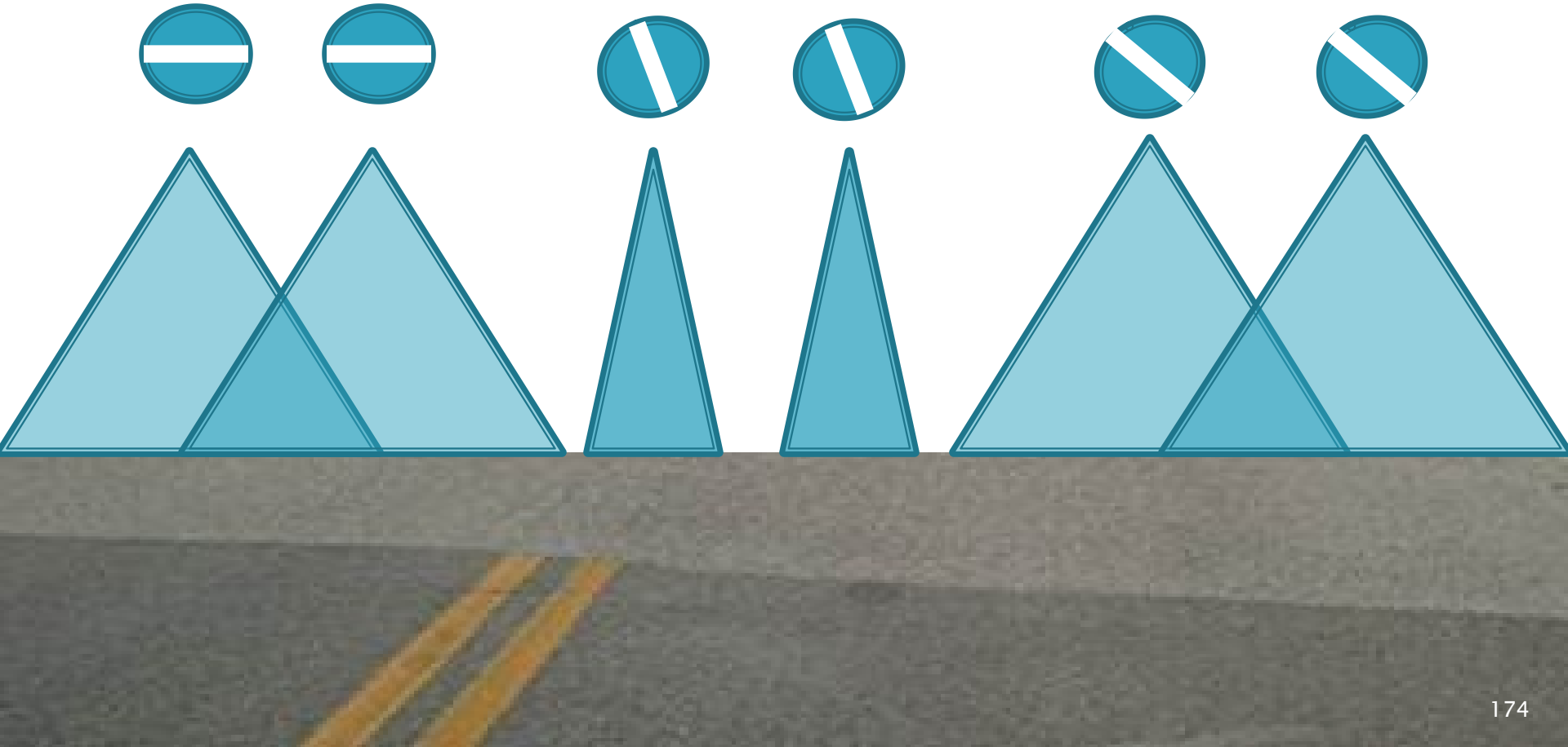
Triple Lap Coverage



Spray Bar/Nozzles



Effect of Nozzle Orientation



Nozzle Selection

Nozzle Selection

- Consult with distributor truck manufacturer to match the material to the nozzle.
- ONE SIZE DOES NOT FIT ALL

Etnyre Spraybar Nozzles

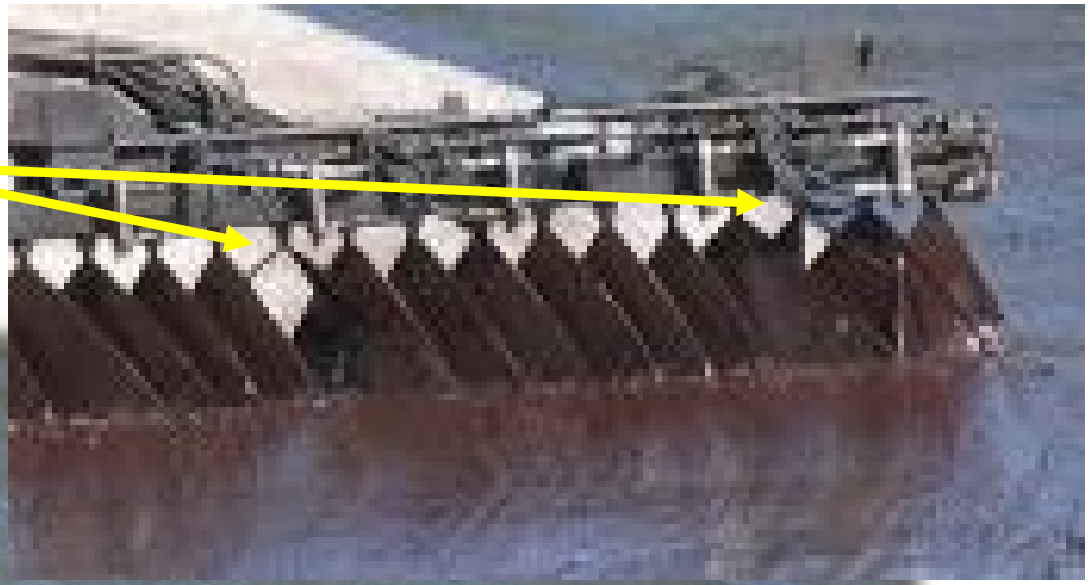
1 2 3 4 5 6 7 8 9 10

3353788 3351008 3351009 3352368 3351015 3352204 3352205 3352210 3351014 3351010

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

* Recommended nozzles for seal and chip with emulsified asphalts.

Nozzles are clogged, but triple overlap covering the gap.



Note: not a tack coat, but principle applies.

Cleaning Distributor Tank

- Critical when changing from one product to another (**see handout**)
- Significant safety hazard can occur
- Product quality can be affected
- Best Practice is to empty the tank and clean if necessary.

Key Items for Inspectors

- Check truck setup.
  - Spray bar height (~12”)
  - Appropriate nozzles
  - Nozzle orientation (15-30°)
  - Check application rate gauge in truck
  - Check application temperature
- Collect samples.
- Know the desired application and residual rates.
- Visually inspect application
- Verify application.
  - Volume
  - Mass
  - ASTM D2995

West Virginia Department of Transportation
Division of Highways

Inspector's Bituminous Emulsion Tack Worksheet

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

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

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

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

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

APPLICATION RATE CHECKS

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

(See handout)

COMMENTS: _____

_____

_____

INSPECTOR: _____

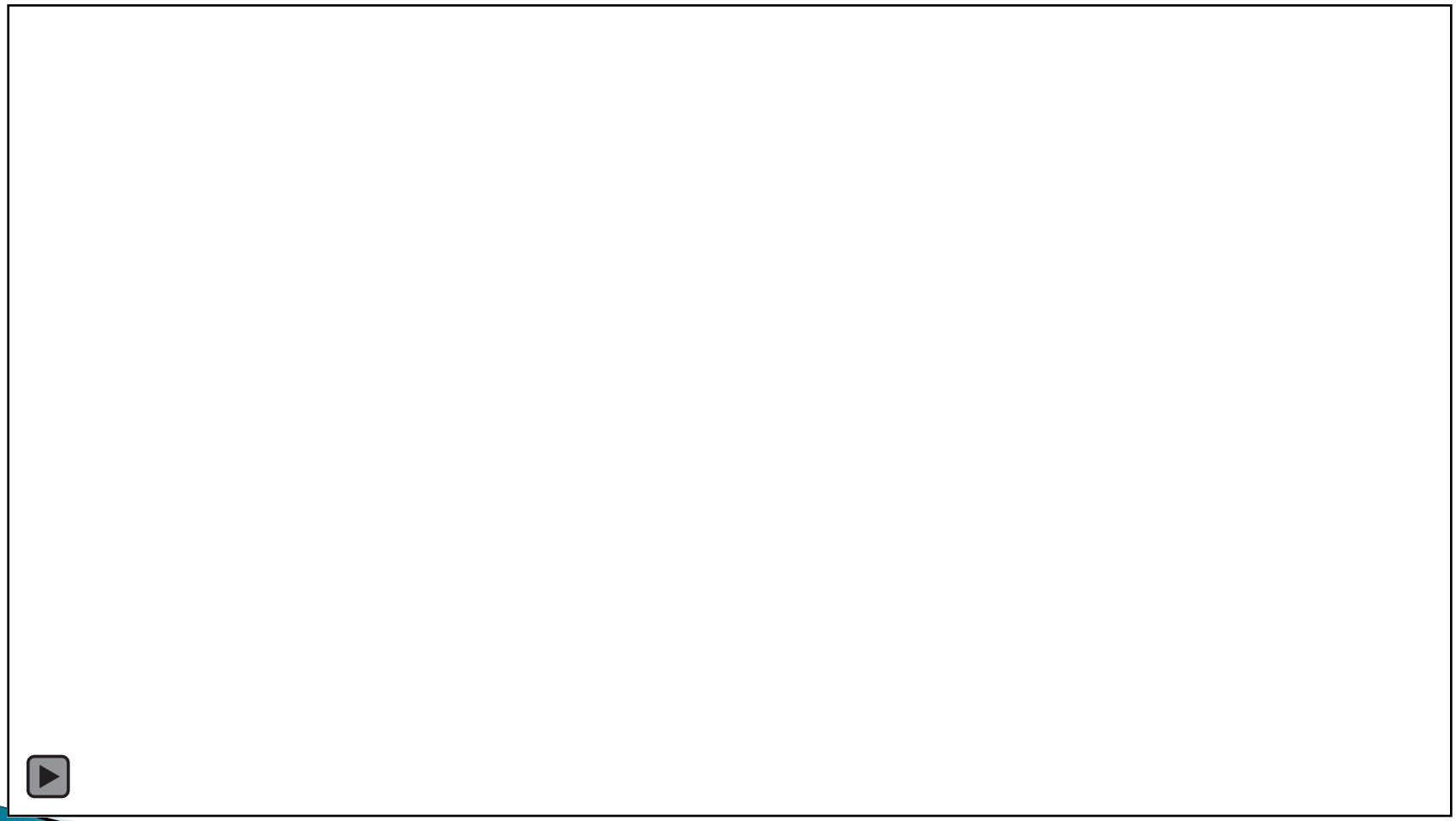
JPZ/TJM 12-23-10

Courtesy of WVDOT


Missed Line
Generally Uniform Application


Filling it in

Tack Coat Application



Tracking and Pickup

Pictures courtesy of Road Science™

Spray Pavers

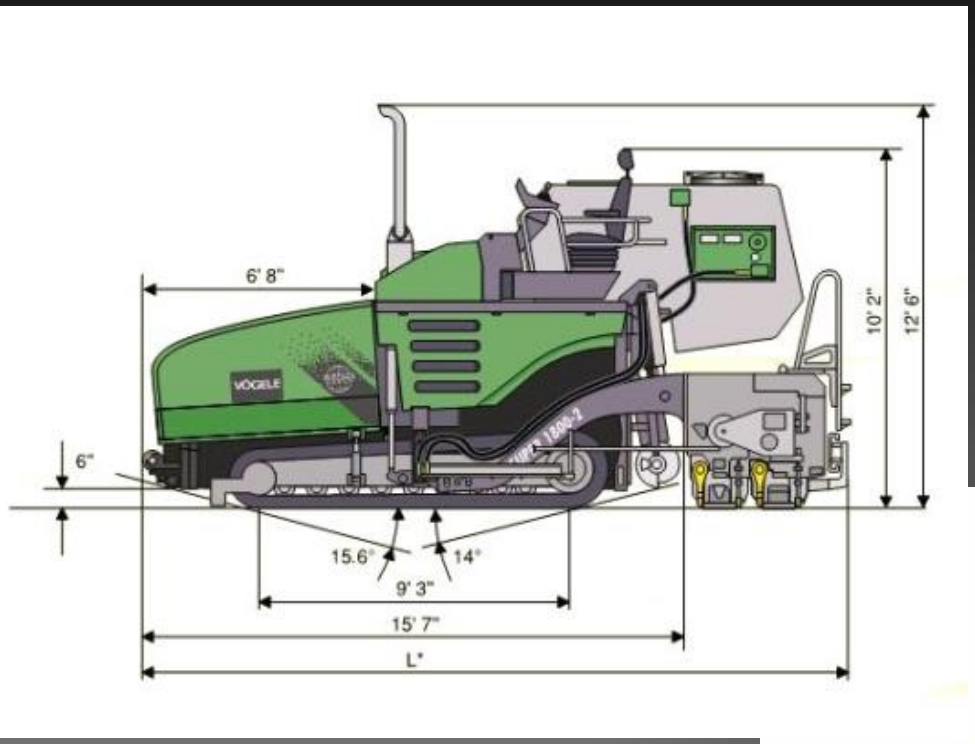
Spray Pavers/Bonded Overlays

- Spray Paver-Single Pass Paving and Sealing
  - Hot mix asphalt overlay
  - Polymer modified emulsion tack
  - Placed with spray paver
    - Paver & Distributor
  - High Application Rates
    - 0.08-0.20 gsy residual
- Examples
  - BondTekk®—bonded overlay
  - Novachip®—thin bonded overlay

Spray Pavers/Bonded Overlays

- Vögele: Spray Jet attachment
- Roadtec: SP 200 Spray Paver
- Limited Number of States Specifying
- Developed in Europe
- Specialty Product–Using a Standard Distributor
  - UltraFuse Bond Coat (not an emulsion)

Spray Paver Illustrations



ROADTEC STEALTH PAVER WITH TACK TANK

Roadtec SP 200 Spray Paver

Courtesy of Roadtec

Vögele: Spray Jet

Courtesy of Road Science™

Purported Spray Paver Benefits

- No tracking of the tack
- Better bonding of overlays
  - Increased Overlay life
  - Reduce Rutting
  - Reduce Cracking
- Improved joint compaction
- Easier compaction

Example Specifications

- Utah and Kansas
- "Self-Priming Paver"
  - Hopper
  - Asphalt emulsion storage tank
  - System for measuring application volume
  - Spray bar
  - Heated, variable width screed
- Material Transfer Vehicle Required


DIESEL

Uniform Tack Application

Workshop Objectives

I. • Importance of Tack Coats

II. • Tack Coat Materials Selection & Handling

III. • Tack Coat Specifications & Manuals

IV. • Quality & Inspection

V. • Testing & Best Practices

VI. • Review & Summary

VI. Review and Summary

(Experts commonly disagree)

Common Tack Coat Questions

- **"Do I still need to tack…"**
  - Milled Surface
  - "Fresh" Pavement
  - Late season/cooler days

- **This workshop recommends tacking all surfaces**

Common Tack Coat Questions

- **"When can I pave on the emulsion?"**
  - Has it Broke?
  - Does it need to be Set?
  - Fresh—spray pavers

- **We recommend paving begin after the emulsion has broke.**

  NOTE: Spray pavers and their emulsions are an engineered system that are designed to perform without the emulsion breaking.

Example of Emulsion Break

Unbroken Emulsion

After Breaking

Common Tack Coat Questions

- **What is the Optimal Application Rate?**
  - Surface Type
  - Surface Condition
- **Workshop Recommended Ranges**

Surface Type	Residual Rate (gsy)	Appx. Bar Rate Undiluted* (gsy)	Appx. Bar Rate Diluted 1:1* (gsy)
New Asphalt	0.020 – 0.045	0.030 – 0.065	0.060 – 0.130
Existing Asphalt	0.040 – 0.070	0.060 – 0.105	0.120 – 0.210
Milled Surface	0.040 – 0.080	0.060 – 0.120	0.120 – 0.240
Portland Cement Concrete	0.030 – 0.050	0.045 – 0.075	0.090 – 0.150

*Assume emulsion is 33% water and 67% asphalt.

Common Tack Coat Questions

- **When to Re-Tack?**
  - Tracking
  - Contamination

If in doubt …
Re-Tack

To Dilute or Not Dilute

Rule No. 1 – Follow the Golden Rule
(Contract Specifications)

- Should tack be diluted? – Depends on Rate
- Distributors tend to get more uniform coverage with a greater shot rate. (0.10 g/sq.yd. or more)

New Asphalt	0.020 – 0.045 *Resid*

If 0.02 Resid ≈ 0.03 emulsion then Dilute 1:3 = 0.12 Tot. Diluted Rate

Milled Surface	0.040 – 0.080

If 0.08 Resid ≈ 0.13 emulsion then No Dilution may be required

Monitoring Dilution

- Verify dilution amount
- Dilution cannot be used to “stretch” tack
- Residual value is key.

This Workshop recommends dilution by supplier only.

Common Tack Coat Questions

- **What Type of Bond Testing?**
  - Shear
  - Torsion
  - Pull off
  - Cyclic
- All have advantages and disadvantages
- Further research and acceptance will likely lead to a generally preferred method.

Areas of Known Agreement

- Layer Bonding is Vital
- Surface Preparation
  - Clean
  - Dry
- Milling Improves Field Performance
  - Shear
  - Cleaning

Areas of Known Agreement

- Application Quality Vital
  - Proper Rate
  - Consistency
- Distributor Truck
  - Setup
  - Calibration/Verification
  - Maintenance
- Tacking of Longitudinal Joints
  - Bonding
  - Confinement
- Excessive Tack is Bad

Areas of Known Agreement

- Tack Coat Rate Depends on Surface Condition
  - Fresh
  - Weathered
  - Raveled
  - Milled
- Need for Research
  - Field Performance
  - Field Testing
    - Bond strength
    - Application amount
- **Treat Tack as Separate Pay Item vs. Incidental Item**

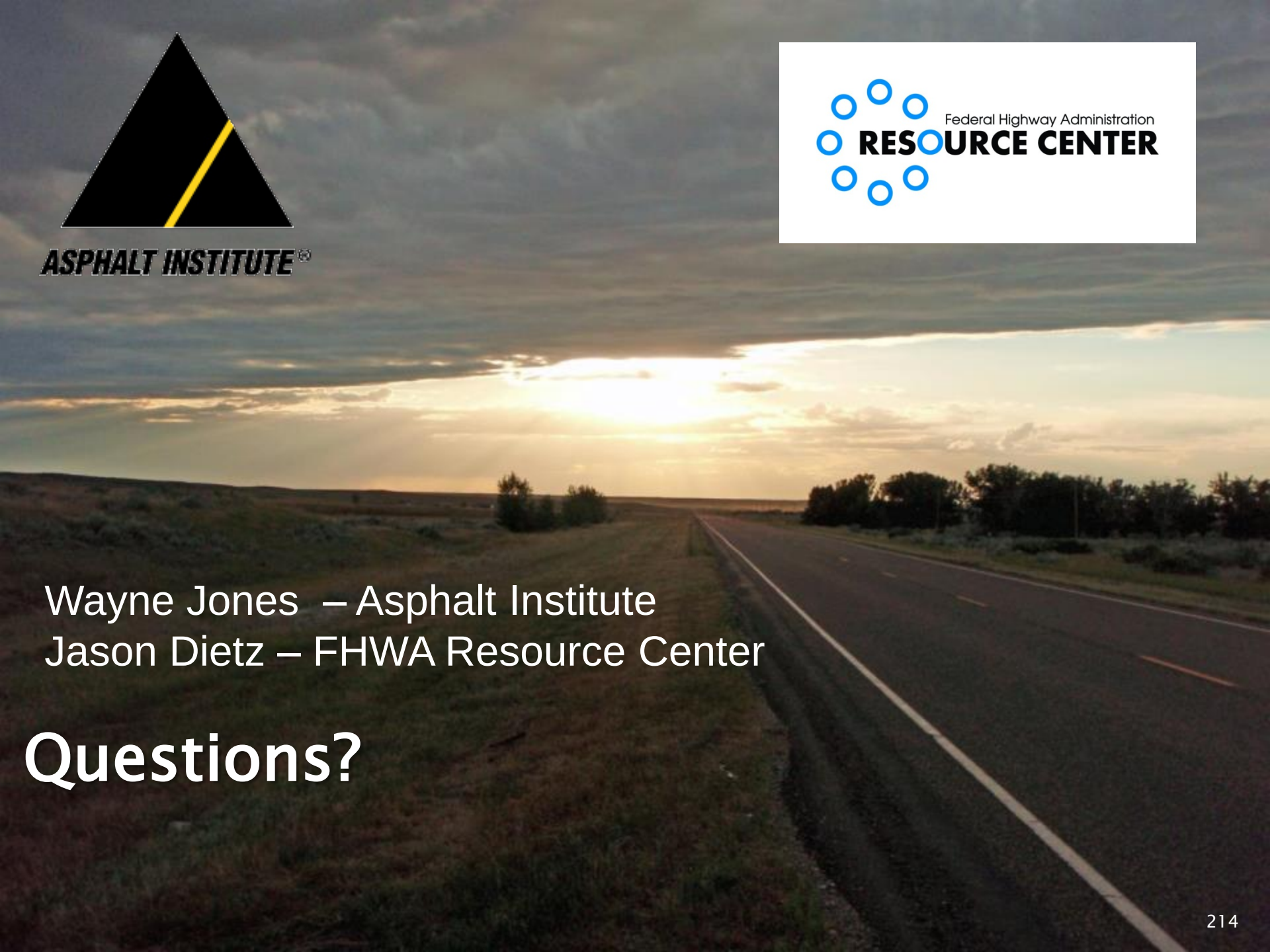
Learning Objectives

Upon completion of this workshop, you will be able to:

1. Recognize the importance of layer bonding.
2. Describe the proper handling, storage, and testing of tack coat materials.

Learning Objectives (continued)

3. Explain the type of field tests used to measure residual application rates.
4. Identify construction best practices that need to be met in order to have a successful tack coat application.



Wayne Jones – Asphalt Institute
Jason Dietz – FHWA Resource Center

Questions?


Thank You!