MnDOT PG3 Scrub / Cape Inspector Training

Intro, Pavement Preservation, Scrub Seal

Rex W. Eberly
National Center Pavement Preservation

MICHIGAN STATE UNIVERSITY

PG3 Pooled Fund Study
MnDOT Scrub / Micro Cape Seal Inspector Training
Agenda

8:00 am – Introduction
- Instructor – Eberly
- PG3 Overview – Joel
- Class Preview

8:15 am – Pavement Preservation Basics
- Why Pavement Preservation
- How does Scrub Cape fit into Preservation / Preservation Maintenance

8:45 am – Scrub Seal Best Practices
- Overview
- Equipment
  - Inspection
  - Calibration
- Materials
- Application

10:00 am – Break

10:15 am – Micro surfacing Cape Seal Best Practices
- Overview
- Equipment
  - Inspection
  - Calibration
- Materials
- Application

11:30 am – What to Expect on Demonstration Day
- Contractor Role
- Inspector Role
- NCPP / Volunteer Role

11:50 am – Questions and Comments

Noon - Adjourn

National Center for Pavement Preservation

DEPARTMENT OF TRANSPORTATION

ncpp
Preserving Our Nation's Transportation Assets

National Center for Asphalt Technology
NCAT
AT AUBURN UNIVERSITY

Transportation Pooled Fund-5(522), PG3

Joel Ulring, Pavement Preservation Engineer
Office of Materials and Road Research

Southeast Pavement Preservation Partnership Conference
March 18, 2025

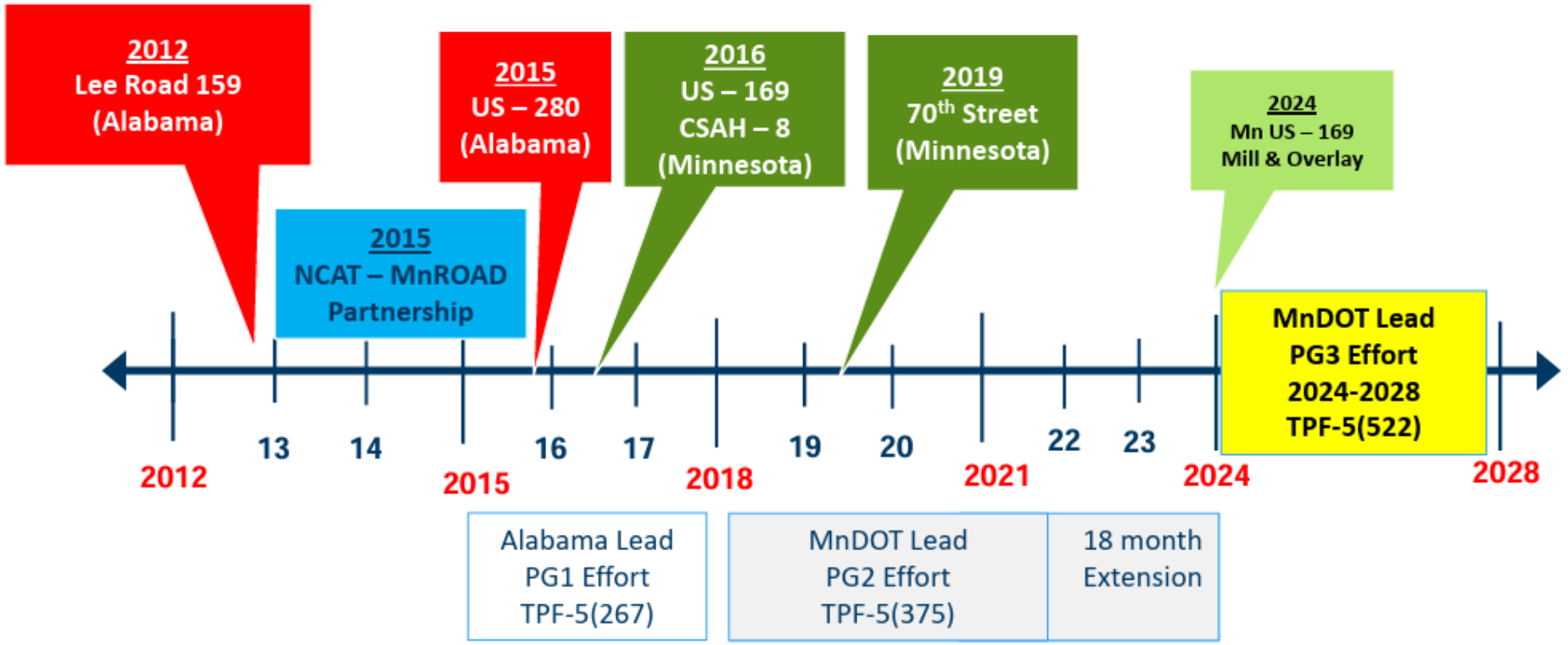
DEPARTMENT OF TRANSPORTATION

MnDOT/NCAT Preservation Group Studies - History:

- **NCAT - Lee Road 159**
  Pavement Preservation Study (2012-Present)
- **TPF-5(267) PG1**
  Accelerated Performance Testing for the NCAT Pavement Test Track (2015-2018).
  - **Alabama – Lee Road 159 & US 280**
  - **Minnesota – Mille Lacs County CSAH 8 & US 169**
- **TPF-5(375) PG2**
  National Partnership to Determine the Life Extending Benefits of Pavement Preservation Techniques (2018-23).
  - **70th Street NE – Rehabilitation & Thinlay Treatments**
- **TPF-5(522) PG3**

  National Partnership to Improve the Quality of Pavement Preservation Treatment Construction and Data Collection Practices (2024-2028).

MnDOT / NCAT Partnership



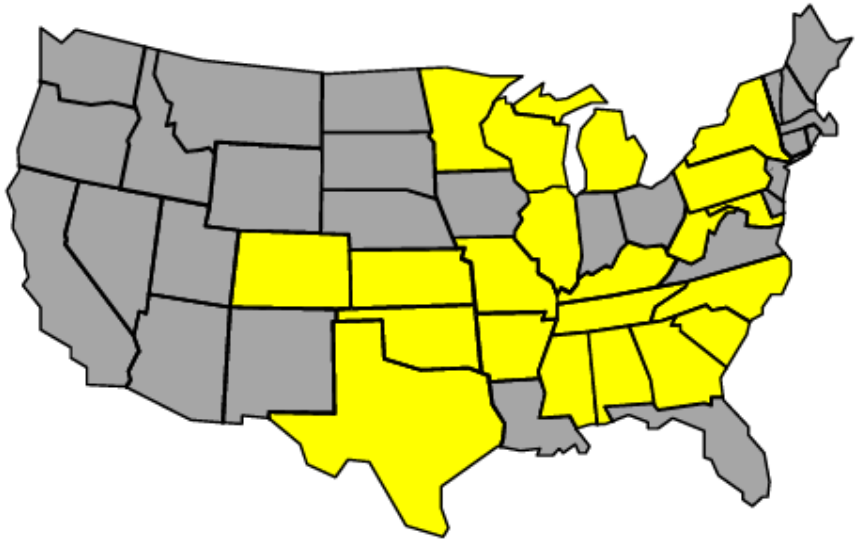
Pavement Preservation Research Update

PG Phase II Partners

21 Agencies/FHWA/FP2

$5,150,000

Completed!

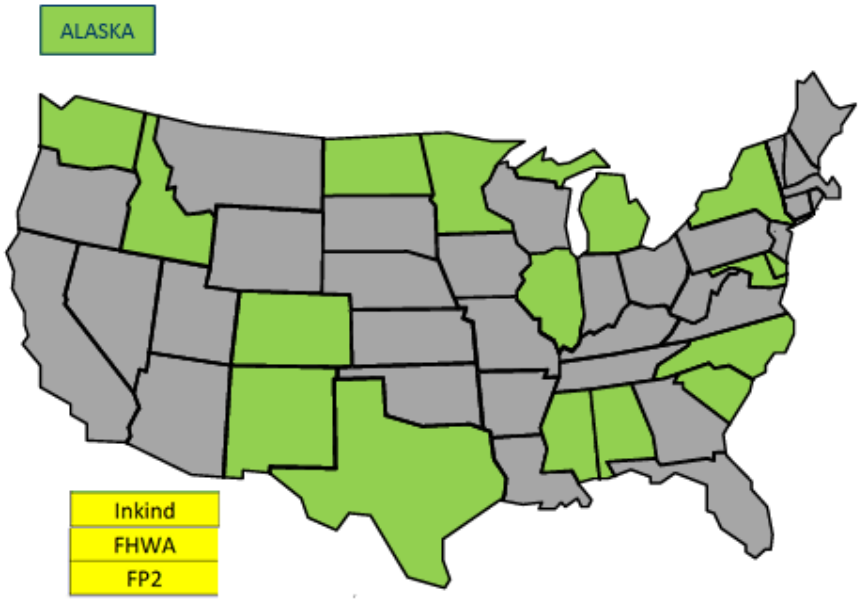


PG Phase III Partners

17 Agencies

Commitment Level: $50,000/yr., Minimum 3 years

Current budget $4,500,000



Alabama
Alaska
Colorado
Delaware
Idaho
Illinois
Maryland
Michigan
Minnesota
Mississippi
New York
New Mexico
North Carolina
North Dakota
South Carolina
Texas
Washington

Phase III or PG3 (Jan 2024-Dec 2028)

- **TPF-5 (522) – PG3**
- **Focus on State Implementation of Pavement Preservation Treatments**
  - Specification review
  - Preconstruction technical support & training (virtual)
  - Construction support (on-site)
  - Performance monitoring
- **Contracts with both NCPP and NCAT to support the effort**
- **Technical Advisory Panel Led (Agencies)**
  - Guidance from NCPP, NCAT, FP2, FHWA
  - Sponsor meetings
    - Two in-person/year
    - Two virtual/year
- **Pooled Fund Started January 2024 extending to December 2028**
- **Web Page: https://pg3study.org**

Pavement Preservation Future

Improving the Quality of Pavement Preservation Treatment Construction and Data Collection Practices

Proposed Projects

State	Treatment 1	Treatment 2	Climate Zone	Region	Timeframe
Alabama	Cape Seal	Micro mill with Micro Surface	Wet No Freeze	Southeast	2025
Alaska	1" Thin HiMA		Dry Freeze	Rocky Mountain West	2026
Colorado	Double Chip Seal		Dry Freeze	Rocky Mountain West	2026
Delaware	Micro Surface		Wet Freeze	Northeast	2025
Idaho	RAP Chip Seal		Dry Freeze	Rocky Mountain West	2026
Illinois	High Polymer Modified Slurry		Wet Freeze	Midwest	2025
Maryland	Scrub Seal		Wet Freeze	Northeast	2025
Massachusetts			Wet Freeze	Northeast	
Michigan	Chip Seal	Stress Absorbing Membrane Interlayer (SAMI)	Wet Freeze	Midwest	2025
Minnesota	Scrub Cape Seal	Scrub Seal	Wet Freeze	Midwest	2025
Mississippi	Scrub Cape Seal		Wet No Freeze	Southeast	2025
New York			Wet Freeze	Northeast	
North Carolina	Rejuvenator		Wet No Freeze	Southeast	2025
North Dakota	Micro Surface	Rejuvenator	Dry Freeze	Midwest	2025
South Carolina	Scrub Seal		Wet No Freeze	Southeast	2025
Texas	Scrub Seal	HFST with Micro Milling	Dry No Freeze	Southeast	2025
Washington	BST Rut Fill & Chip Seal		Dry Freeze	Rocky Mountain West	2026

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Who is NCPP?

- The National Center for Pavement Preservation
  - NCPP was established by Michigan State University and FP2, Inc. to lead collaborative efforts among government, industry, and academia in the advancement of pavement preservation by advancing and improving pavement preservation practices through education, research and outreach.

What Does NCPP Do?

- Collaborate
  - AASHTO
    - TSP2 Preservation Partnerships
    - Emulsion Task Force (ETF)
  - MnROAD, NCAT, PPRA
- Advance
  - National Pavement Preservation Conference (NPPC)
  - Research Projects
  - Training and Education Survey
- Improve
  - National Pavement Preservation Certification Program
  - Agency and Industry Training

Pavement Preservation Is…

- "Programs and activities employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety and improve motorist satisfaction while saving public tax dollars".

  - The treatment must:
    - Address pavements while they are still in good condition
    - Reduce aging
    - Extend Pavement Life
    - Restore Serviceability**

Define the Definition

- **Network Level**
  - All Pavements (Urban, Rural, Airports)
    - Asphalt and Concrete
- **Long-Term Strategy**
  - Budgeted Expense
- **Integrated**
  - Department Wide
  - All Stakeholders
- **Cost-Effective**
  - Right Treatment, Right Road, Right Time
- **Improve Road User Satisfaction**

Why Develop a Preservation Mindset?

- Budgets
  - Few agencies can afford a strategy of Build It, Rehab It, Build it Again
- Pavement Performance
  - FHWA Performance Thresholds will be difficult to meet without Preservation.
- Material Changes
  - Pavements don't seem to be lasting as long. Preservation stretches the service life of your pavements
- Sustainability
  - Carbon Reduction Act
  - Environmental Product Declarations (EPD's)

DEPARTMENT OF TRANSPORTATION

CARBON REDUCTION STRATEGY

2023

DEPARTMENT OF TRANSPORTATION

Low Carbon Infrastructure and System Management

Low carbon and infrastructure system management projects reduce carbon emissions throughout the entire transportation process, from construction and maintenance of infrastructure to vehicle operations. These projects support the use of:

- Low carbon materials in project construction.
- Improving construction and maintenance practices.
- Reducing emissions associated with transportation infrastructure and vehicle operations.

Eligible projects can support three strategies in the CRS:

- Optimize transportation systems management and operations.
- Utilize low carbon methods for construction and maintenance of transportation infrastructure.
- Support renewable energy generation.

THE BEST REASON IS – IT WORKS!

Why Don’t We Just Mill and Fill Everything?

Construction Equipment Magazine.com

State Example #1 – Worst First / Overlay Heavy

The FY 2023 Highway Program approximately $1.6 billion for roadway preservation activities.

The MDOT estimates for their FY 2023 Repair and Rebuild Roads program (roadway preservation) will include approximately: 1,111 lane miles of reconstruction and improvements, 821 lane miles of capital preventive maintenance, and 206 lane miles of freeway and non-freeway resurfacing.

2138 L.M. / 32,045 L.M = 6.7% of the network

32,045 L.M / 2138 L.M = 15 Year Cycle

1.6 Billion / 2138 L.M = $ 748,363 / LM

State Example #2 – Preservation Mindset

- Improved 7,102 miles of pavement in fiscal year 2023.
- Improvement includes Seal Coat, Micro surfacing, Thin Lift and Regular HMA Paving
- 7,102 miles / 35,776 miles = 20% of the network or a 5-year cycle.
  - Mix of treatments
    - Seal Coat – 60%
    - Paving – 20%
    - Other – 20%

From Theory To Practice

- A Worst-First Rehabilitation Program Won't Save Your Network.
- Deferring Preservation Maintenance does **NOT** save $$$.
- A balanced approach is best.
- Use Planned, Lower Cost Treatments To Extend Remaining Service Life.

PRESERVATION VS. PRESERVATION MAINTENANCE

- **PRESERVATION**
  - GOAL IS TO PLACE A TREATMENT THAT PRESERVES THE SURFACE AND EXTENDS RSL (REMAINING SERVICE LIFE)
  - TIME BASED
    - EARLY AND OFTEN
  - ADD SERVICE LIFE
  - GENERALLY, LESS EXPENSIVE TREATMENTS

- **PRESERVATION MAINTENANCE**
  - GOAL IS TO REPAIR SURFACE DEFECTS, PRESERVE THE SURFACE AND EXTEND RSL (REMAINING SERVICE LIFE)
  - TIME AND CONDITION BASED
    - PLACED AS EARLY AS POSSIBLE WHEN DEFECTS OCCUR.
  - STOP THE DETERIORATION AND ADD SERVICE LIFE.
  - MORE AGGRESSIVE PRESERVATION TREATMENTS
    - COMBINATION TREATMENTS

When Should We Not Use Thin Surface Treatments? Structural Defects Vs. Functional Distress

- Chip Seal or Micro surfacing should **NOT** be placed on a Pavement with Structural Defects.
- A Structural Defect means either the Pavement or the Base has failed.
  - Pavement Failure
    - Stripping – the asphalt no longer adheres to the rock
    - Potholes – if not repaired
    - Rutting – if continuing to rut
    - Longitudinal and Transverse Cracking – Heavy
  - Base Failure
    - Alligator Cracking – the base or sub-base has failed and no longer supports traffic loading.
    - Water and / or fines pumping – the base is failing, and Alligator Cracks will soon appear

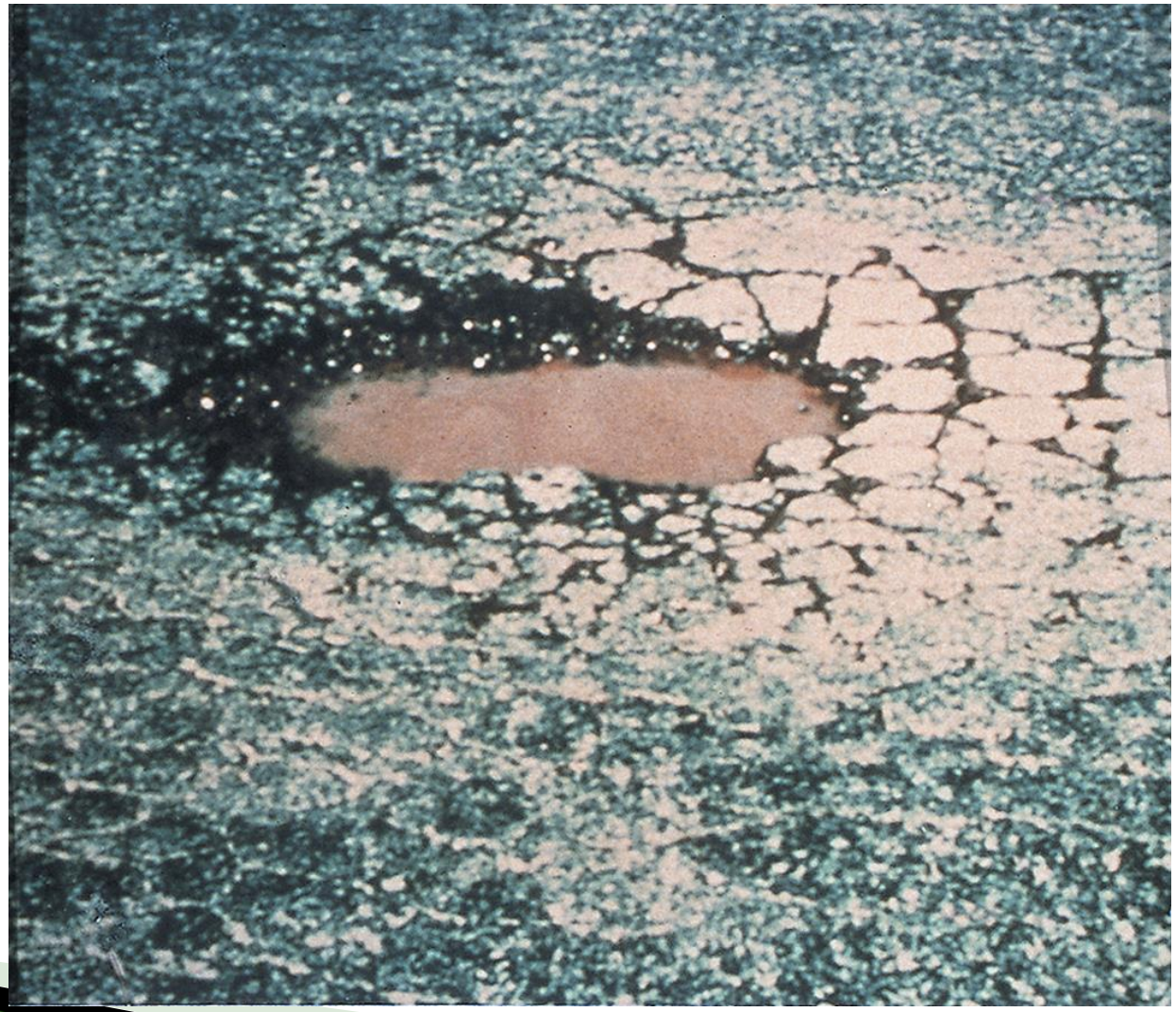
Structural

- Chip Seal or Micro surfacing can be used to treat **moderate** Functional Distresses.
- A Functional Defect, if not treated may become a Structural Defect.
- A Functional Defect is often caused by environmental or traffic conditions.
  - Rutting – if rutting has stopped
  - Bleeding
  - Longitudinal and Transverse Cracks – Light to Moderate
  - Polishing
  - Raveling

Functional (Surface)

Pavement Structural Distress – Stripping

Pavement Structural Distress – Potholes (Unrepaired or Inadequately Repaired)



Pavement Structural Distress – Rutting (Continuing to Rut)

Pavement Structural Distress – Cracking
High Severity

Pavement Structural Distress – Cracking
High Severity

Base Structural Distress – Fatigue Cracking – High (Alligator Cracking)

Base Structural Distress – Water or Fines Pumping

Functional Distress – Bleeding

Functional Distress – Rutting (Compaction)

Functional Distress – Cracking Light

Functional Distress – Cracking Moderate

Functional Distress – Polishing Light

Functional Distress – Raveling Light

Functional Distress – Cracking Light

WWW.RoadResource.org

Project Selection and Preparation for Pavement Preservation

Questions to Guide Project Selection

- Is the intent Preservation or Preservation Maintenance?
- Do I have any untreated light to moderate cracking?
- Do I have isolated base repairs?
- Is a Chip Seal feasible for this location?
  - Traffic, Night Work, High Speed, Political
- If Preservation Maintenance:
  - What are the Primary and Secondary Distresses?
  - How Quickly is the Deterioration Happening?
  - Is the Pavement Dry and Oxidized or Flushed and Slick?
  - Is there Light (< 1/2”) or Moderate (>1/2”) Rutting?

Preparation for Preservation Projects

- Early Stage-
  - Crack Treatments
  - Structural Leveling
  - Full Depth Repairs
  - Tree Trimming
  - Herbicide Treatment
  - Edge Milling
  - Micro Milling

- Final Stage
  - Surface Cleaning
  - Structure and Casting Protection
  - Pavement Marking Removal
    - Thermoplastic and Buttons
    - Paint is not generally removed unless it is very thick.
    - Pre-Tacking prior to Chip Seal.
  - Gutter Protection
  - Railroad Crossing Protection

Crack Treatments

- Crack Treatments Should Always Precede a Surface Treatment
- All Crack Treatments Should be Completed At Least 30-Days Prior to Surface Treatment.
- Overband Thickness Should be Less Than 1/8”
- Mastic Applications Should be Flush or Slightly Below the Surface.

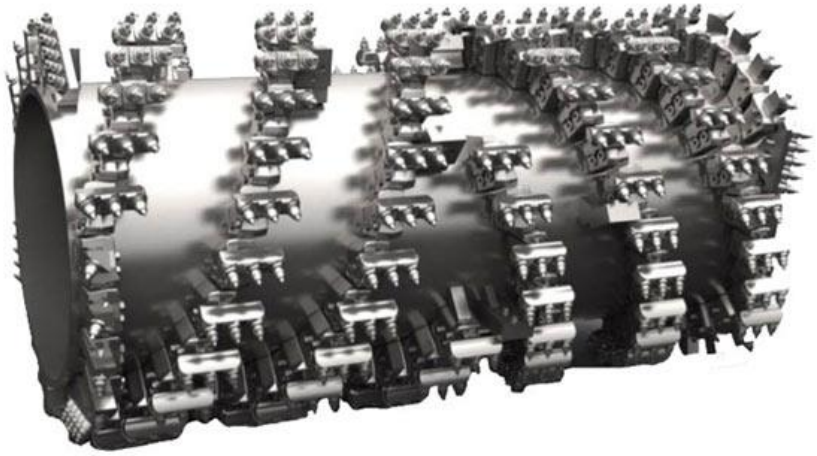
Leveling and Full Depth Repairs

- Surface Repairs Should Be Completed at Least 30-Days Prior to Surface Treatment.
  - Cold Mix Patches Should be Given Additional Cure Time
- Patches Should Be Left Flush or Slightly Below the Surface.
- Ride Quality of Leveling and Patches Must Equal the Desired Ride Quality of the Finished Pavement.

Important Note: Chip Seal and Micro surfacing May Level Slight Depressions in the Pavement. A Bump Will Always Be a Bump!

Edge Milling / Micro Profile Milling

- Severe Edge Drop Offs on Curb and Gutter Sections should be Edge Milled before Preservation Treatments.
- Rough, Flushed or Highly Oxidized Surfaces Can be Profile Milled with a Micro Milling Head.



Micro Milled Surface *Fine Milled Surface*

Keystone Mfg.

WHAT DO YOU DO WITH A ROAD LIKE THIS?

WHAT DO YOU DO WITH A ROAD LIKE THIS?

Scrub Cape Seal

Scrub Cape Seal

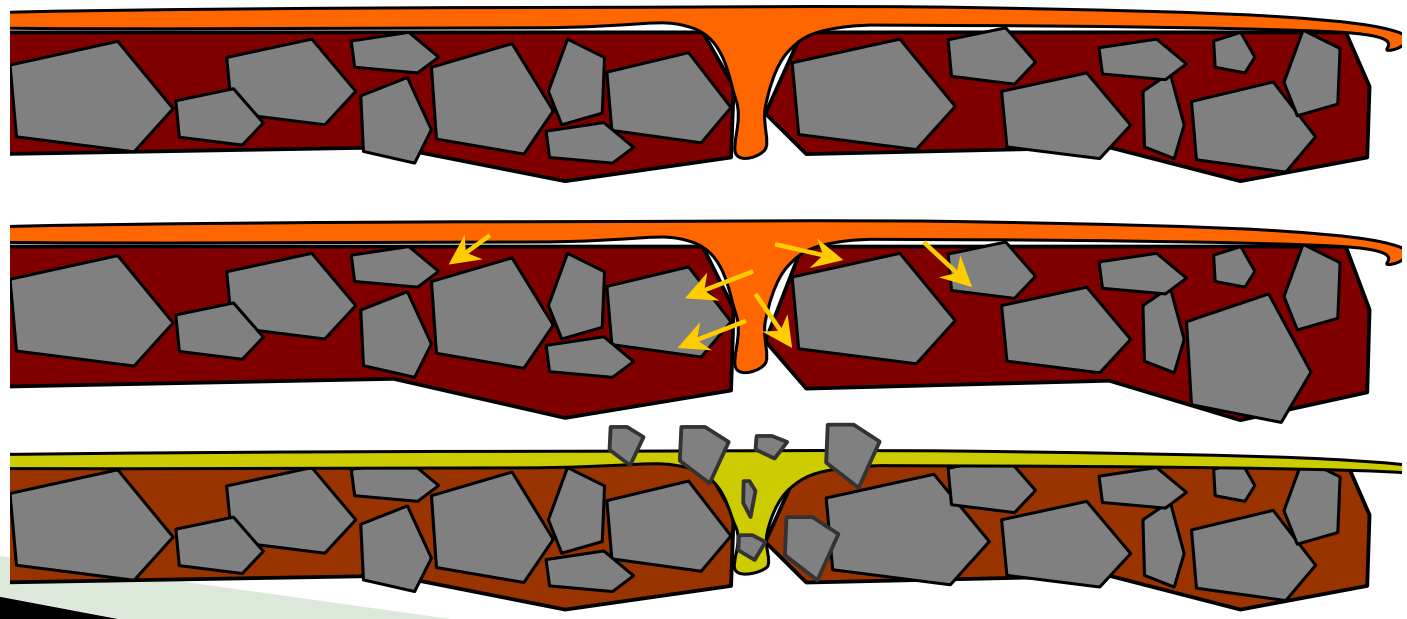
SCRUB SEAL

Same as a chip seal except :

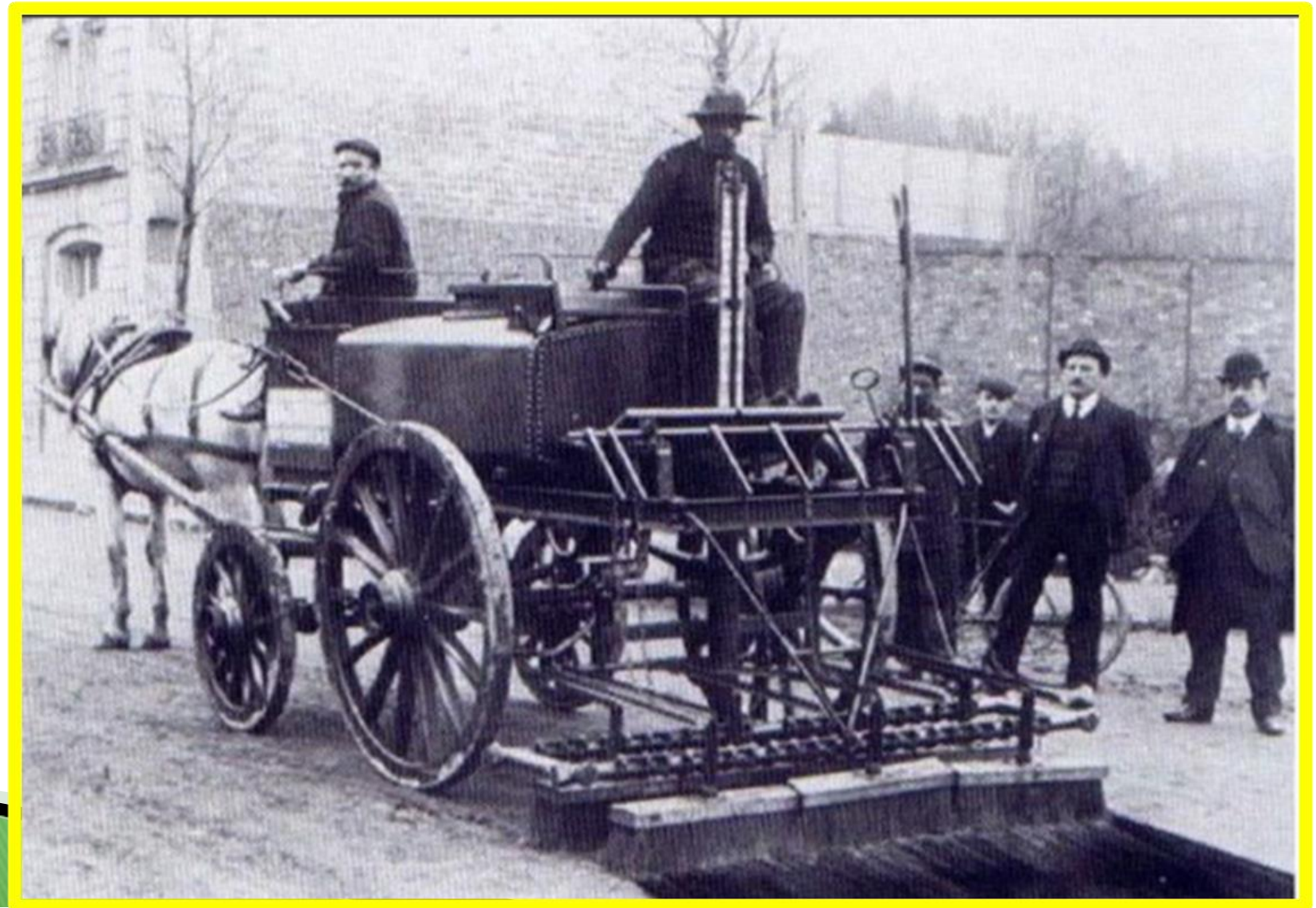
- A broom sled is connected to the distributor to “scrub” the emulsion into cracks in the existing surface.
- May use a Polymer Modified Rejuvenating Emulsion (PMRE) to soften and add Maltene Fractions to the pavement.

How Scrub Seals Work

- Fills cracks and voids
- Rejuvenates existing asphalt
- Forms a reflective crack resistant membrane between existing pavements and future overlays or seals. This membrane is called a SAMI (stress absorbing membrane interlayer).



SCRUB SEAL

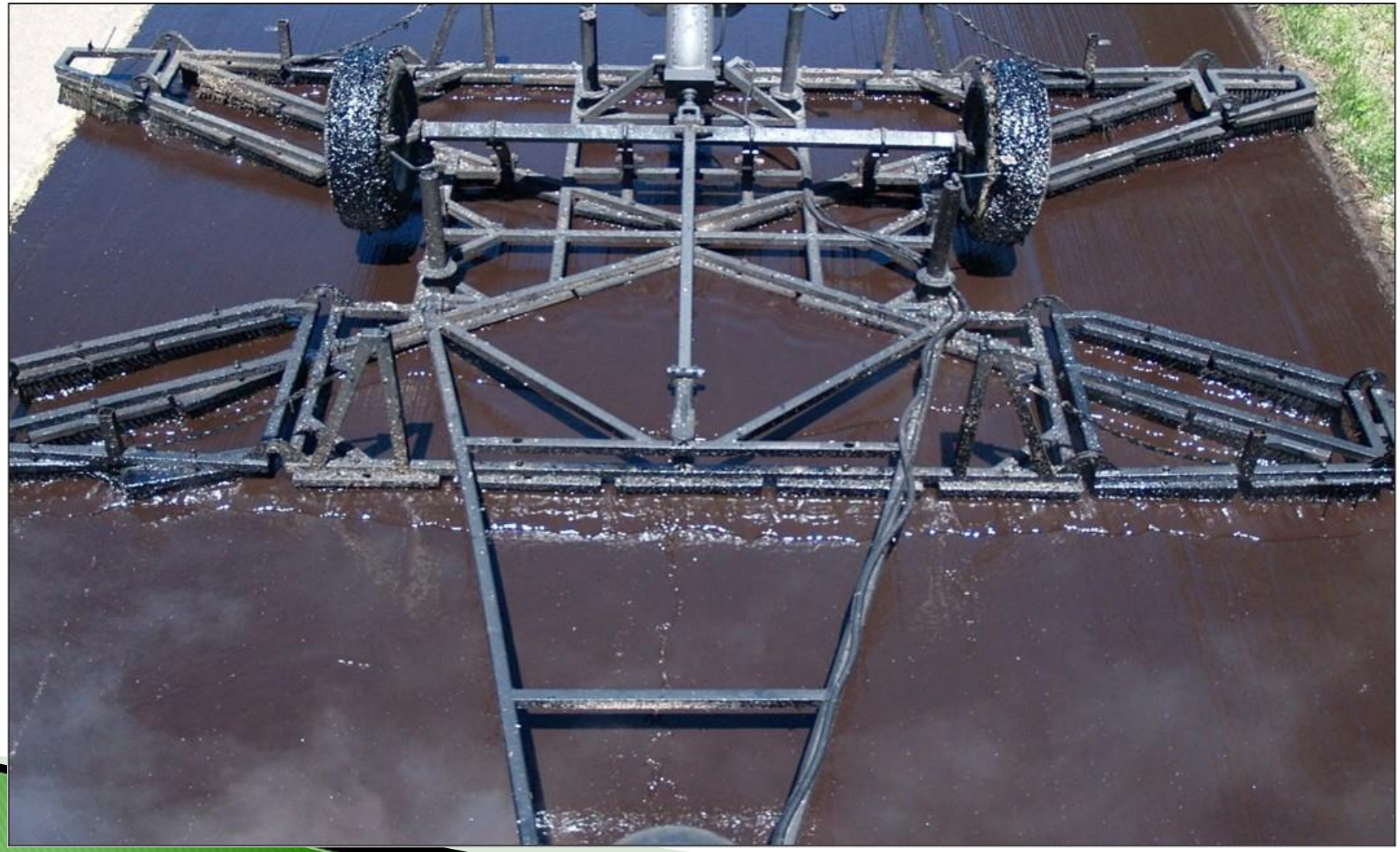


SCRUB SEAL

ETNYRE BROOM BOX

GREENSBROOM BROOM TRAILER

SHOP BUILT BROOM



What's a good candidate for a Scrub Seal Job?

Good Candidate

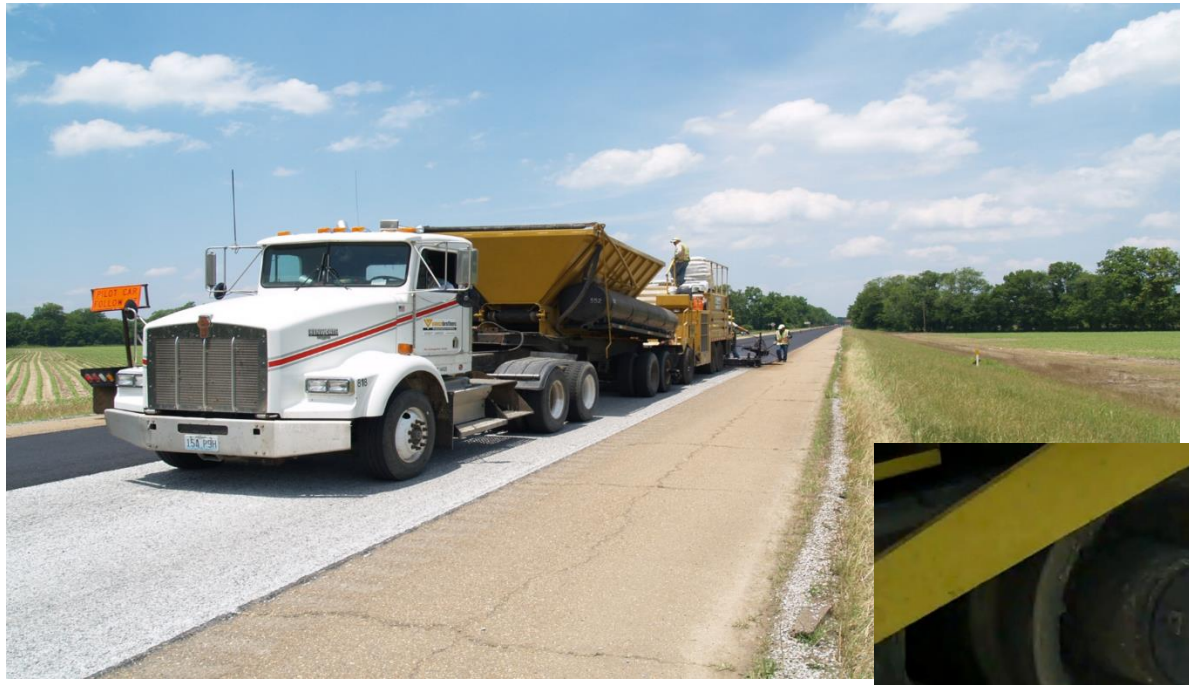
Good Candidate Continued

Stand alone surface treatment

- **Mississippi HWY 35**

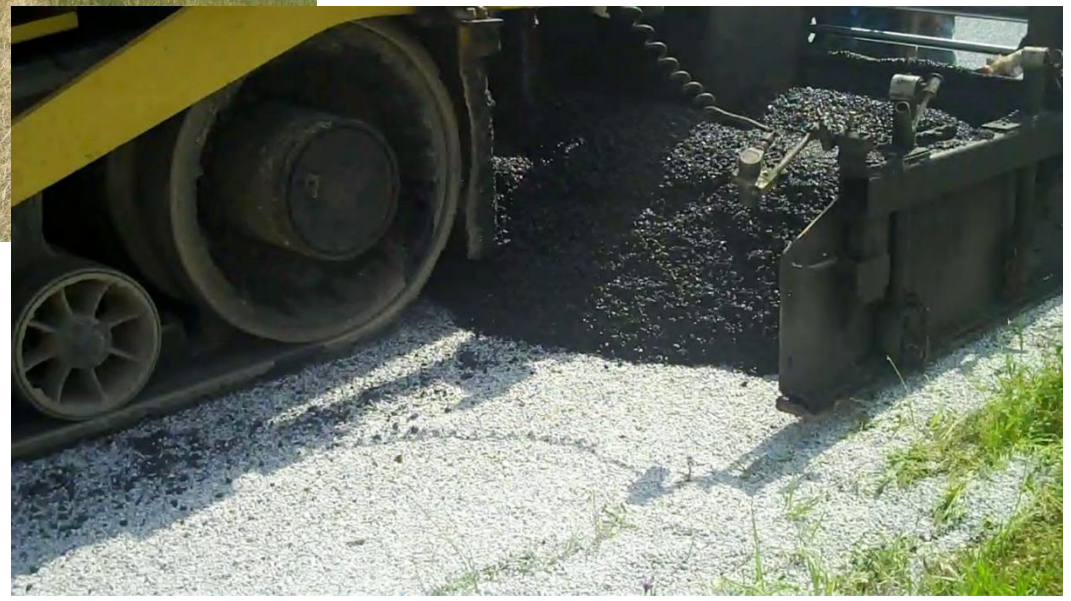
Primary Uses

Combination Treatments

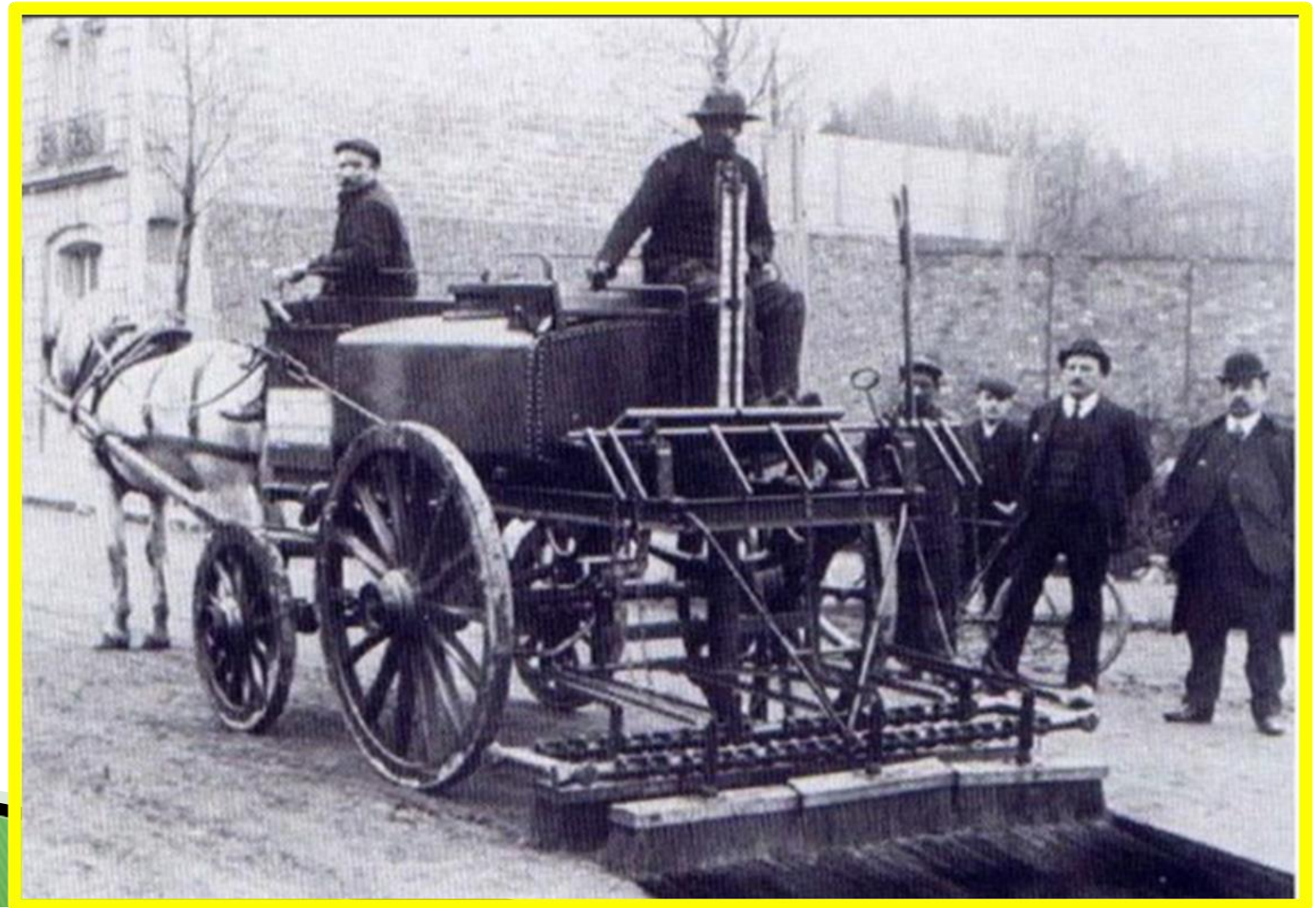


Interlayer with Micro over the top

Interlayer with HMA



SCRUB SEAL
BEST PRACTICES



SCRUB SEAL
BEST PRACTICES

- Every Best Practice that applies to a Chip Seal applies to a Scrub Seal.
  - Clean Stone
  - Clean Pavement
  - Consistent Emulsion Shot Rate
  - Quick Application of Stone
  - Don’t Over Apply Stone
  - Roll before the Emulsion Breaks
  - 70% Stone Embedment
  - Plus – Do No Harm with the Scrub Broom

SCRUB SEAL BEST PRACTICES

- Pre-Treatment of Cracks
  - Transverse Working Cracks Greater than ½" should be routed, cleaned and filled with asphalt rubber crack sealers.
  - Transverse "cupped" cracks should be sealed and leveled with mastic.
  - Non-working cracks should be cleaned by sweeping, vacuuming or blowing and left un-sealed.

Why Chip Seal?

- Chip Seals help preserve the pavement by:
  - Protecting the surface asphalt from oxidation.
    - Oxidation, caused by sun and chemicals make the asphalt cement brittle and more prone to cracking and raveling.
  - Protecting the surface and base from moisture intrusion.
    - Moisture causes:
      - Stripping of base layers
      - Potholes
      - Base Failures
  - Providing a skid resistant, sacrificial wearing surface that protects the underlying surface from traffic wear and damage.

Why Chip Seal?

- A “chip seal” (also called a “seal coat”) is essentially a single layer of asphalt binder that is covered by embedded aggregate (one stone thick) whose primary purpose is to seal the fine cracks in an underlying pavement’s surface and prevent water intrusion into the base and subgrade.

- The main advantages of chip seals include:

- **Improved Skid Resistance**: Chip seals provide good skid resistance,
- **Cost Effective Treatments**: Chip seals are typically cost effective when properly placed on the right type of pavement,
- **Good Durability**: By using durable aggregates, chip seals wear well and can have long service lives,
- **Ease of Construction**: Chip seals are typically constructed rapidly and cause less disruption to the traveling public.

Why Chip Seal?

- Chip Seal is an effective form of Pavement Preservation.
  - The combination of liquid asphalt and single size chips is an economical tool that provide great value.
- Chip Seal can also be an effective form of Minor Rehabilitation.

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Why Chip Seal

- Arrests light raveling
  - As asphalt ages, top layer gets brittle
  - Small aggregate begins to wear away
  - Seal coat adds new binder to halt this

Why Chip Seal

- Provide new wearing course
  - Improves surface friction
    - Lot of data –increase friction numbers to 40+
  - Traffic and weather hit the chip seal first
- Improve surface appearance

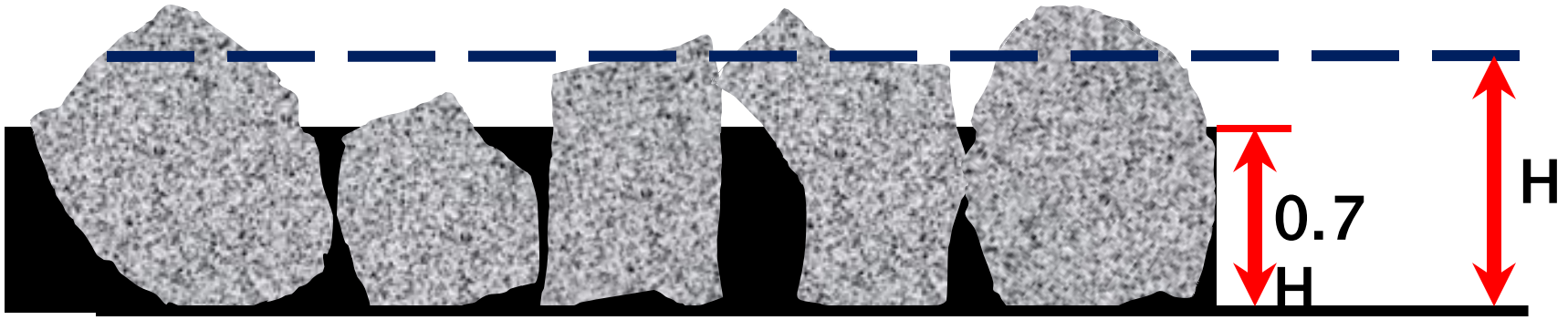
Caution

- A Chip Seal does not add structure to a road
- If you have a bad road before, you'll still have a bad road.


Bear Cat
CRC
Computerized
Rate Control
INTERNATIONAL

Embedment

Average Least Dimension (H)



Embedment (0.7 H)

Inputs that affect Embedment

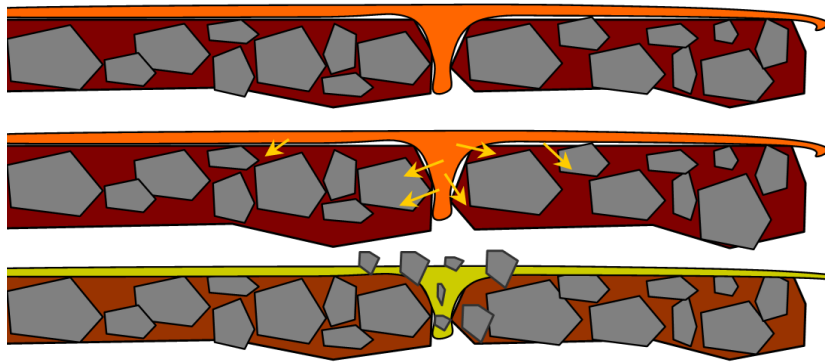
- Materials
  - Emulsions
  - Aggregates
- Equipment
  - Asphalt Distributor
  - Chip Spreader
  - Rollers
  - Brooms
- Application
- Existing Pavement

CHIP SEAL EMULSION

- CRS-2P
  - C = Cationic or Positive Charge
  - RS = Rapid Set
  - 2 = Higher Viscosity
  - h = made with a harder base stock – more viscosity
  - P = Polymer Modified.

SCRUB SEAL EMULSION

- CMS-2P + REJUVENATOR = PMRE
  - The Rejuvenator does two things:
    - Softens the oxidized asphalt on the surface an in the cracks.
    - Adds in Maltene Fractions which are the cemical that are lost when asphalt oxidizes.



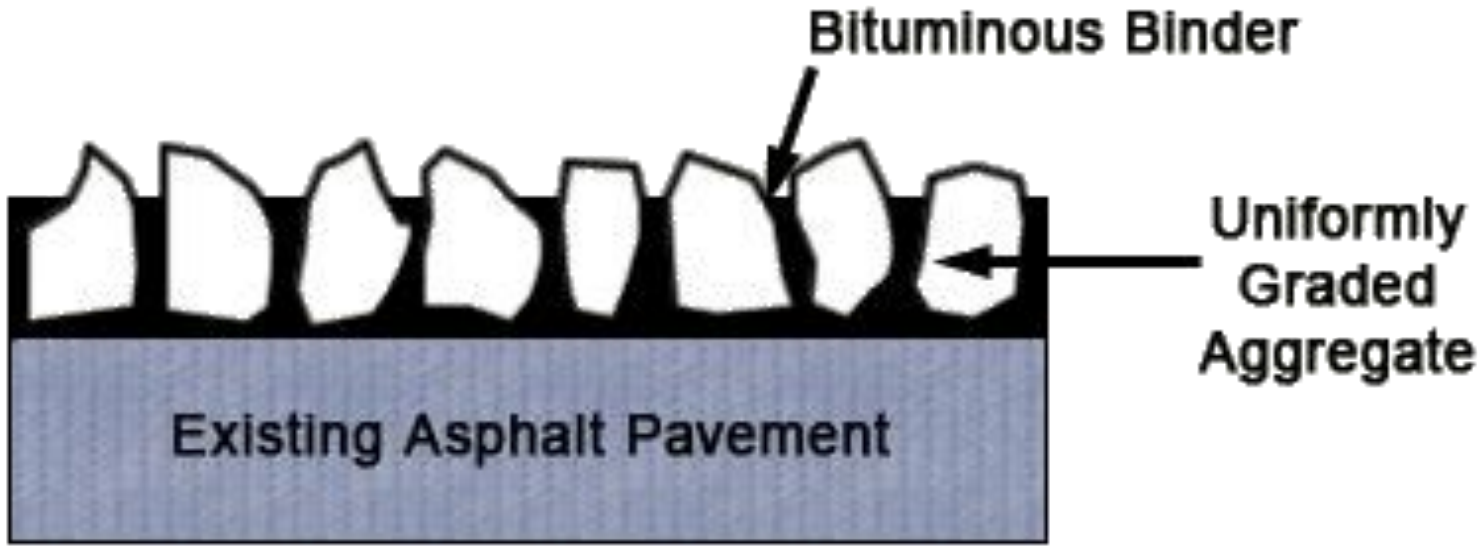
Why Do We Use Polymer (Latex) in Emulsion?

- First – Latex and polymer are often used interchangeably. Kind of like tissue and Kleenex.
- The industry started using Natural Latex from Rubber Trees. That got expensive so someone invented Synthetic Latex (Polymer) which has then morphed to other forms of Polymers (SBS, SBR) which are used in emulsion.
- Polymer is added to emulsion to change the normal properties of the base asphalt.

Why Do We Use Polymer (Latex) in Emulsion?

- Polymer coats the asphalt particles while they are in suspension. It does not evaporate with the rest of the chemical package.
- The Polymer:
  - Lowers the temperature at which the asphalt gets brittle.
  - Raises the temperature at which the asphalt softens
  - It can also add strength to the asphalt / aggregate bond

Materials

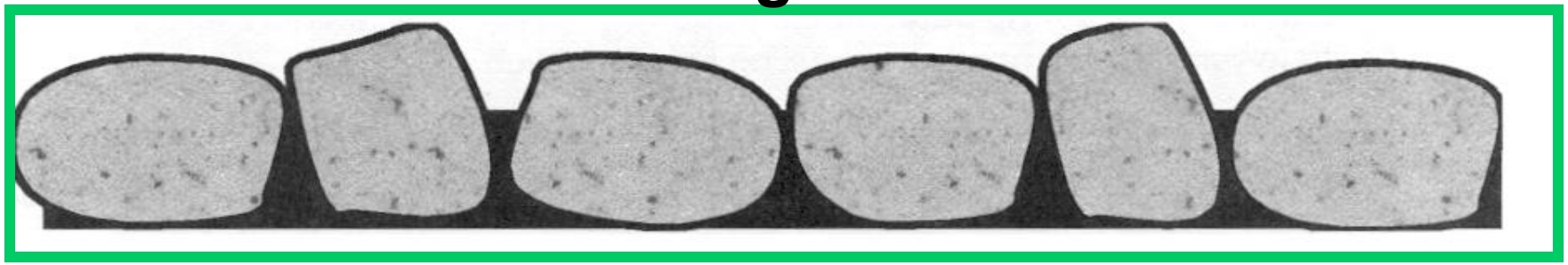


Single Chip Seal

Materials

Dense Graded

Single Size



Materials

Best Aggregate Performance when:

- Single sized
- Minimum fines
- Clean
- Free of clay
- Cubical
- Crushed faces
- Abrasion < 30%
- Binder compatible
- Damp for emulsions
- Dry for hot binders

MnDOT Scrub Seal Aggregate

Table-SP2356-2
Aggregate Gradation

Sieve size	Percent passing by weight
⅜ in	100
No. 4	10 - 80
No. 8	5 - 30
No. 16	0 – 15
No. 200	0 – 2.0

Application Rates

- Emulsion –
  - Gal / S.Y.
- Aggregate –
  - Lbs. / S.Y.

Chip Seal Design

- "Design" means determining target emulsion and aggregate application rates
- How do we typically determine how much stone/oil to apply?
  - Spec range
  - Experience

TYPE *(see Note 1)*	APPLICATION	COVER AGGREGATE SIZE NO. AND COURSE	RATES OF APPLICATION PER SQUARE YARD (SQUARE METER)	
			AGGREGATE lb (kg)	ASPHALT MATERIAL GALLON (LITER) AT 60°F (16°C)
1 *or 1P* *(see Note 2)*	Single	23, 24	12-15 (5.4-6.8)	0.12-0.16 (0.45-0.61)
2 *or 2P*	Single	12	14-17 (6.4-7.7)	0.29-0.33 (1.09-1.25)
3 *or 3P*	Single	11	16-20 (7.3-9.1)	0.36-0.40 (1.36-1.51)

MnDOT Chip Seal Design

The McLeod Design Procedure

MnDOT uses the McLeod procedure to design chip seals. In this procedure, the aggregate application rate depends on the aggregate gradation, shape and specific gravity. The binder application rate depends on the aggregate gradation, absorption and shape, traffic volume, existing pavement condition and the residual asphalt content of the binder.

The McLeod design procedure has been modified by MnDOT to apply slightly more binder to improve resistance against snowplow damage in the non-wheel path areas. This will be discussed later in this chapter.

The McLeod procedure (Figure 25) is based on two basic principles:

- The application rate of a given cover aggregate should be determined so that the resulting chip seal will only be ***one-stone-thick***. This amount of aggregate will remain constant regardless of the binder type or pavement condition.
- The voids in this aggregate layer need be **70% filled with asphalt cement** for good performance on pavements with moderate levels of traffic.

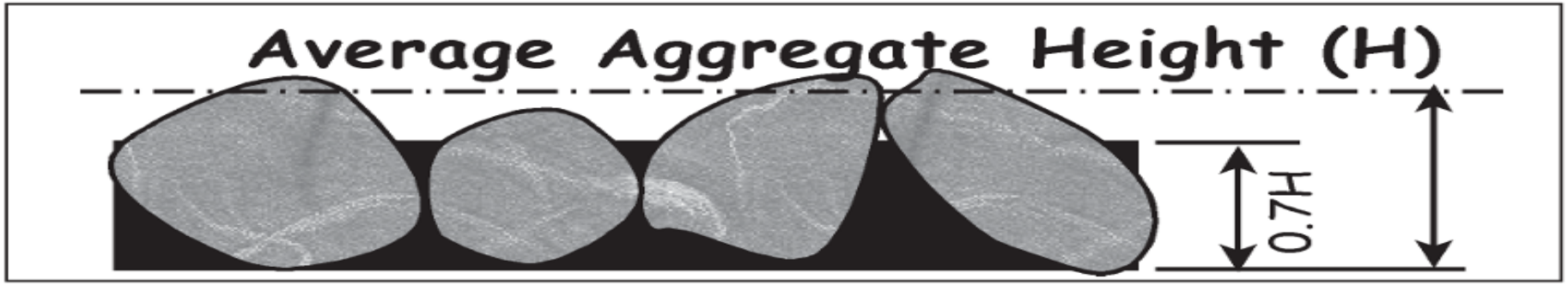


Figure 25. McLeod Design: One-Stone-Thick and Proper Embedment (70%)

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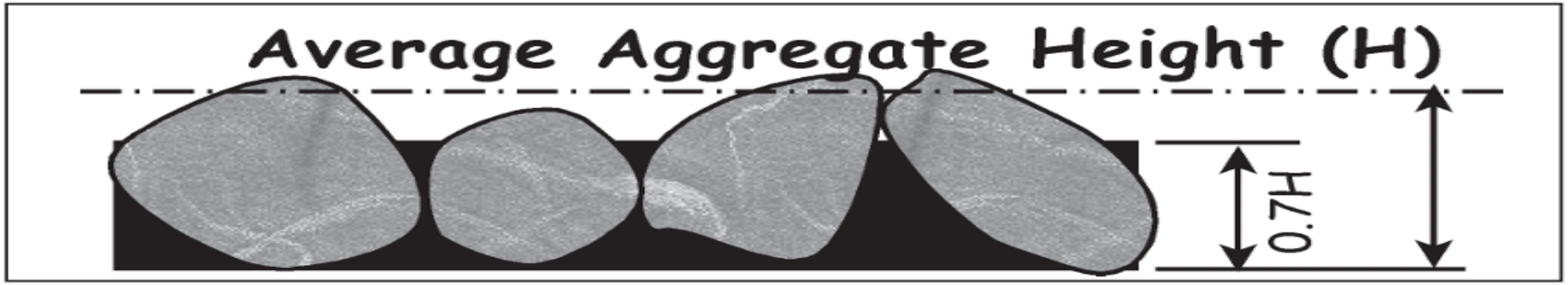


Figure 25. McLeod Design: One-Stone-Thick and Proper Embedment (70%)

Chip Seal Design

- Designs combine:
  - Specific material properties
  - Specific road conditions
    - How much emulsion will the road “drink”?
    - How “dry” is the pavement?

Equipment Condition and Calibration

General Note:

- ✓ No Hydraulic Leaks!

Asphalt Distributor Checklist

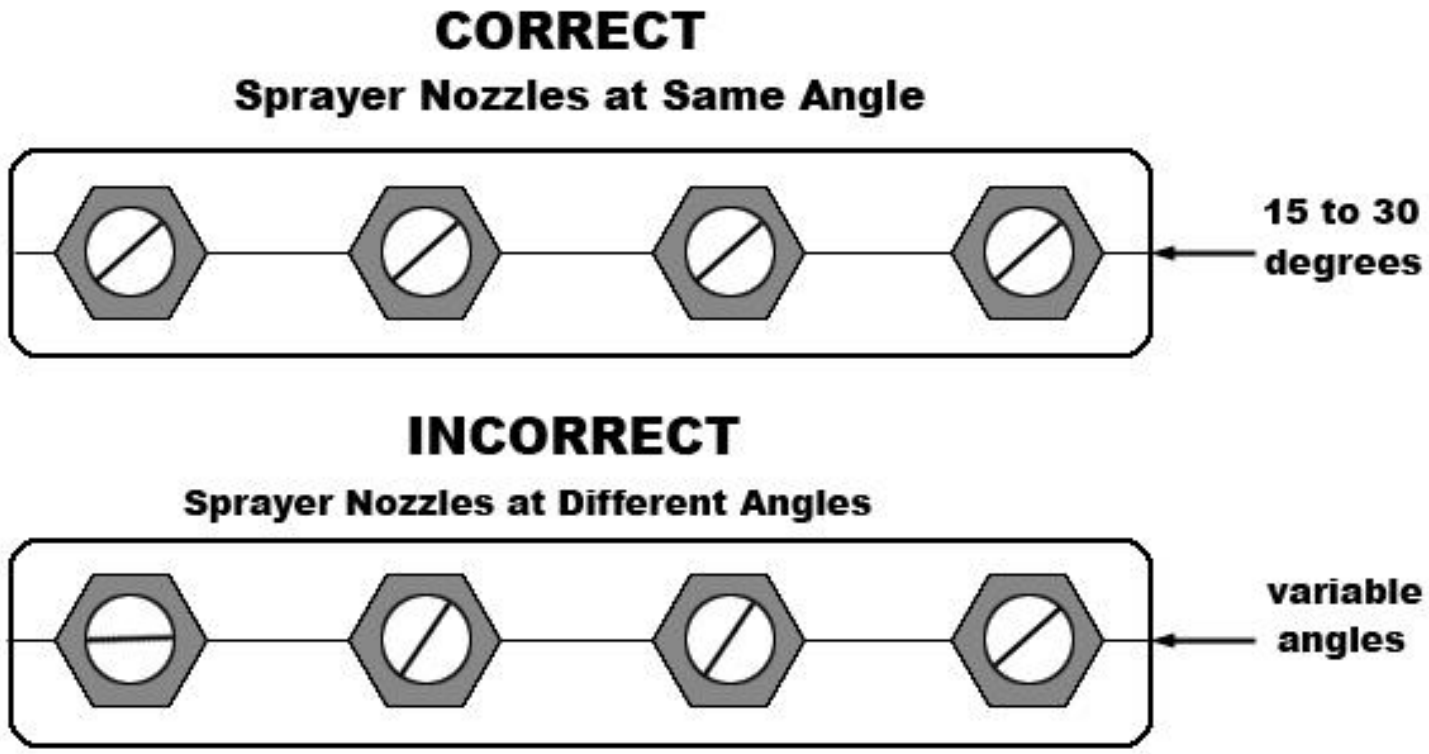
Distributor Check List

- Computerized
- Able to Circulate between tank and Bar
- Working radar
- Working Thermometer for measuring temperatures in the tank.
- Heating when required
- Gallon Gauge / Calibrated dip stick
- Correct tips (nozzles) for application
- Strainers are cleaned. No clogs

Why Should You Check Your Distributor's Calibration?

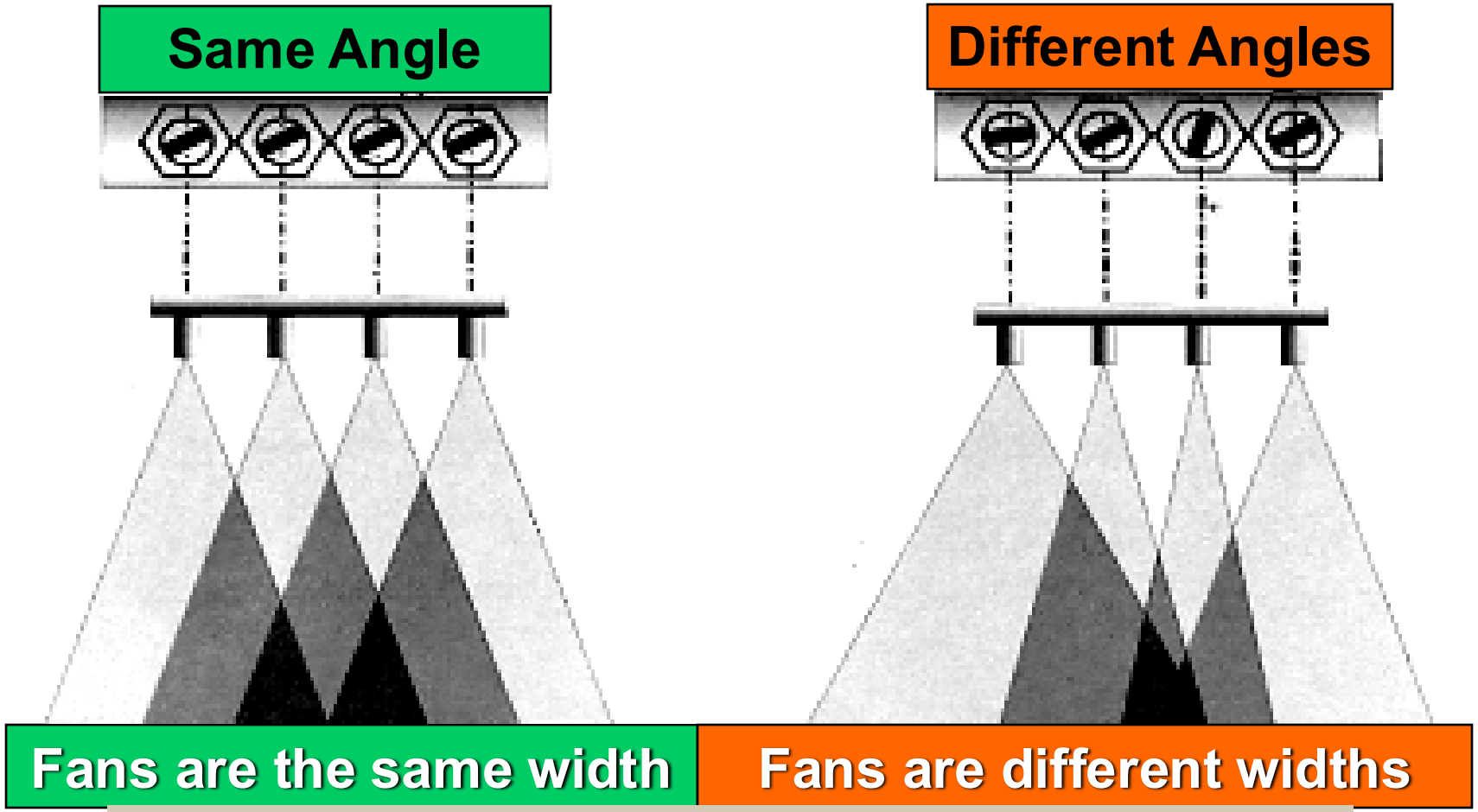
- To make sure the computer rate matches what's going on The ground
- To avoid bleeding or flooding of material
- To make sure there is enough material to retain the chip, or assure a good bond for paving surface
- To avoid increased cost of material, due to over application

Distributor Checklist



Spray Bar Nozzle Alignment

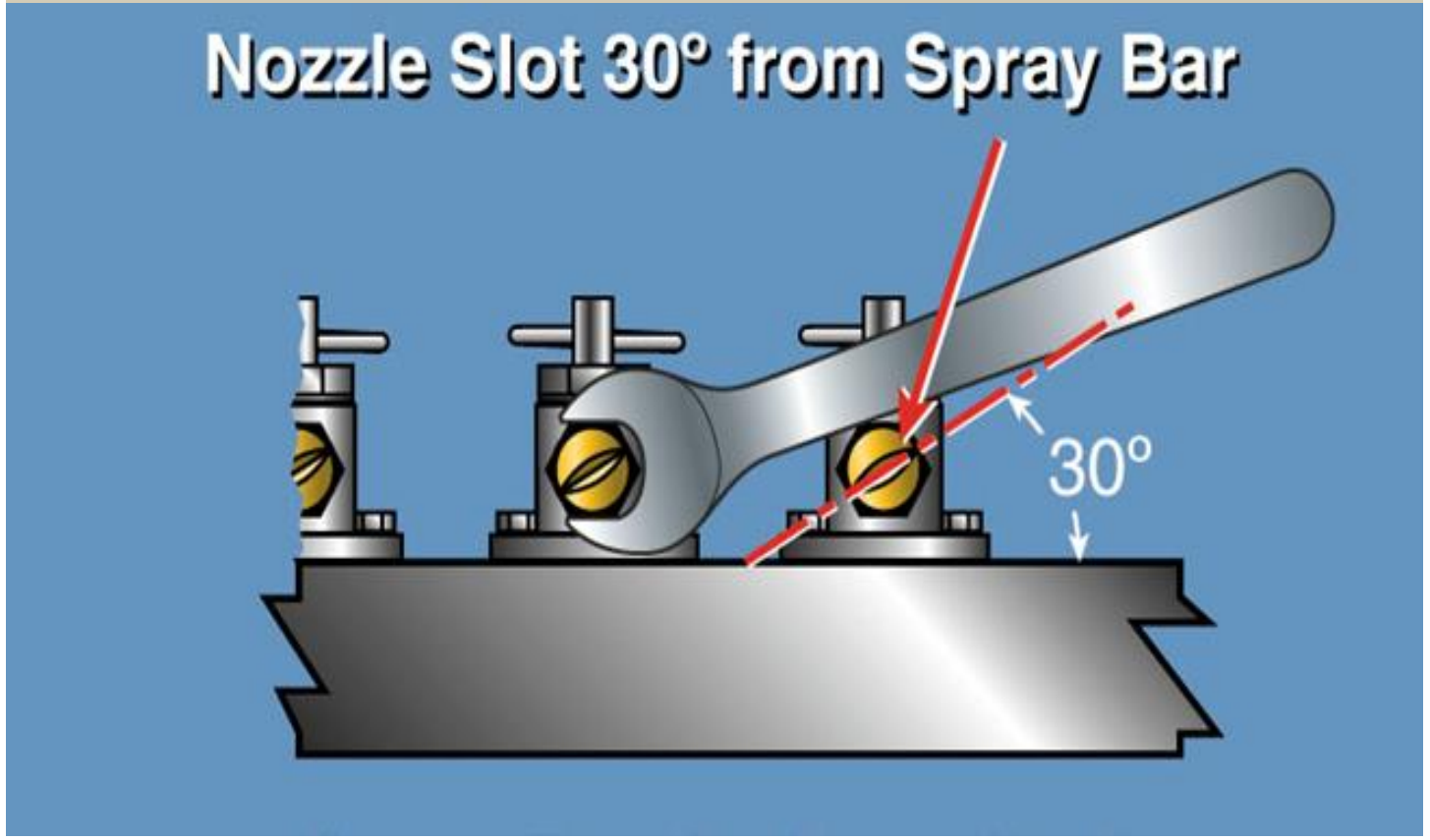
Distributor Checklist



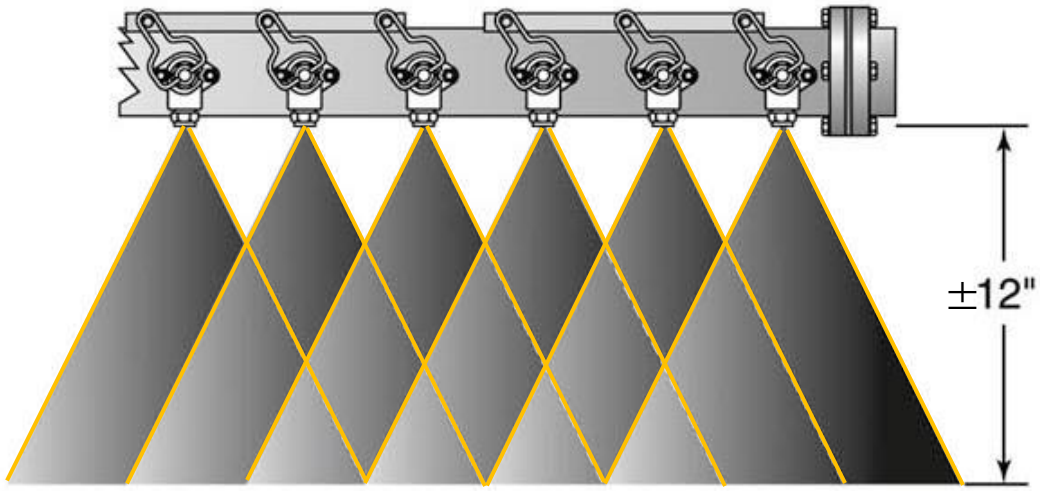
Spray Bar Nozzle Alignment

Distributor Checklist

Spray Bar Nozzle Alignment



Distributor Checklist

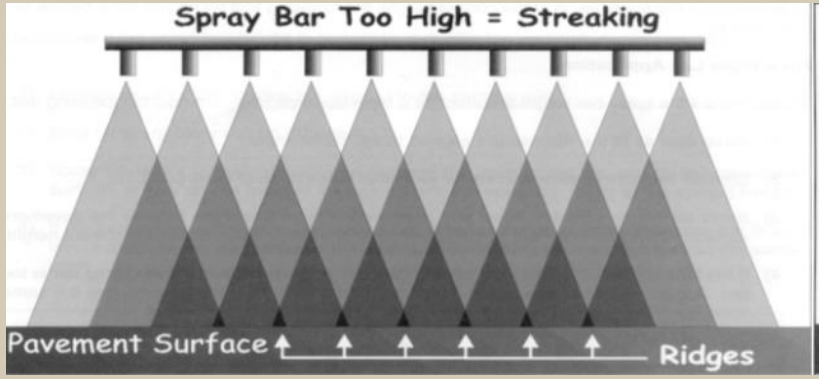


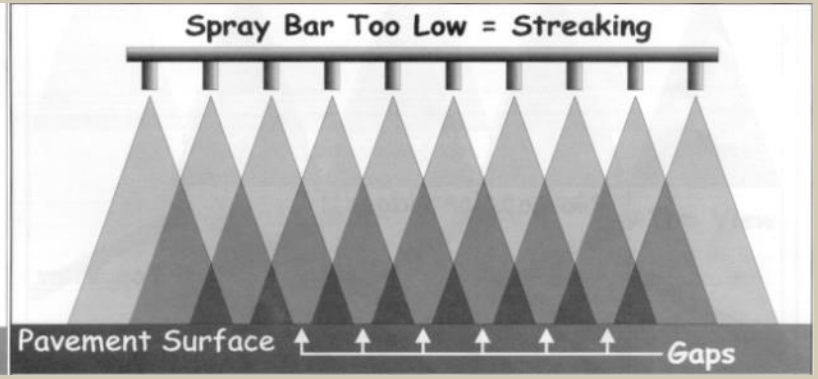
Triple-Lap Coverage

With nozzles on 4" centers, material sprayed from each nozzle overlaps two other sprays.

Calibration

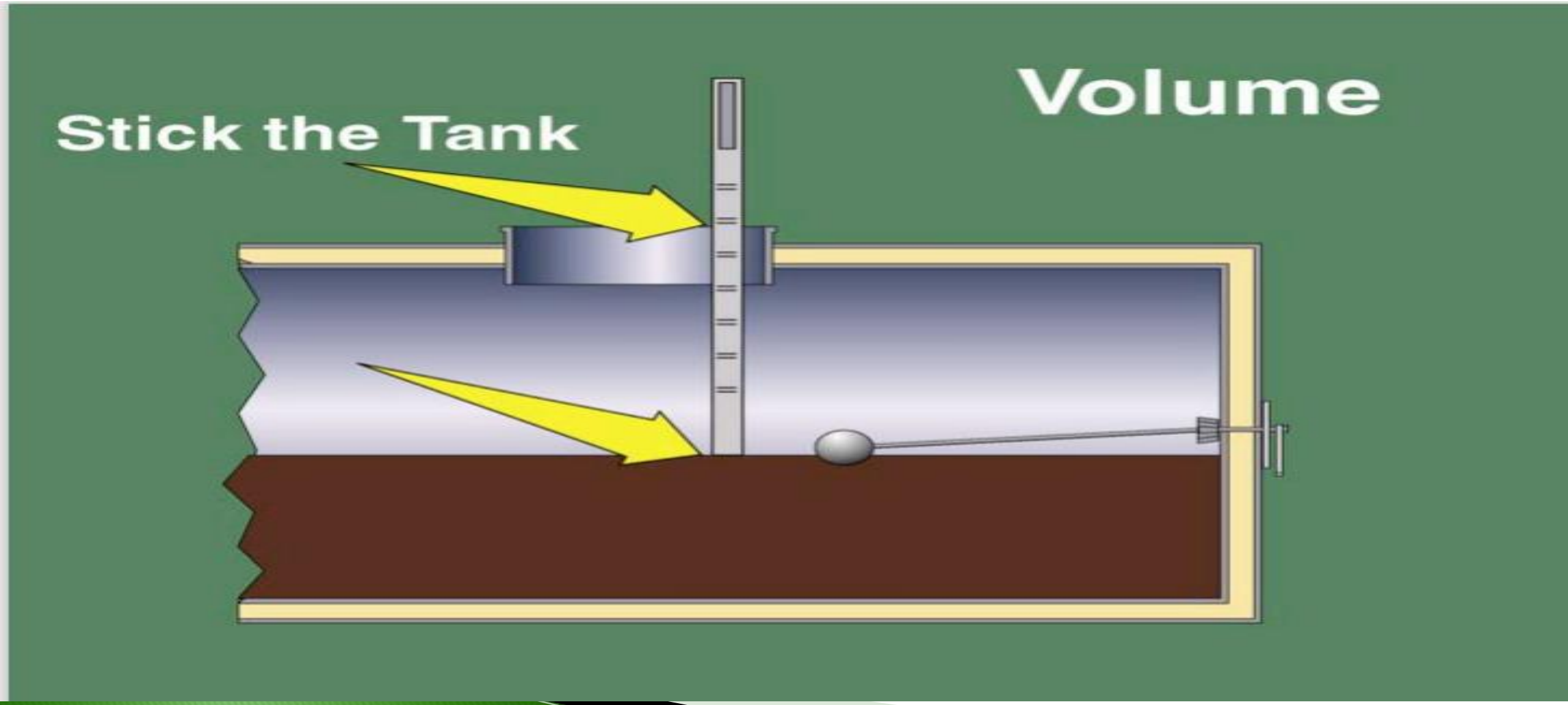
Adjusting Spray Bar Height





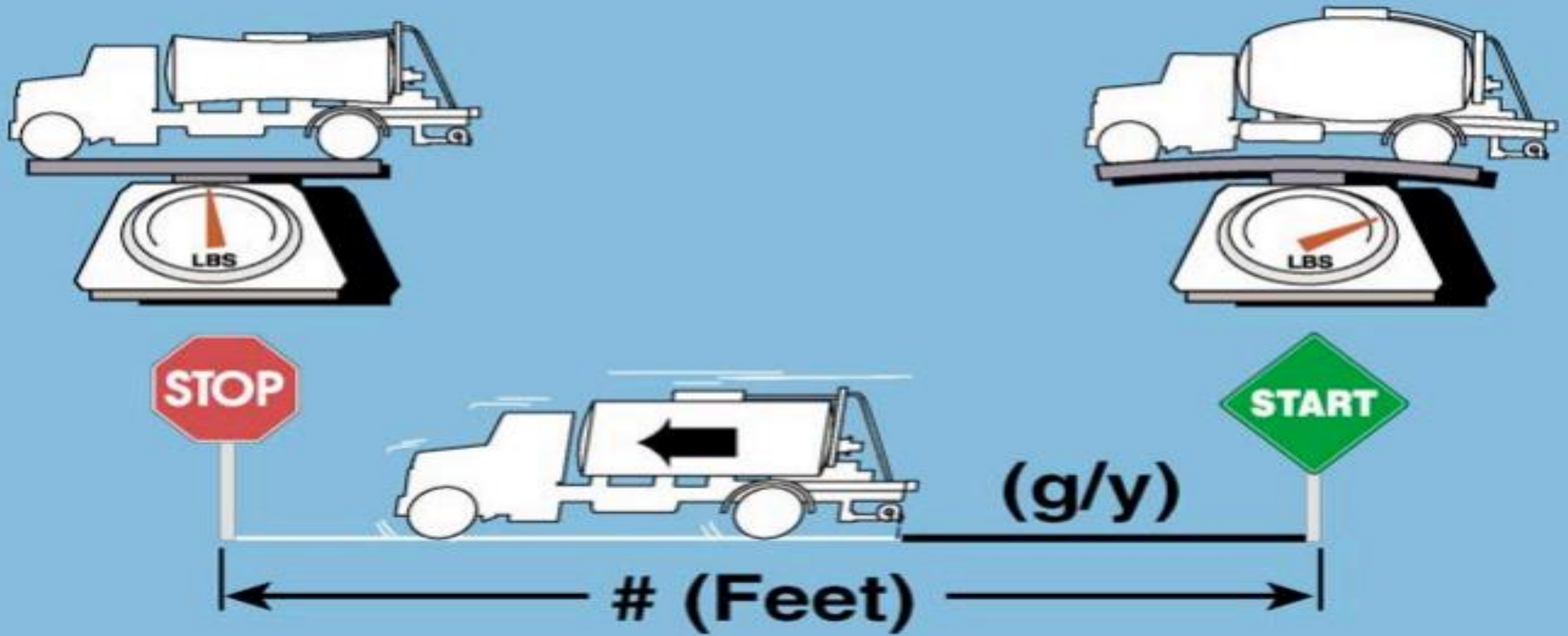
Too High = Ridges

Too Low = Gaps

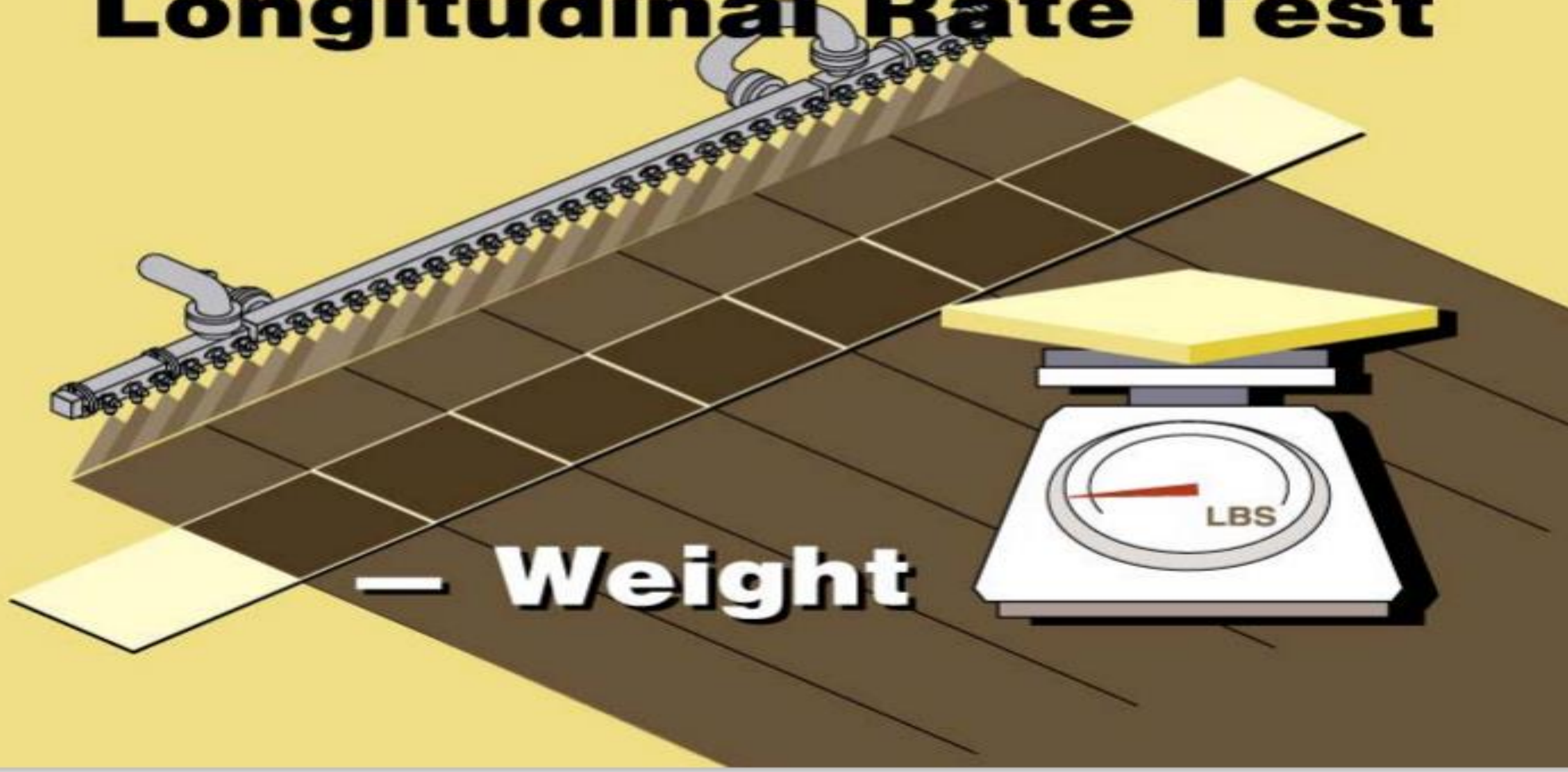

Stick the Tank
Volume

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

Weight

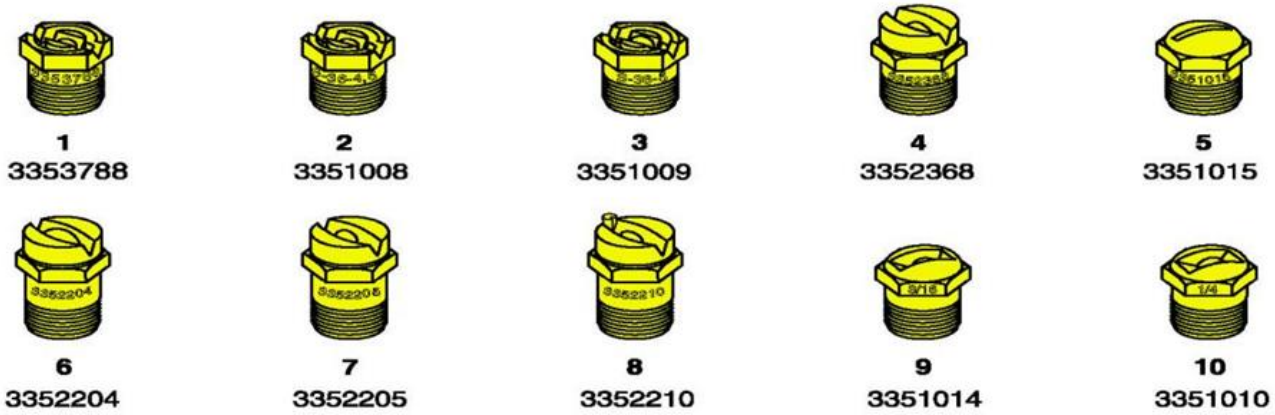


Longitudinal Rate Test



— Weight

Distributor Checklist



Ref.	Part No.	Description	Application Per Square Yard	Application (Metric) Liters Per Square Meter	Flow Gallons Per Minute Per Foot
1	3353788	V Slot Tack Nozzle	.05 - .20	.19 - .75	3.0 to 4.5
2	3351008	S36-4 V Slot	.10 - .35	.38 - 1.30	4.0 to 7.5
3	3351009	S36-5 V Slot	.18 - .45		7.0 to 10.0
4	3352368	Multi-Material V Slot	.15 - .40	.57 - 1.50	6.0 to 9.0
5	3351015	3/32" Coin Slot	.15 - .40	.57 - 1.50	6.0 to 9.0
6	3352204	Multi-Material V Slot	.35 - .95	1.30 - 3.60	12.0 to 21.0
7	3352205	Multi-Material V Slot	.20 - .55	.75 - 2.08	7.5 to 12.0
8	3352210	End Nozzle (3352205)	.20 - .55	.75 - 2.08	7.5 to 12.0
9	3351014	3/16" Coin Slot	.35 - .95	1.30 - 3.60	12.0 to 21.0
10	3351010	1/4" Coin Slot	.40 - 1.10	1.50 - 4.16	15.0 to 24.0

#6 Recommended for Chip Seals

Match Nozzles to Application

Scrub Seal
Emulsion Application Rates

- Target rate for Scrub Seals is based on the Minnesota Seal Coat Procedure plus 12% for the Scrub.
- Actual application rate is dependent on pavement condition and aggregate gradation. Don’t cheat on the application rate.

Shot Rate Adjustments

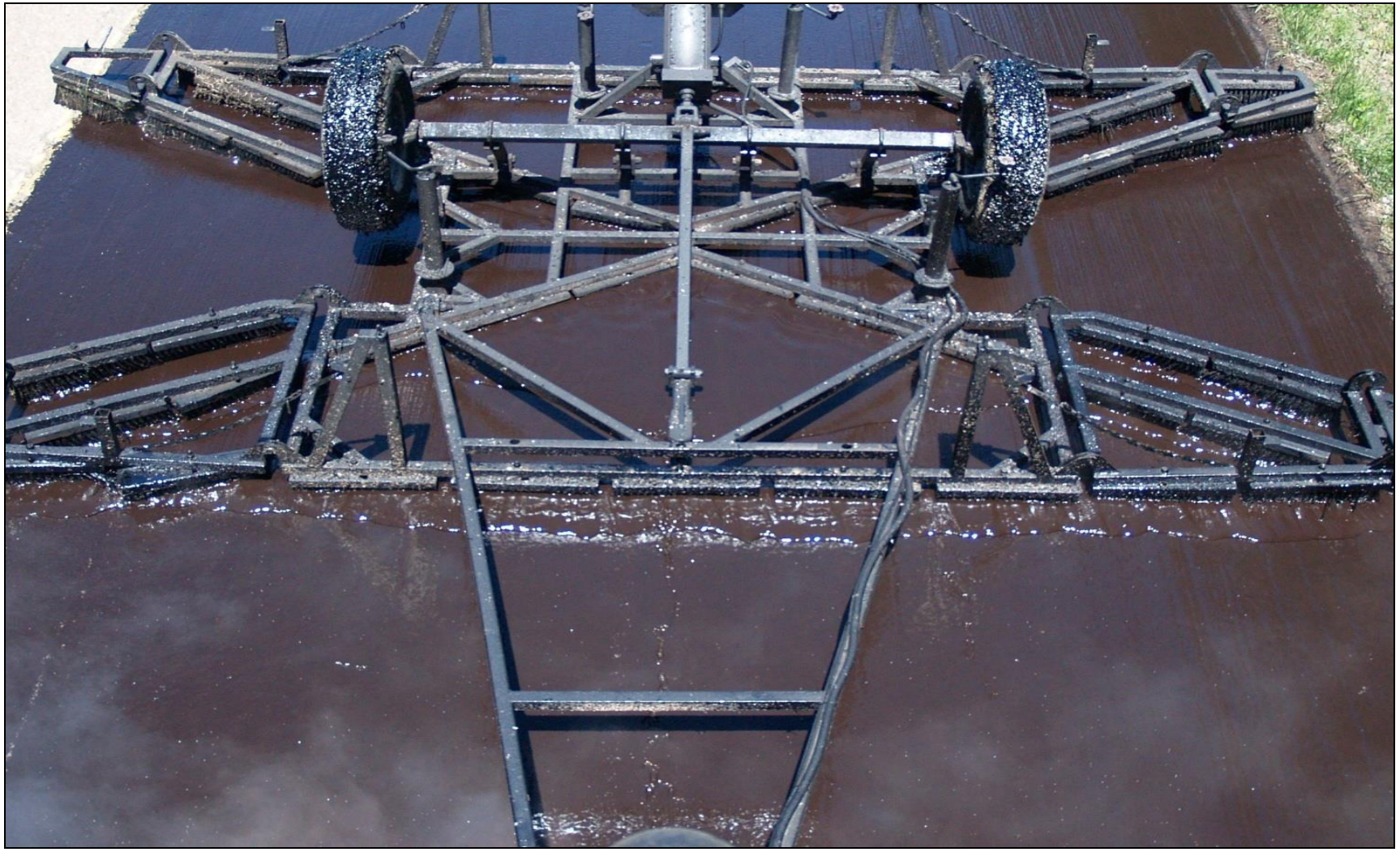
Pavement Condition	Factor	Adjustment
Flushed asphalt surface	0.70	-0.03 gal/yd^2
Smooth, non-porous surface	0.90	0.00 gal/yd^2
Slightly porous, oxidized surface	0.94	+0.02 gal/yd^2
Slightly pocked, porous surface	0.90	+0.04 gal/yd^2
Badly pocked, porous, oxidized surface	0.90	+0.06 gal/yd^2

Broom Checklist

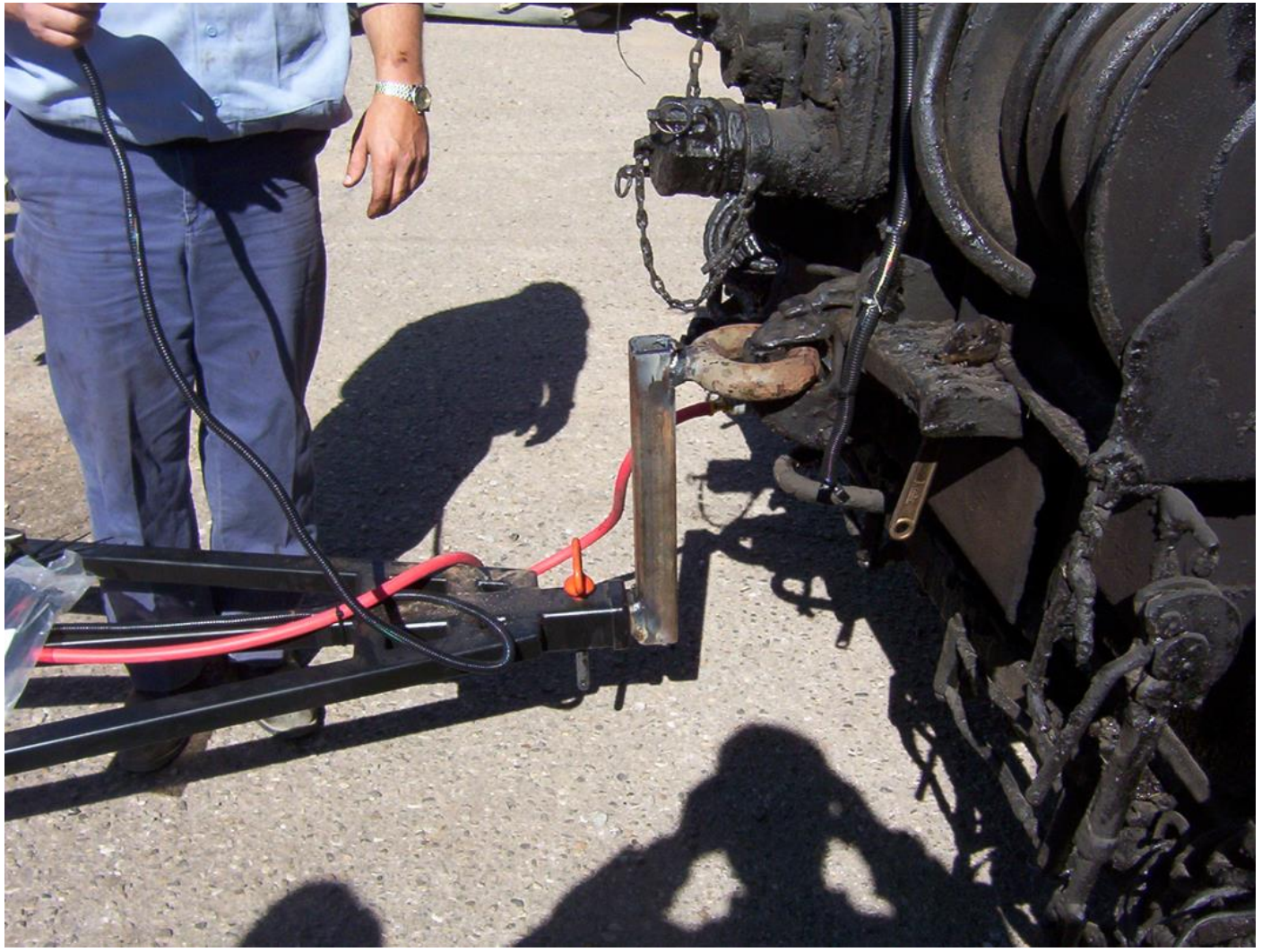
Broom Checklist

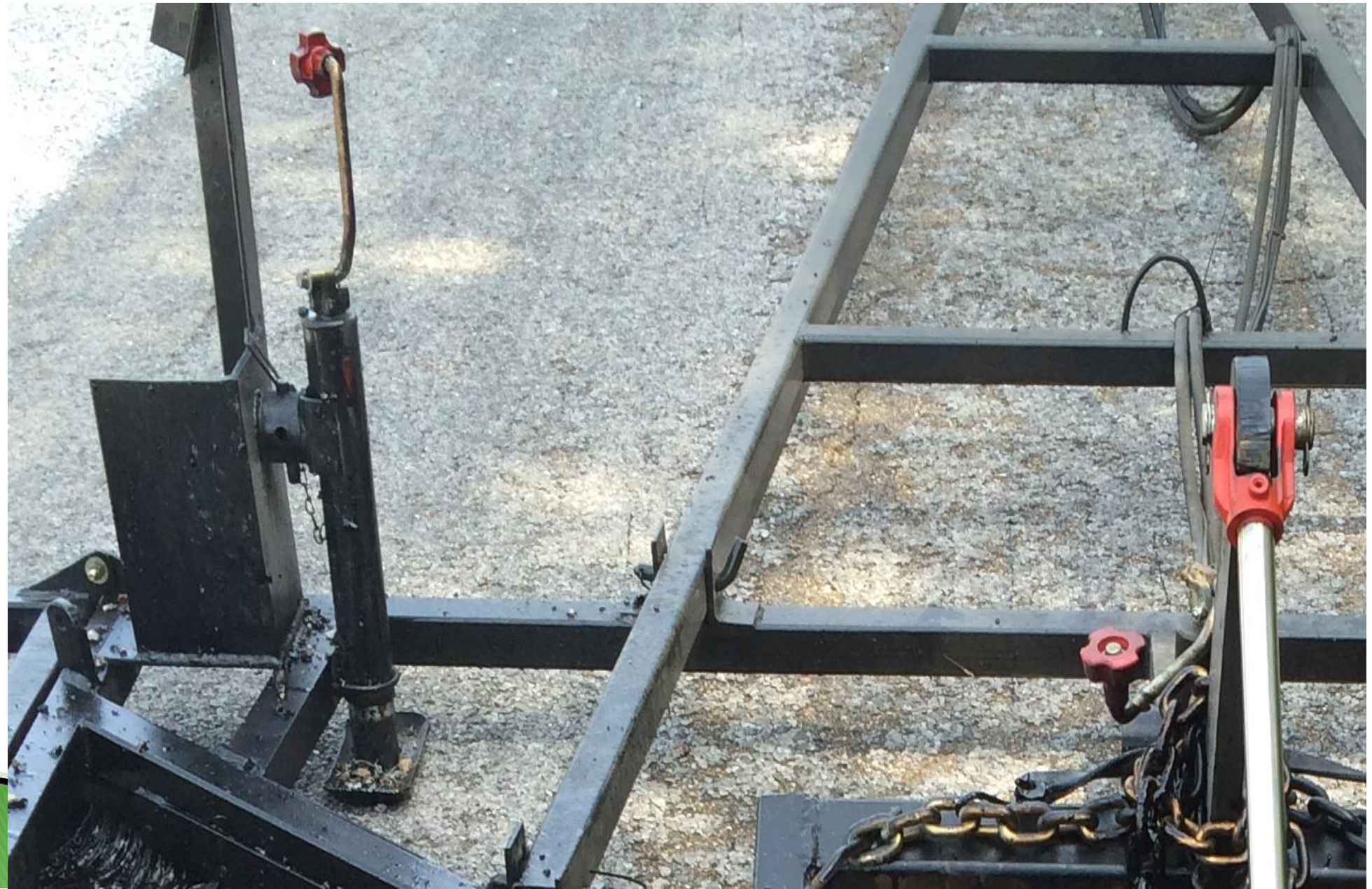
- Make sure air is working to the Broom
- Make sure Broom Heads are clean
- Make sure Broom Heads are touching the surface
- If Broom uses Skis, make sure they are adjusted correctly and supporting the Brooms.
- Do a Dry Run with the Broom to get acquainted
- Start the project with a 500 ft. test section
- Clean Broom Heads daily

Emulsion Wave



Keep Broom Level with Road Surface





Too MUCH weight on broom heads.

Brushes barely touching the pavement.

Broom Heads Ride on the Surface

Brooms should be aligned

Bristles should be clean

Broom

- What should you do when you are stopping?
- You need to refill the distributor. Now what?
- What should you do when you can't use the broom?

Transverse Joints

- The application of the polymer modified asphaltic rejuvenating emulsion and scrub broom operation shall cease 40 feet prior to the end of the application.

- The remaining polymer modified asphaltic rejuvenating emulsion shall be drug out by the scrub broom. Remaining emulsified material required to complete the pass to be applied by distributor truck.

Spreader Checklist

Chip Spreader Checklist

- Uniform aggregate application is a must
- Calibrated to ensure consistent discharge across width
- Hopper clean and clear of debris and clogs.
- Spread Hopper Gates are set correctly.
- Well Maintained, no hydraulic leaks.
- Correct Tire Pressure
  - Unit will bounce if pressure is too high.

Haul Trucks Checklist

- Compatibility
- Dirty Tires cause “ pick ups”
- No sharp turns
- Enough trucks to do the job
- No Leaks
- Stagger wheel paths
- Chip Bar and Tailgate latch required.
- Watch the Air Tank Bleed Valve. Can damage seal if directed straight down.

Check each truck for hitch acceptance!

Stockpile and Loader Checklist

- Loader must be leak free
- Stockpile must be clean and stable to avoid contamination of aggregate.
- Stockpiles free draining avoid water entrapment
- Minimal handling will help reduce degradation.

Roller Checklist

- Nine Wheel Pneumatic Rollers
- Minimum two rollers, three is best
- Orients aggregate on flattest side.
- Embeds aggregate in binder
- Achieves mechanical lock of aggregate particles
- 8 ton minimum
- Tire Pressure
  - 85 psi
  - No variance of more than 5 psi between all tires

Broom Checklist

- Self propelled
- Four Wheels
- Watch Speed – Do No Harm
- Plastic Bristles (Not Wire)
- Cleans existing road surface and joints
- Used to remove excess aggregate when binder is fully cured.
- Water may be used for dust.
- Rotary / Vacuum / Pick up

Application Strategies

Road Preparation Checklist

- Weed Removal Complete
- Fog Longitudinal Paint Lines
- Thermo-Plastic striping removed
- Pre-Sweep Complete
- Utilities Protected
- Temporary Markings in Place

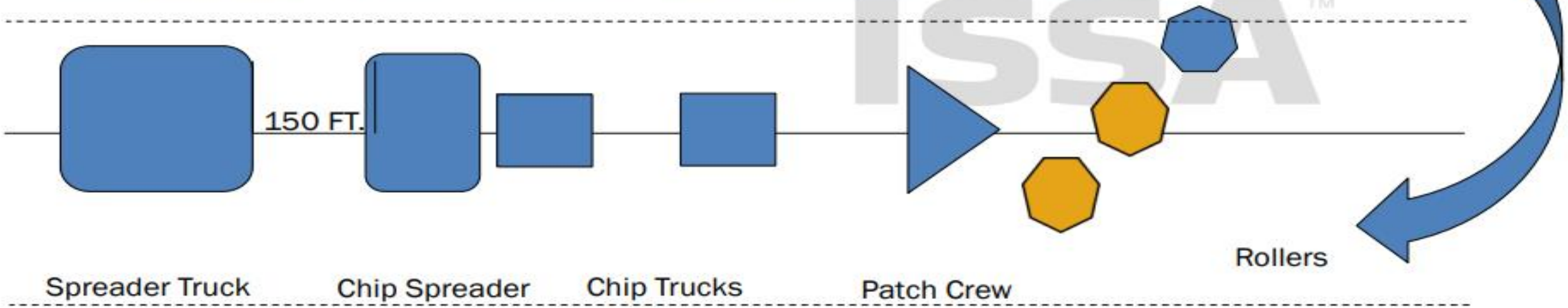
Traffic Considerations

- Ideally, keep traffic off until emulsion cures sufficiently to hold the aggregate.

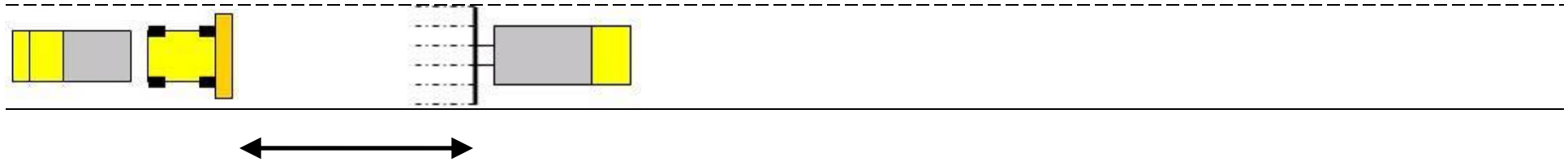
Traffic Considerations

- Control traffic by:
  - Use of pilot vehicles
    - Pilot vehicle is the lead through the workzone.
    - Maintains low (15 mph) speed.
  - Close road
  - Advance notice signage, alternate route
  - Multilane roads – keep lane closed

Equipment Placement



Emulsion/Agg Spreading



This way…

Distributor and Agg Spreader Virtually Joined Together

Emulsion/Agg Spreading

NOT this way…

Causes too many joints, and may cause uneven chip retention

Application Checklist

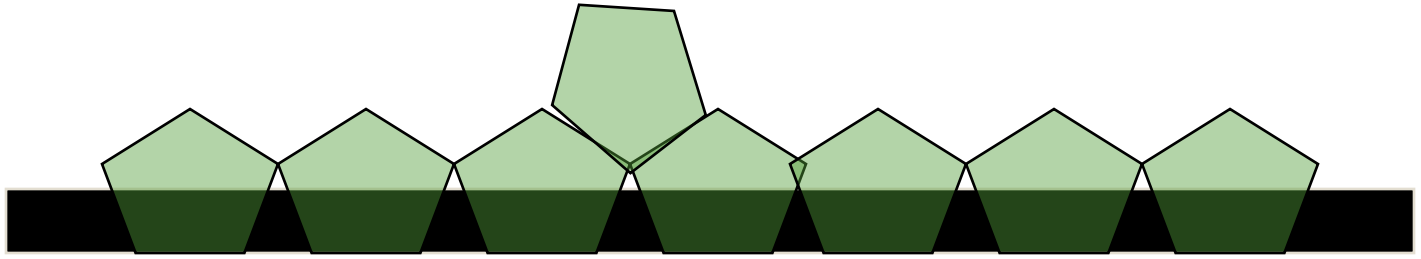
- Air and Ambient Temperature above 55F*. Above 40F overnight
- Dry pavement, no rain forecast for 24 hours.
- Emulsion heated to manufacturers requirements (145 – 185F)
- Aggregate damp but not wet
- Tar Paper set at beginning and end of emulsion shot.
- Chip Spreader width set to leave a narrow strip of uncoated emulsion.

Application Checklist

- Chip Spreader stays within 150 ft. of Asphalt Distributor.
- Adjust speed so that Chip Spreader doesn't bounce.
- Stop after first 1,000 ft. Check for:
  - Emulsion Application Rate
    - Too Little Emulsion is much worse than Too Much!
  - Aggregate Application Rate
    - Salt and Pepper
    - Embedment
  - Quality of Mat
    - No streaks, ridges, pickups

Aggregate Application

- Don’t over apply
  - Ideally, 1 stone thick
  - Too much is as bad as not enough
  - “Salt and Pepper” appearance

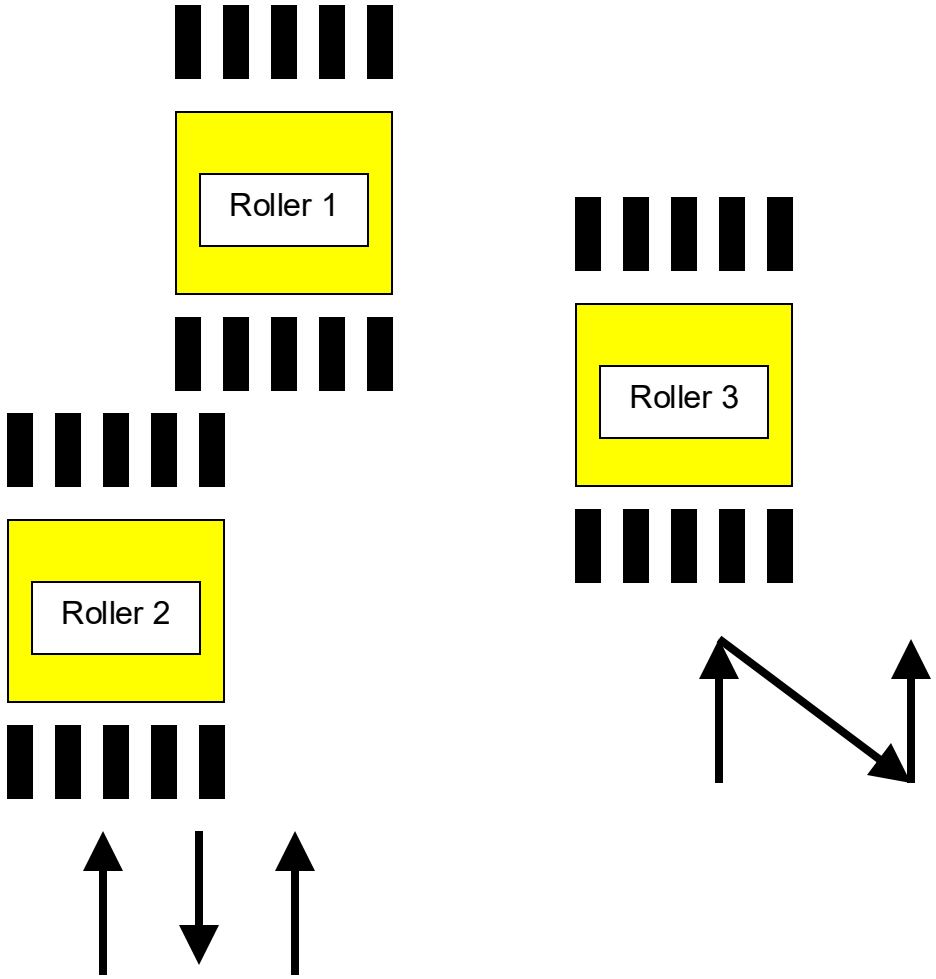


Application Checklist

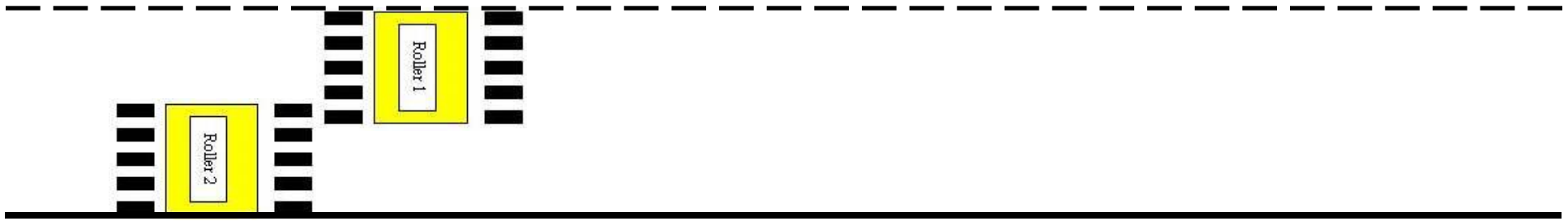
- Enough rollers available to make three passes while keeping up with the Chip Spreader without exceeding 3 – mph.
- Watch for rooster tails of dislodged aggregate for fast rolling.
- Rollers limit turning and stopping on fresh seal.
- Keep tires clear of emulsion.

Construction

- Rollers
  - At least 3 passes (“Applications”)
  - 2 Roller Pattern
  - 3 Roller Pattern

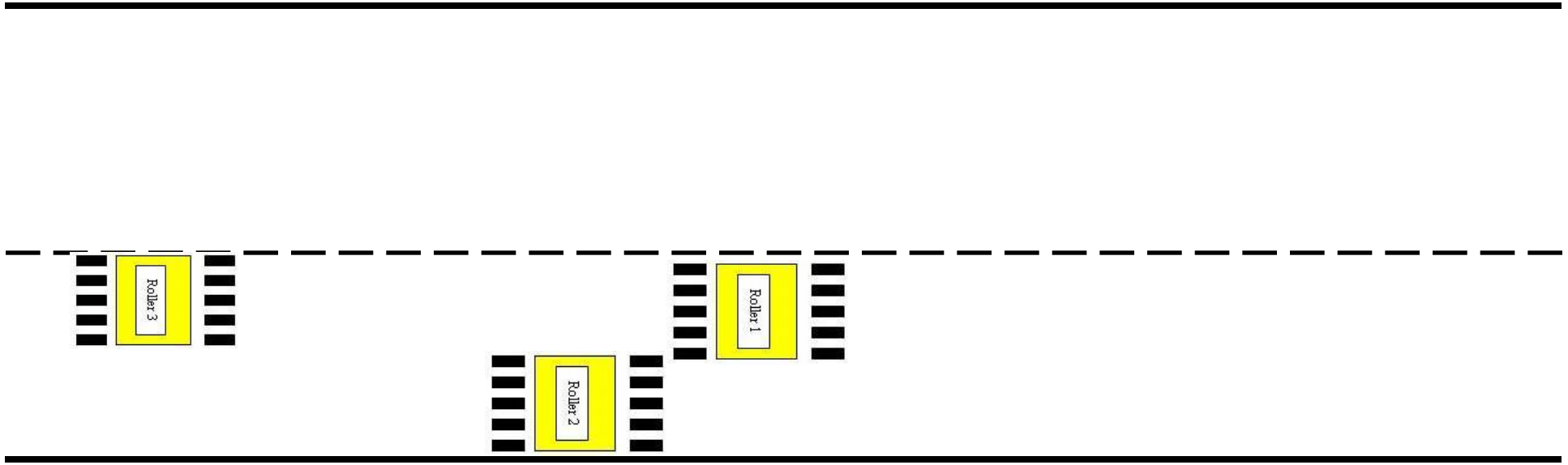


2 Roller Preferred Pattern



Both rollers stay in line

3 Roller Preferred Pattern



Rollers 1 and 2 stay in line (same as 2 roller pattern),

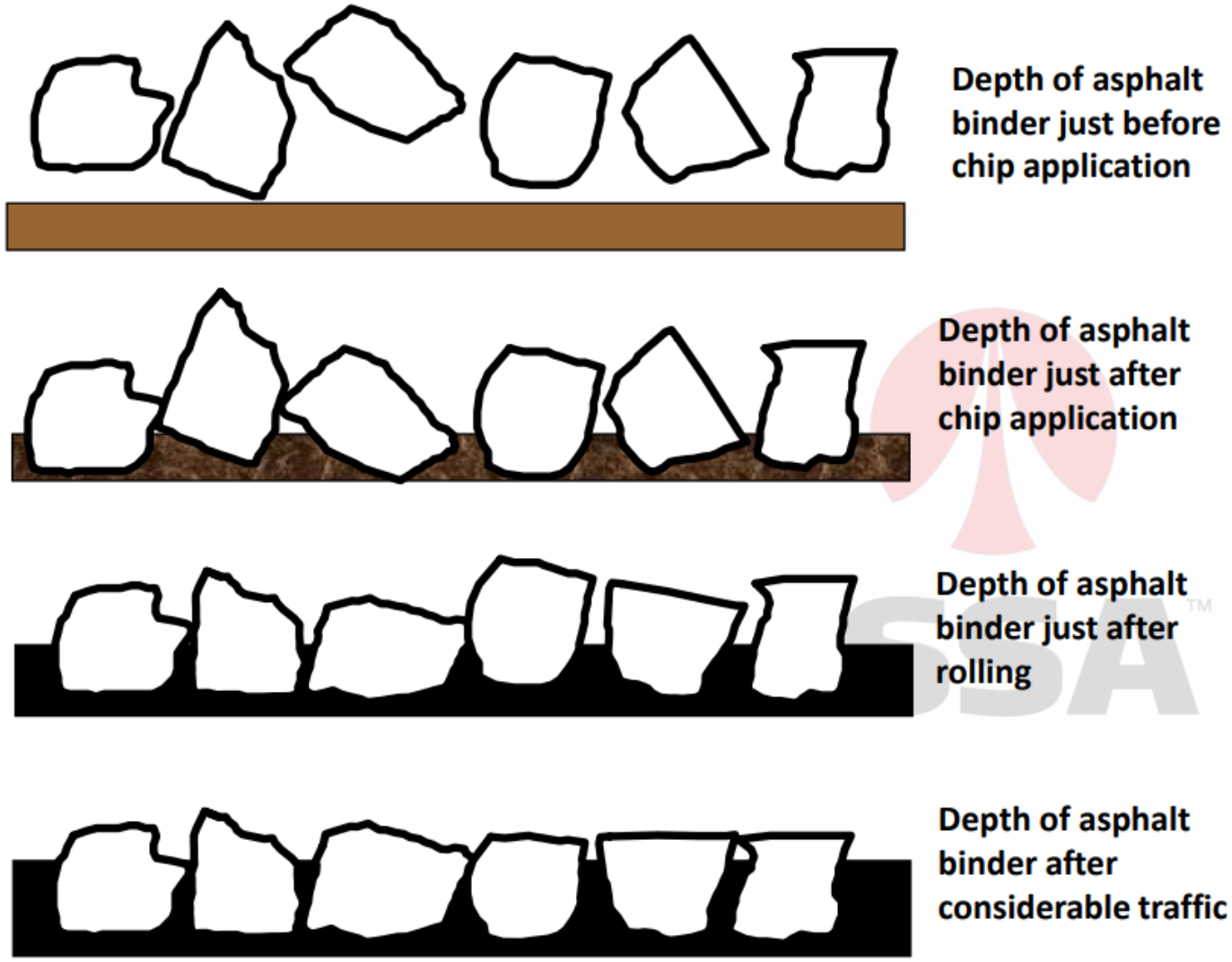
Roller 3 zigzags

Application Checklist

- Brooming should start when emulsion is cured; usually between one and two hours after rolling.
- Light brooming only. Heavy brooming removes excess chips. Excess chips remove other chips. Embedment is lost.
- Broom centerline joint if necessary.
- Open to controlled rolling traffic as soon as safely possible

Final Thoughts

- Remember, Embedment of the stone is key!
- Everything you do should be aimed at achieving proper embedment and minimum stone loss.



Aggregate Application

Fog Seal

Why Fog Seal?

- Dense Graded HMA
  - Protects asphalt from oxidation and moisture intrusion
  - Reduces raveling on dry mixes
  - Fills fine cracks
- Chip Seals
  - Protects asphalt from oxidation and moisture intrusion.
  - Locks In Chips
  - Reduces Snowplow damage
  - Dark surface helps with snow and ice melt.
  - Dark surface highlights traffic markings

Fog Seal Materials

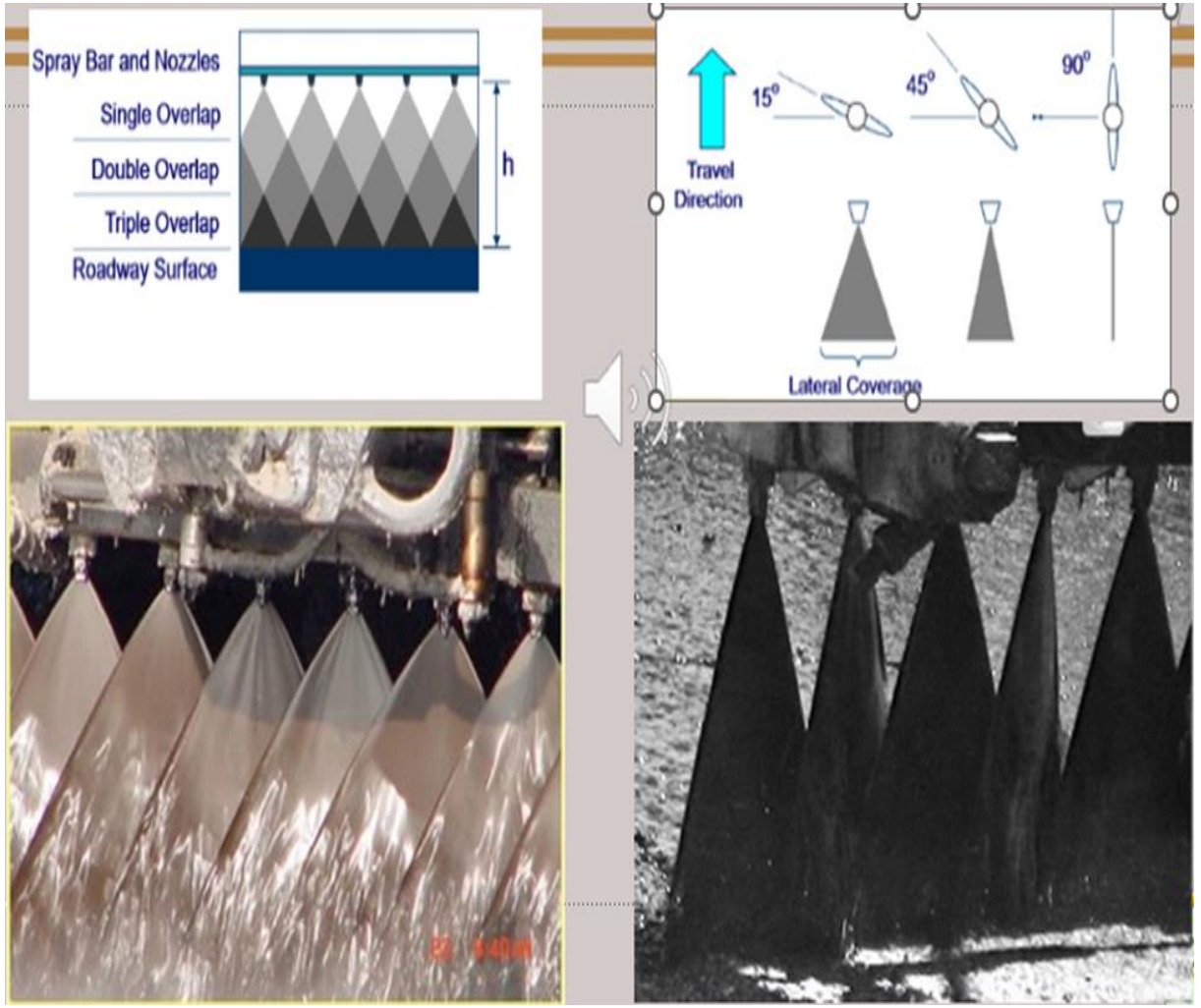
- Emulsion
  - CSS-1h
    - Pre-Diluted to 27 to 35% residual by manufacturer
    - Do not field dilute
    - Heat CSS-1h to 150 F prior to application
    - Never heat CSS-1h over 185 F
- Blotter Aggregate
  - Fine Aggregate
  - Used as needed (pedestrian traffic, over applied emulsion)

Application Rate

- Emulsion Application Rate typically ranges from 0.10 gal/sy to 0.15 gal/sy.
- Start test strip application at .12 gal/sy to make sure surface isn't flooded.
- Adjust as needed to completely coat surface without puddling.

Distributor Best Practices

- Set spray bar at 12” Height to ensure triple overlap
- Check Nozzle Alignment
  - Outside nozzles may be turned for straight edgeline.
- Ensure correct distributer nozzles
  - Etynre Part # 3353788
  - Different than Chip Seal Nozzles



Application Best Practices

- Sweep roadway immediately ahead of Fog Seal Operation.
- Cover all Manholes, Valley Gutters, etc.
- Start with a 500 ft. Test Strip to check application rate, nozzles, spray bar height.

Opening To Traffic

- Allow the asphalt emulsion to cure before permitting traffic.
- Minimum cure time is 30 minutes but may extend due to environmental conditions, application rate and emulsion residue content.

Troubleshooting

- Excessive Splattering
  - Bar height is incorrect
  - Spray pressure is too high
- Streaking
  - Cold emulsion
  - Nozzle angles are incorrect
  - Bar height is incorrect
  - Plugged nozzles
  - Pump pressure too low
  - Clogged Screens
- Bleeding or Flushing
  - Application rate too high

SPECIFICATION REVIEW

S-1 (2356) BITUMINOUS SCRUB SEAL

S-1.1 DESCRIPTION

This Work consists of constructing a bituminous scrub seal in accordance with MnDOT 2356. Delete 2356 Bituminous Seal Coat and Bituminous Underseal and replace with this specification.

S-1.2 MATERIALS

A Bituminous Materials

A.1 Bituminous emulsion .....

Provide polymer modified rejuvenating emulsion (PMRE) meeting the requirements of AASHTO M 345, "Standard Specification for Materials for Emulsified Asphalt Scrub Seal," Section 5, with the following modification: (1) Distilled at 400°F for 15 minutes.

A.2 Bituminous emulsion for Fog Seal ..... MnDOT 3151.2D.1.a

B Scrub Seal Aggregate

Job mix formula tolerance .....MnDOT Table 3127.2-1
Quality requirements.....MnDOT Table 3127.2-2
Scrub seal Aggregate ..... Table SP2356-2

Table-SP2356-2
Aggregate Gradation

Sieve size	Percent passing by weight
⅜ in	100
No. 4	10 - 80
No. 8	5 - 30
No. 16	0 – 15
No. 200	0 – 2.0

C Water .....MnDOT 3906

S-1.1 CONSTRUCTION REQUIREMENTS

A Scrub Seal Design

Design the scrub seal and determine the starting application rate for the bituminous Material and scrub seal Aggregate in accordance with Minnesota Seal Coat Handbook. Base the mix design on the traffic volume and pavement conditions.

Provide the following two weeks prior to beginning the Work:

(1) Gradation and quality test results as specified in MnDOT 3127.3, "Sampling and Testing"
(2) Scrub seal Aggregate design application rate
(3) Bituminous Material design application rate, plus 12%.
(4) 150 pound sample of Aggregate from each proposed Aggregate source

Obtain acceptance from the Engineer prior to beginning the Work.

B Weather, Time and Date Limitations

Apply the bituminous scrub seal in accordance with the following:

(1) From May 15 to August 31, or as approved by the Engineer
(2) During daylight hours
(3) Pavement and air temperatures are 60°F and rising
(4) The Road surface may be damp, but do not perform Work if there is standing water on the Road surface
(5) Do not perform Work during foggy weather or if the National Weather Service forecast predicts rain in the construction area within 12 hours

A Provide the following Equipment for the Work.

A.1 Distributor in accordance with MnDOT 2360.3B.2.d, "Distributor".

A.2 Aggregate Spreader

Self-propelled mechanical type Aggregate spreader, mounted on pneumatic-tired wheels, capable of distributing the Aggregate uniformly to the pavement surface over the width shown in the Plan at the design application rate.

Calibrate the Aggregate spreader to meet the requirements of *ASTM D5624, Standard Practice for Determining the Transverse-Aggregate Spread Rate for Surface Treatment Applications*, if required by the Engineer.

A.3 Pneumatic-Tired Rollers

A minimum of three self-propelled Pneumatic-tired rollers in accordance with MnDOT 2360.3B.2.e(2), "Pneumatic Tired Rollers."

A.4 Brooms

Self-propelled motorized brooms with the following characteristics:

(1) Positive means of controlling vertical pressure
(2) Capable of cleaning the Road surface before applying bituminous Material
(3) Capable of removing loose Aggregate after scrub sealing

B Test Strip

Begin the rate of application for the bituminous Material as determined by the mix design (plus an additional 12%) and the Aggregate at the design application rate. Construct a 200 foot long test strip, to ensure the application rates are adequate given the field conditions. Obtain the Engineer's acceptance of the test strip before proceeding with the Work. Additional test strips will be constructed until the emulsion application rate is accepted by the Engineer.

C Road Surface Preparation

Sweep pavements with broom, including depressions, before scrub sealing. Cover iron fixtures in or near the pavement to prevent adherence of the bituminous Material. Remove the protective coverings before opening the Road to traffic.

D Application of Bituminous Material

D.1 Pre-Treat Longitudinal Pavement Markings

Apply bituminous Material 1 foot wide over longitudinal pavement markings. Cover centerline skip stripes with continuous coverage. Apply in a rate range of 0.10 to 0.15 gallons per square yard. Apply bituminous Material for scrub seal immediately after pre-treating pavement markings.

D.2 Application of Bituminous Material for Scrub Seal

Apply the bituminous Material to the pavement.

Scrub bituminous Material with the scrub broom system.

Maintain a minimum brush bristle length of 5 inches.

Add weight to the scrub broom if necessary to fill the cracks and pores.

Remove weight from the scrub broom if excess bituminous material is brushed off the pavement surface.

Construct one full lane width at a time.

Apply the CMS-2P at a temperature between 140°F and 180°F.

A Application of Aggregate

Maintain the Aggregate application rate within 1 pound per square yard of the mix design.

Blend Aggregate at the stockpiles to provide uniformly damp material.

Place Aggregate within 1 minute after applying the bituminous Material.

Do not use previously applied Aggregates.

B Rolling Operations

Complete the initial rolling immediately after applying the Aggregate at a speed no greater than 5 mph to prevent turning over Aggregate. Make at least 3 complete passes over the entire width of the treatment area.

C Sweeping

Remove surplus Aggregate on the same day as the scrub seal construction. Resweep areas the day after the initial sweeping.

Provide at least one street sweeper (with pickup broom) on roadways with curb and gutter to remove loose aggregate. Dispose of the swept material in accordance with MnDOT 2104.3D.3.

D Protection of the Surface

Do not allow traffic on the scrub sealed Road surface until after the initial sweeping is completed.

E Protection of Motor Vehicles

The Contractor is responsible for damages claims; insurance in accordance with MnDOT 1714.

A Application of Bituminous Material for Fog Sealing

Apply a bituminous fog seal in accordance with MnDOT 2355, "Bituminous Fog Seal," and the following:

Cure scrub seal a minimum of one Calendar Day before applying the fog seal.

Minimize overspray of materials during application.

Construct a 200 foot test strip using an application rate between 0.07 gallon to 0.18 gallon per square yard diluted unless otherwise indicated in the Plan. Review the application rate of diluted bituminous Material and adjust the application rate as necessary to yield a uniform full coverage of the underlying scrub seal. Obtain Engineer's acceptance prior to proceeding.

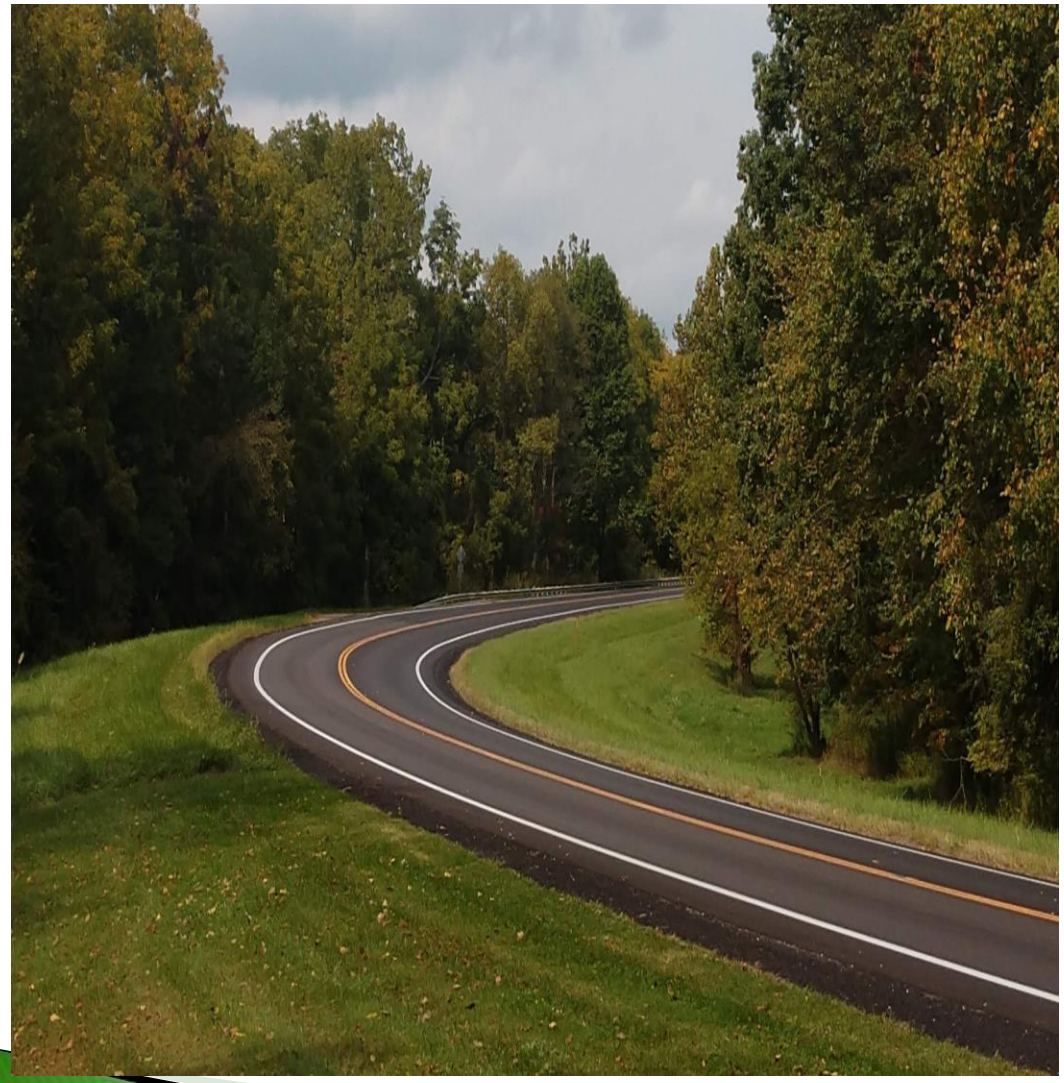
Do not allow traffic on the fog seal until it has cured.

B Pavement Markings

Cure fog seal a minimum of 3 Calendar Days before placing permanent pavement markings when using latex paint.

Cure fog seal a minimum of 14 Calendar Days before placing all other types of permanent pavement markings.

Questions or Comments ?



15 MINUTE BREAK!