Mississippi PG3 Training

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NCPP

National Center for Pavement Preservation

MICHIGAN STATE UNIVERSITY

Best Practices for *Scrub Seal* Applications

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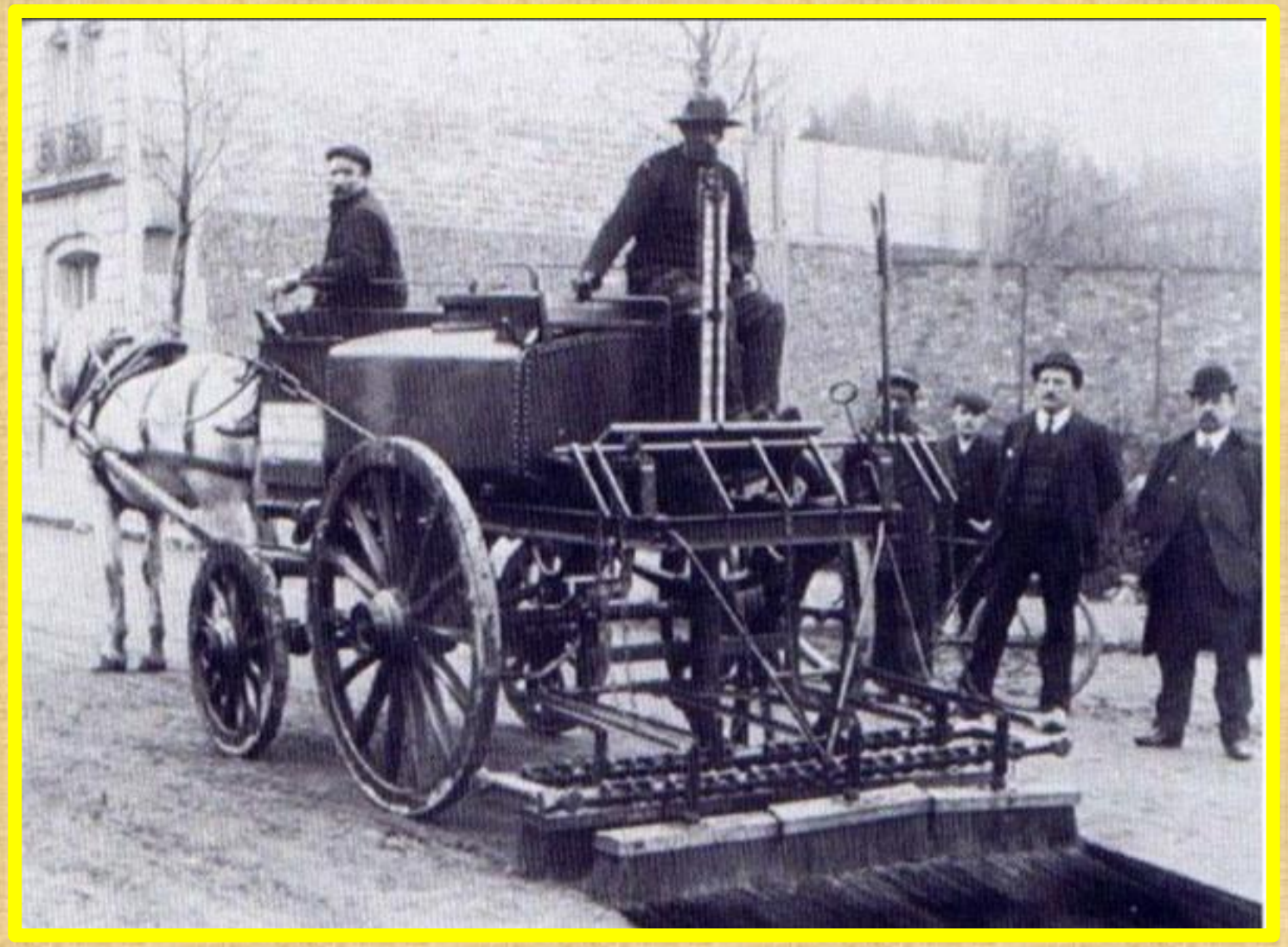
What is pavement preservation?

- When the right treatment is applied to the right road at the right time, roads can be kept in good condition instead of performing costly rehabilitation and reconstruction alternatives later in the pavement's life when the structure has deteriorated.

Source: National Center for Asphalt Technology (NCAT) at Auburn University.

Pavement Preservation
Scrub Seal in early 1900

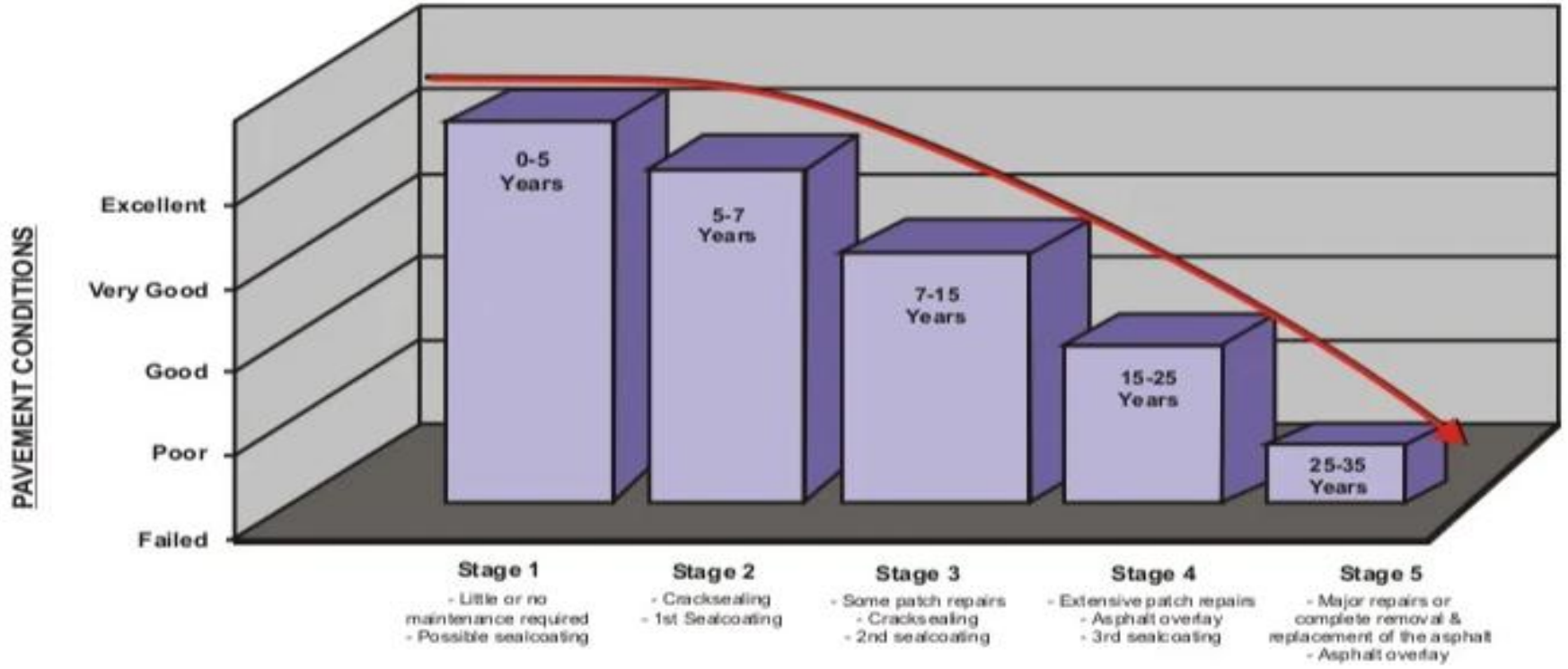


Pavement Preservation
Micro Surfacing in China

Pavement Preservation

BLACK DIAMOND
PAVING

PAVEMENT LIFE CYCLE

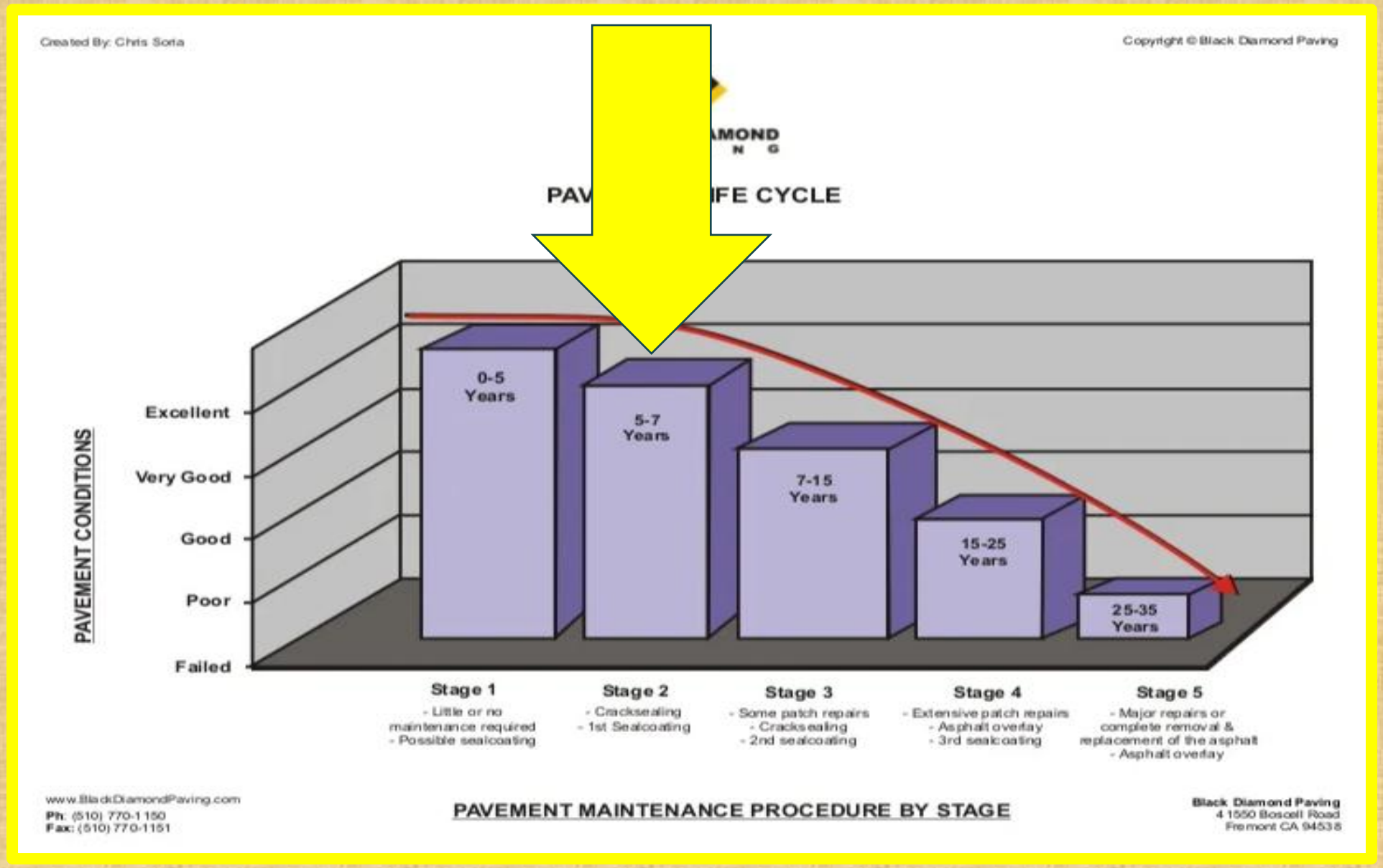


PAVEMENT MAINTENANCE PROCEDURE BY STAGE

www.BlackDiamondPaving.com
Ph: (510) 770-1150
Fax: (510) 770-1151

Black Diamond Paving
41550 Boscell Road
Fremont CA 94538

Time for Scrub or Micro?

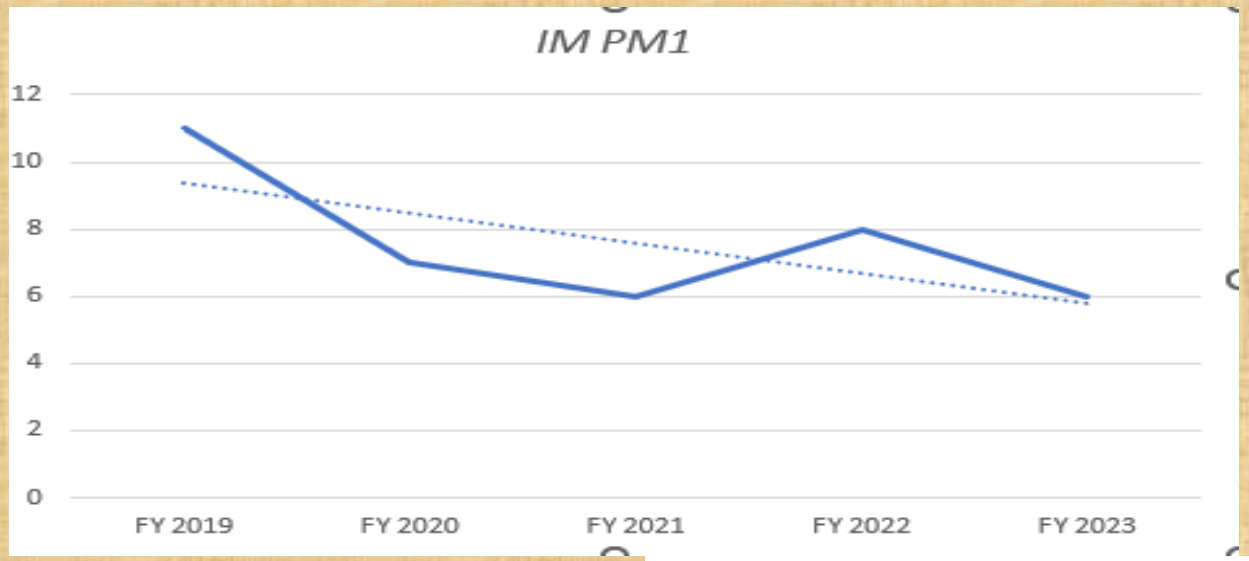


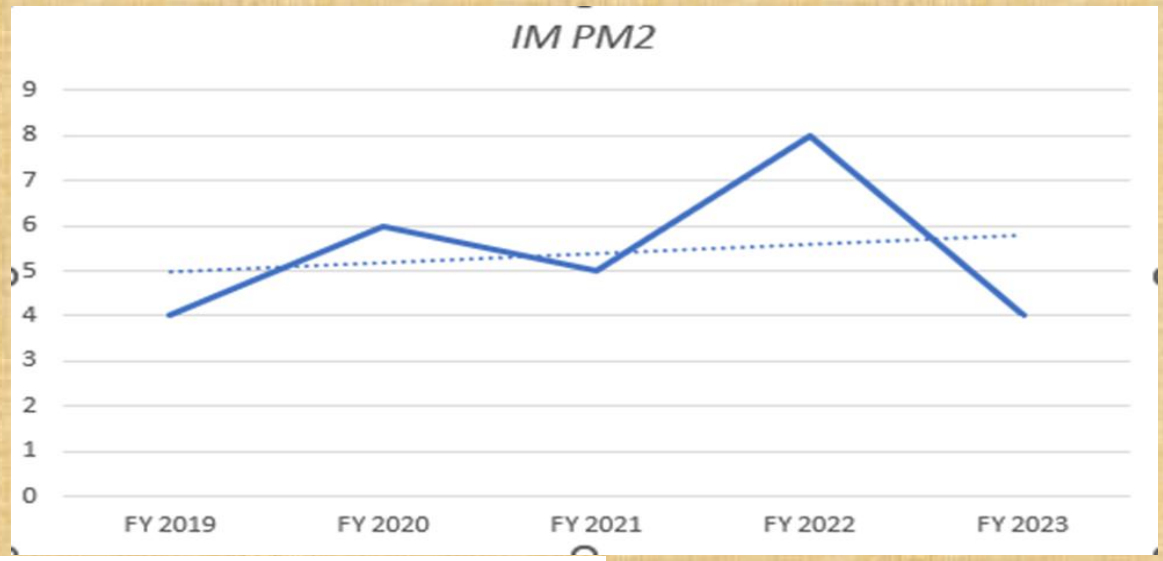
FY 2019 – FY 2022 Overview
Amount spent on IM preservation projects

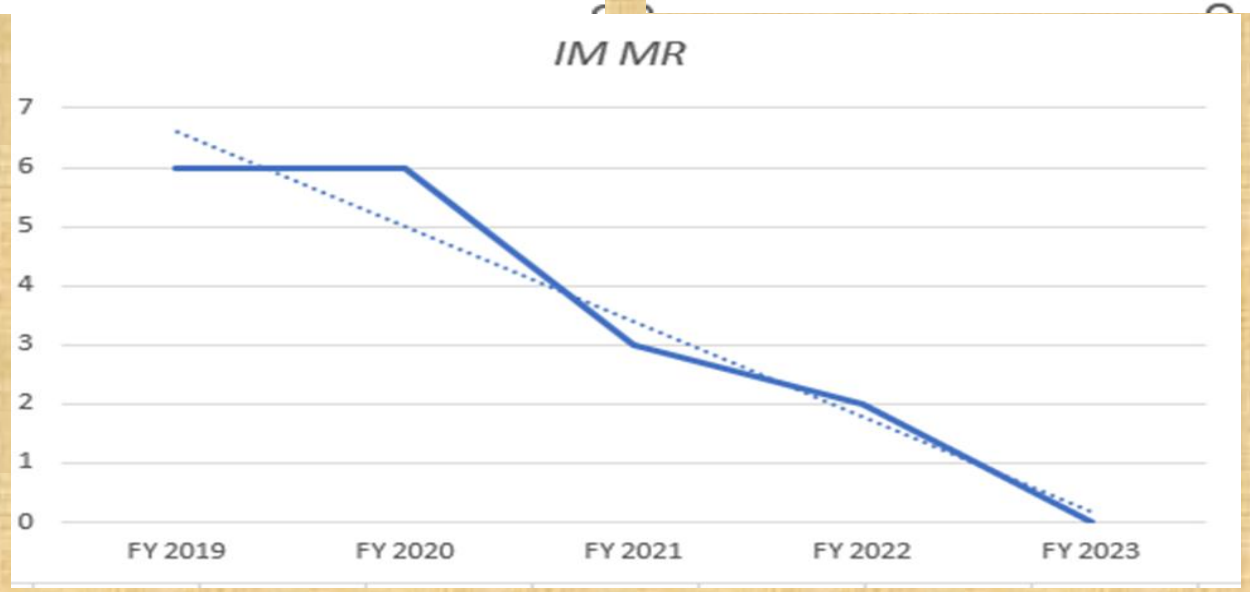
- **24%** of the $587.7m used for IM Pavement management, from 2019-2022, was spent on **PM1**

IM Resurfacing FY 2019 - FY2022				
	PM 1	PM 2	MR	total
FY 2019	11	4	6	21
Amount Spent	$40.60	$46.10	$92	$178.70
FY 2020	7	6	6	20
Amount Spent	$41.20	$41.90	$67.40	$150.50
FY 2021	6	5	3	14
Amount Spent	$26.50	$54.60	$42.30	$123.40
FY 2022	8	8	2	18
Amount Spent	$32.10	$56.90	$46.10	$135.10
Total:	32	23	17	$587.70

FY 2019 – FY 2022 Overview
Amount spent on IM preservation projects







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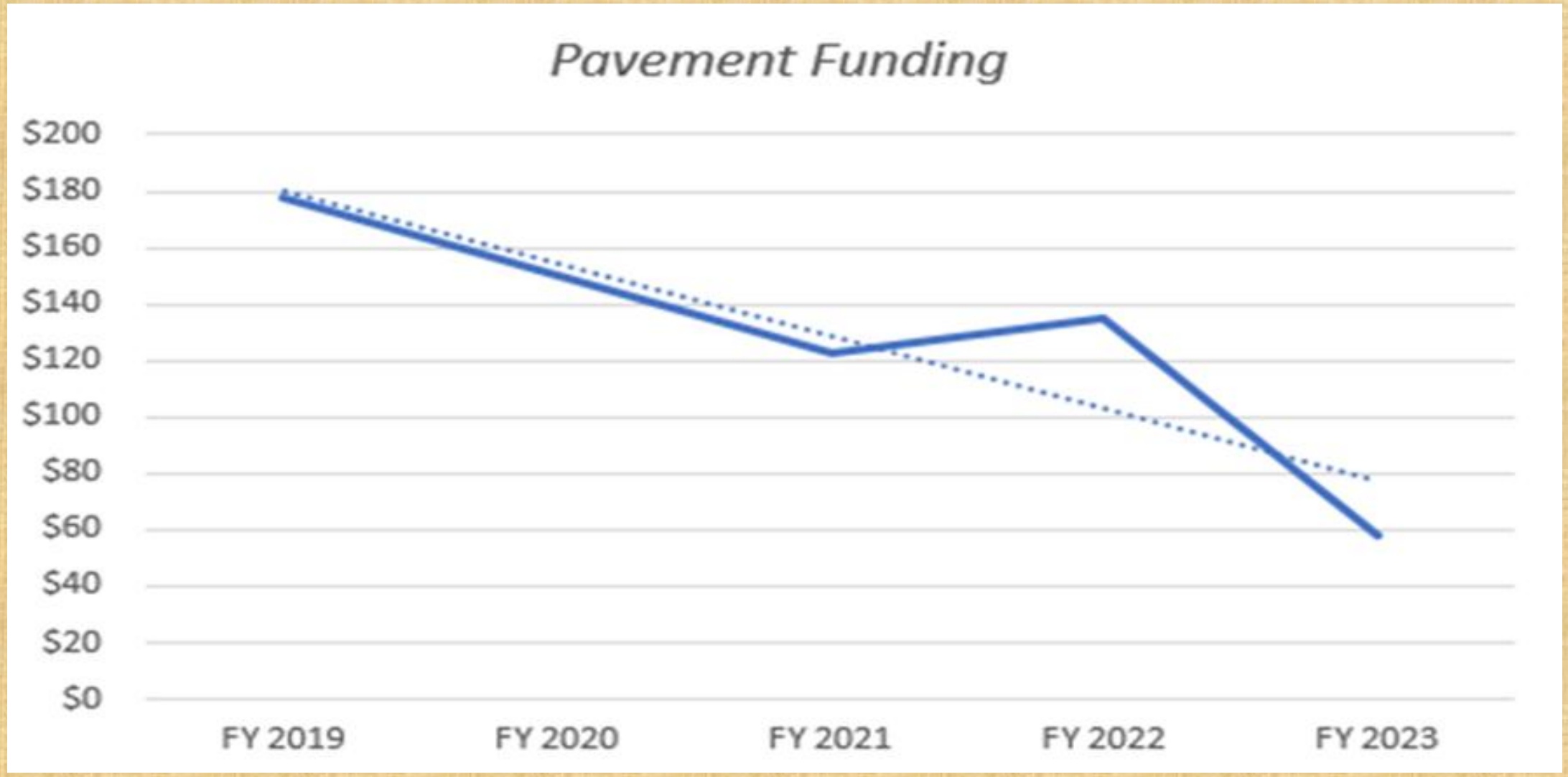


Chip Seals

- Are Not Intended As Permanent Surfaces
- Are Expected to Last 5-7 Years
- May be placed in multiple applications (Don’t stack fresh scrub seal applications!!)
- May be placed as repeat applications over time
- Improve skid

Chips Seals Do NOT

- Provide structural strength
- Strengthen the existing pavement
- Increase load-bearing capacity
- Restore profile
- Bridge > 1/4” cracks
- Smooth rough pavement
- Eliminate the need for Maintenance or Reconstruction

What is a Scrub Seal?

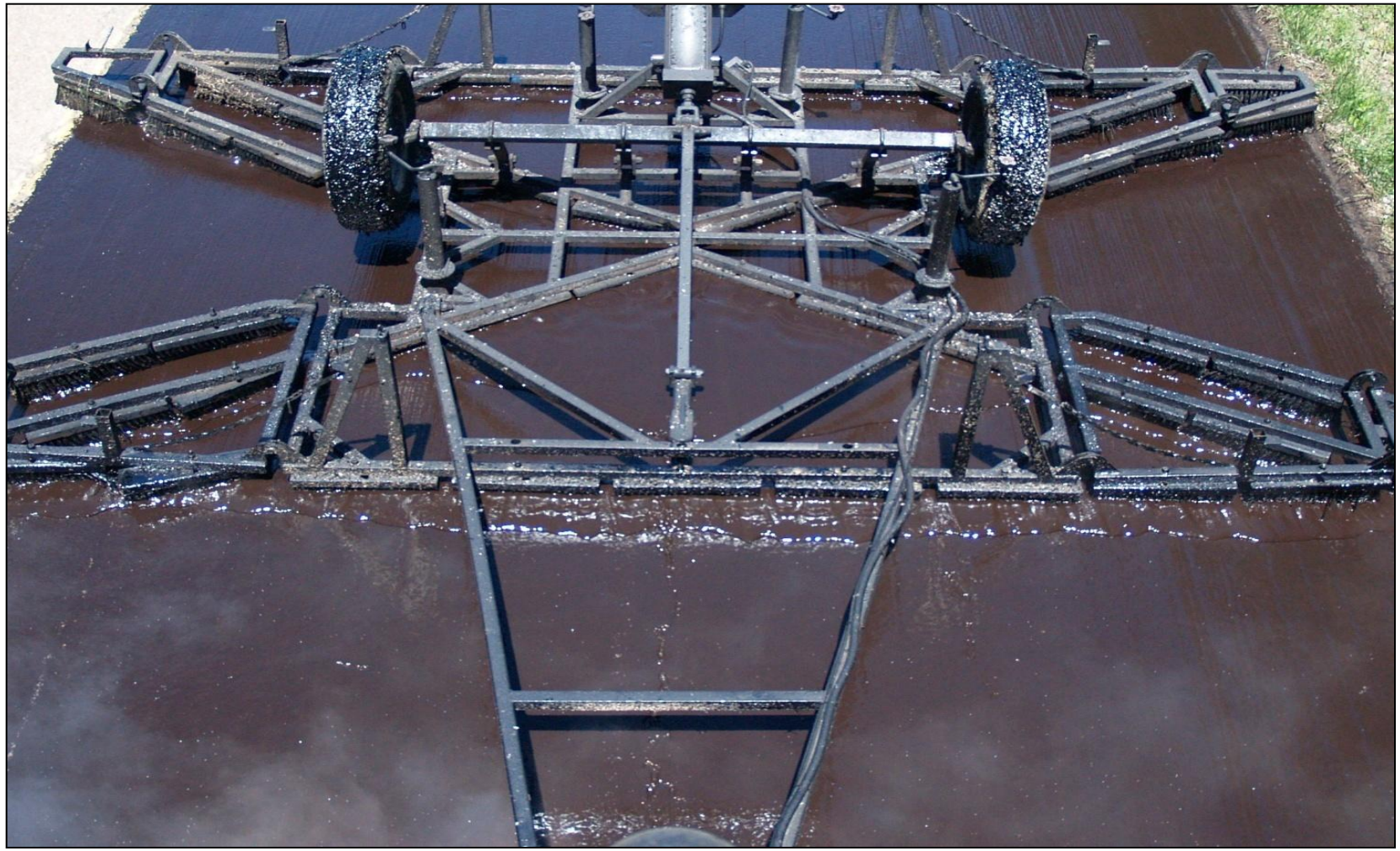
Same as a chip seal except for:

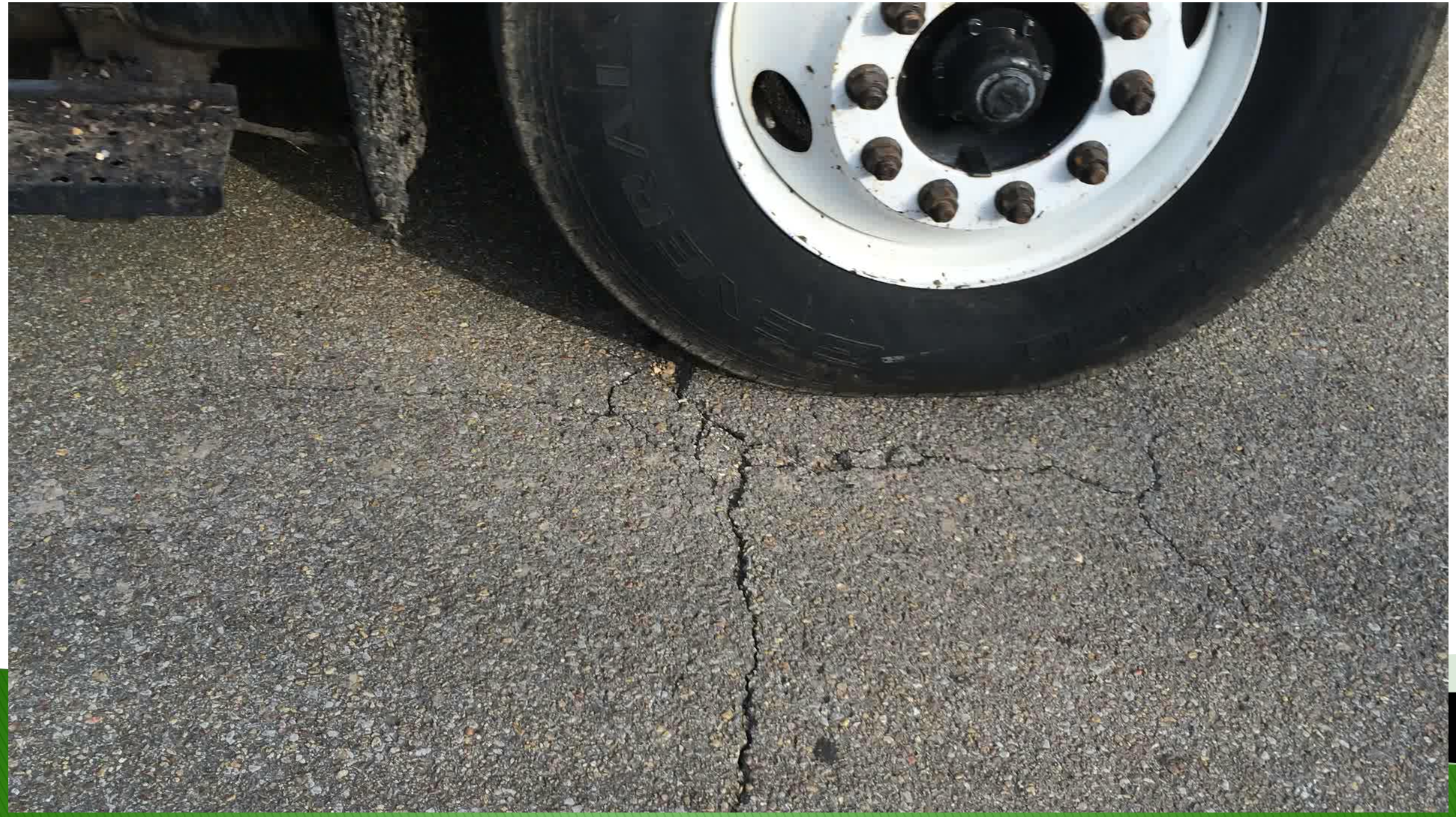
- A different emulsion (polymer-modified asphalt rejuvenation emulsion) is utilized, CMS-1PC.
- A broom sled is connected to the distributor to "scrub" the emulsion into cracks in the existing surface.

Scrub Seal Application

Scrub Seal Application

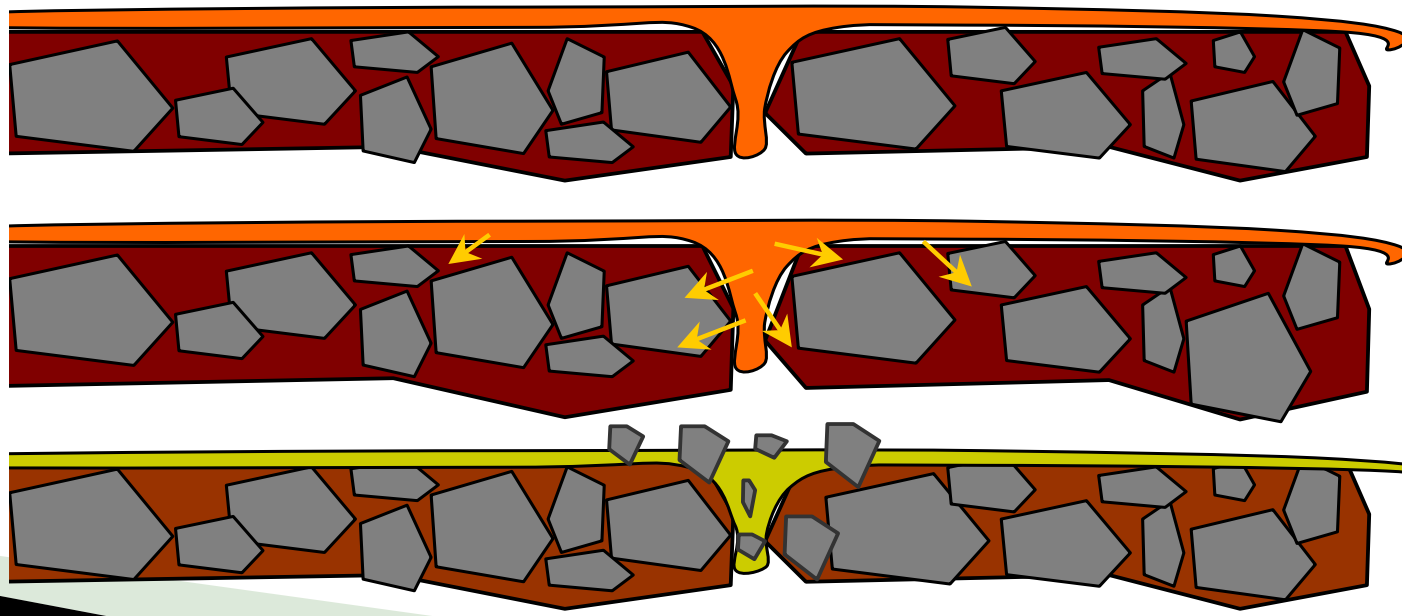
Scrub Broom



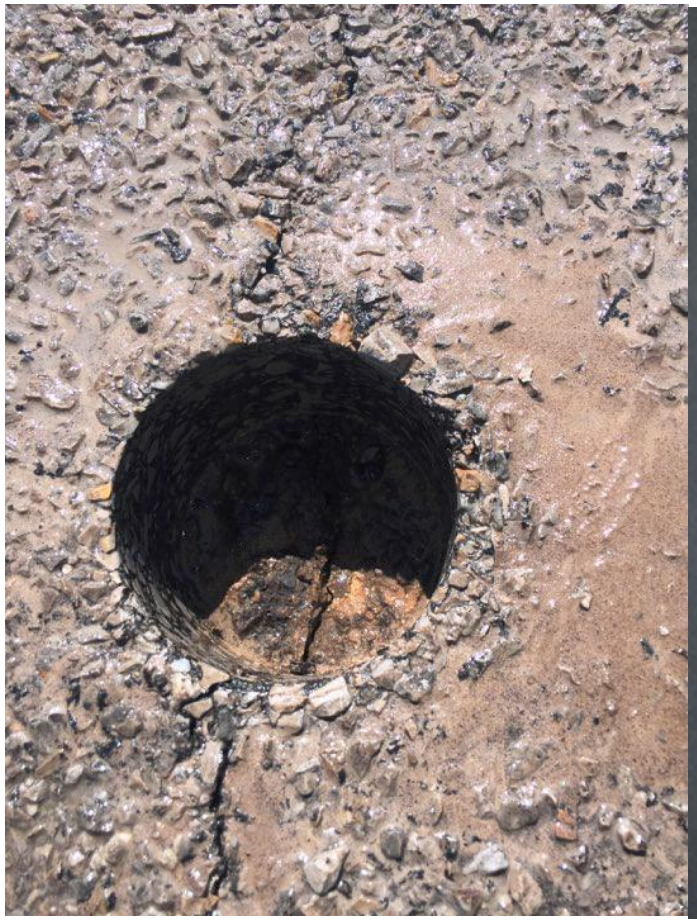


How Scrub Seals Work

- 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).



CORES



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

Roads with mass cracking where crack sealing isn't economical.

Road Selection

To get a successful scrub seal, select roads that:

- have a sound structural section
- are in no need of repair

Isolated digouts and crack sealing should be completed before the chip seal is applied (lead time varies depending on prep method).

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

Good Candidate

Good Candidate Continued

Primary Uses

Stand alone surface treatment

- **Mississippi HWY 35**

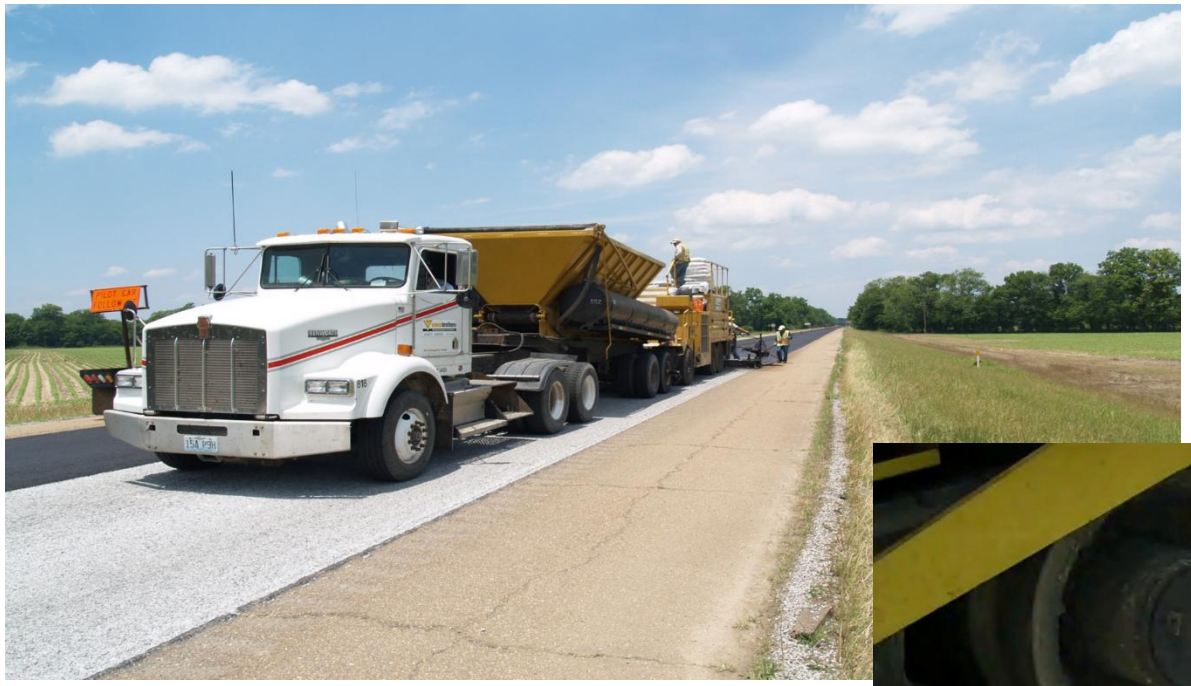
Primary Uses

Mass crack sealing treatment

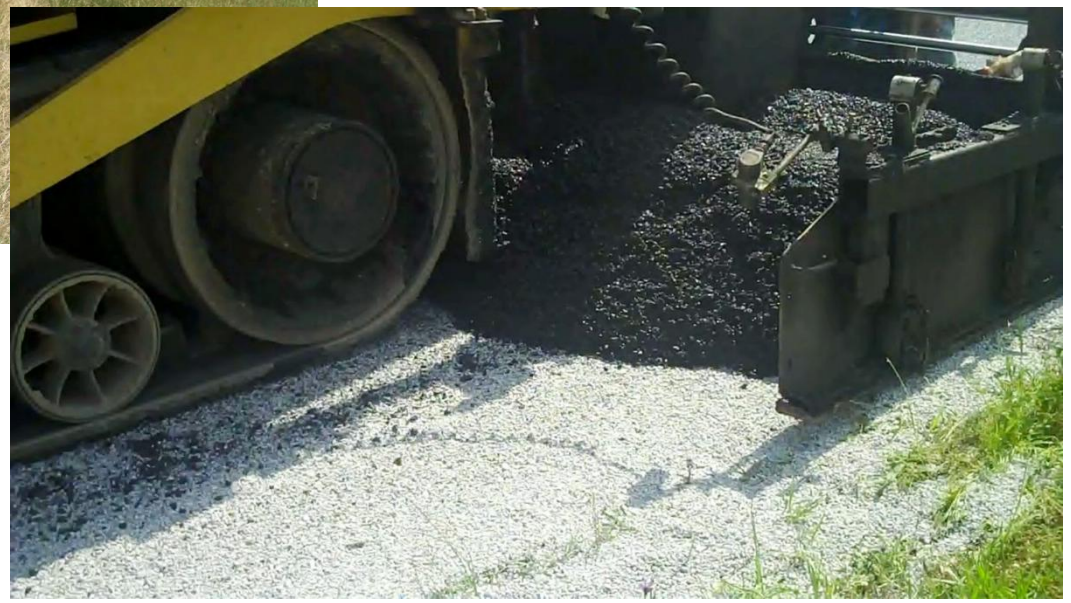
- **Mass Crack Sealing**

Primary Uses

Combination Treatments



Interlayer with Micro over the top



Interlayer with HMA

Mississippi Hwy 35
Scrub Seal =
Stand alone wearing course

Mississippi Hwy 35
Scrub Seal =
Stand alone wearing course


6 years untreated
surface


6 years treated
surface

Materials

Asphalt Emulsion

- CMS-1PC
  - Medium Set
  - Polymer modified
  - Rejuvenating agent
- 140° – 180° temp range
  - Check with manufacturer.
- #7 – 0.33 ± 0.03 gal/yd^2
- #89 – 0.30 ± 0.03 gal/yd^2

Seal Coat Aggregates

- One-sized
  - #2 – approximately 20 lbs per square yard for limestone
  - #3 – approximately 30 lbs per square yard for limestone
- Cubical
- **Clean**
  - **< 1 – 2% fines**
- Angular
- Durable
  - Non-polishing

Design

- Chip Embedment at Least ½ of Chip in the Oil, After Rolling
- McLeod or Modified Kearby for starting points

In order for aggregate particles to remain on the roadway, they need to have approximately 70 percent of their height embedded into the *residual asphalt*. For this to occur with an asphalt emulsion, the binder must rise near the top of the aggregate particles. This is demonstrated in the Figure 4.2. If the emulsion rises just below the top of the aggregate (voids ~ 100 percent filled), the voids will be roughly two-thirds filled after curing since about one-third of the binder will evaporate. Failure to allow emulsions to rise this high will result in insufficient embedment and loss of the cover aggregate as soon as the seal coat is exposed to snow plows and traffic.

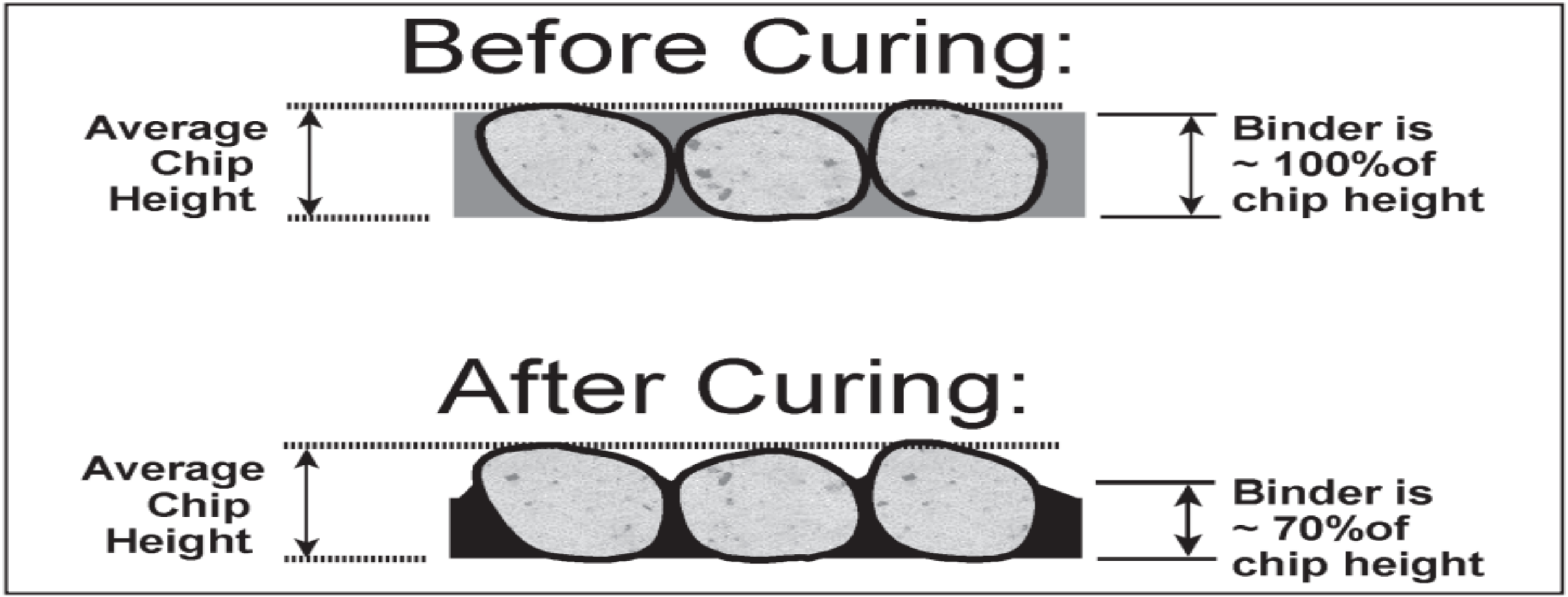


Figure 4.2. Change in volume after emulsion has cured

Figure 4.3. McLeod design: One-stone thick & proper embedment

Figure 4.4 shows an inspector checking for proper chip embedment. Notice that the chip is embedded about 70 percent into the residual asphalt. This will help to ensure good chip retention.

Figure 4.4. Proper embedment (~70%) into the residual asphalt

Salt & Pepper

Loss of Cover Aggregate

- Dirty aggregate
- Insufficient asphalt
- Chips spread too late
- Unequal spray bar distribution
- Too Much Aggregate

Preparation

Road Preparation

Sweep Roadway Prior to Starting Work.

Make Sure it's Clean and Dry

Fresh Patches need to oxidize (60 days), tack coat or fog seal

Road Preparation

- Hot Mix Cold Lay: Should Cure – 60 days
- Hot Mix Hot Lay: Should Cure 2 week minimum
- **BEST PRACTICE: Fog Seal Patches and Leveling Prior to Scrub Seal**
- Sterilize And Remove Vegetation
- Remove Thermoplastic striping
  - Sealing over old roughed up striping should be OK
  - Do NOT create a trough when removing stripe

What do we do with the striping?

- On pavements where the scrub seal is to be the final layer, the Contractor should remove all existing thermoplastic striping, markings, and legends within the scrub seal limits prior to the scrub seal operation. If a subsequent surface treatment or pavement layer will be placed over the scrub seal, removal of the existing thermoplastic may not be required.

What do we do with the striping?

907-414.03.4.3--Stripe Removal. Prior to the scrub seal operations, the Contractor shall remove all existing thermoplastic striping, thermoplastics legends, and raised pavement markers within the scrub seal limits. Such removal shall be performed to the satisfaction of the Engineer.

Road Preparation

Prevent water from entering roadway

Protect utilities

Road Preparation

Repair Pot Holes

Remove Existing Pavement Markers and Place Temporary Pavement Markers

The Existing Pavement Must

- Structurally sound
- Repaired, patched, allowed to cure
- Clean, no loose fragments
- Relatively dry
- Proper drainage
- No road is better than the base it is built on

Variables Effecting Performance

- Weather
- Design
- Binder
- Aggregate Properties
- Roadway Condition
- Traffic
- Equipment

Weather Issues

Effects of rainstorm before emulsion has cured

Weather Issues

Emulsion should only be applied when the ambient and pavement temperatures are above 70° F.

Help Yourself! It's not the fault of the process!

Don't place when rain is in the forecast!

Application

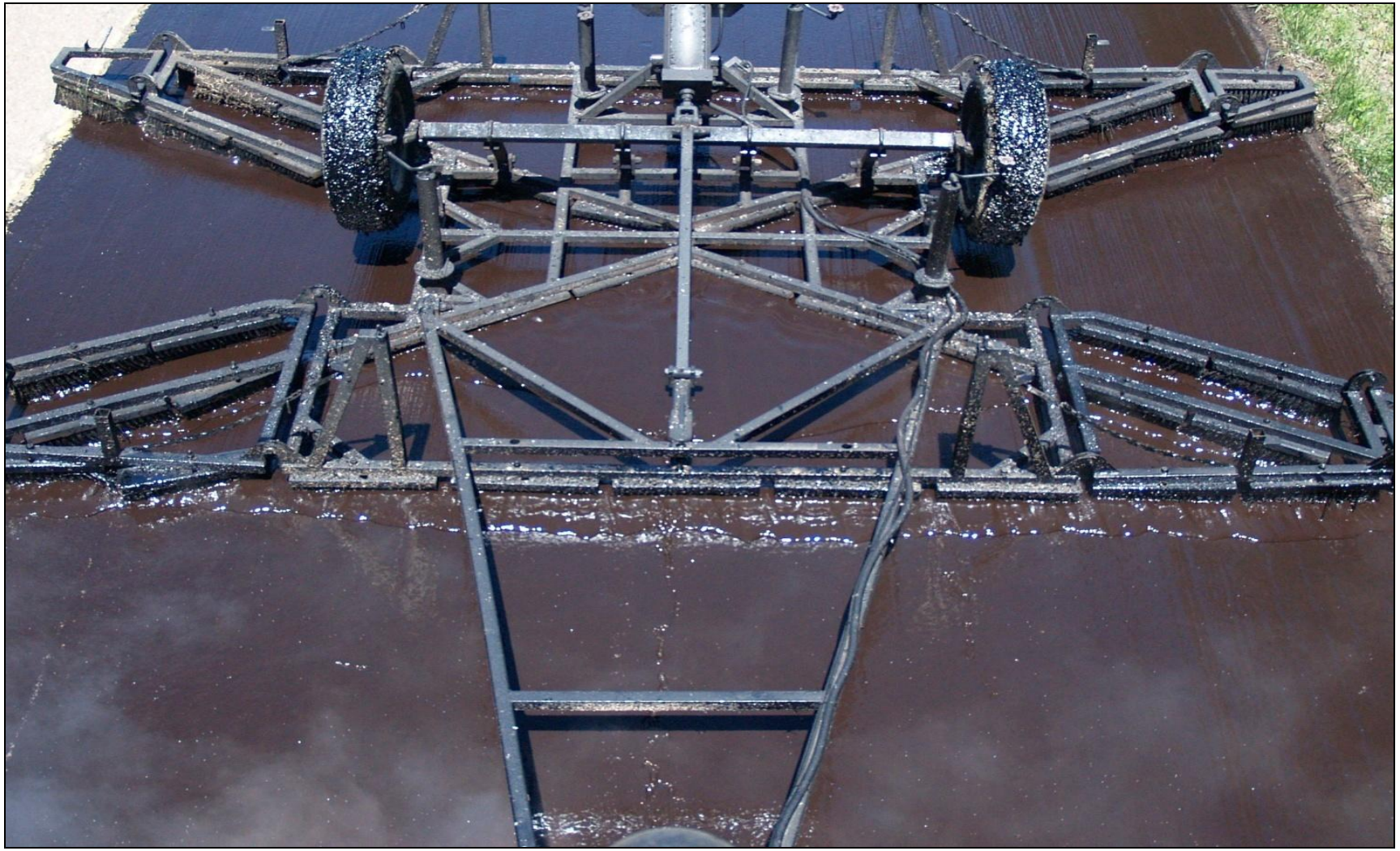
Emulsion Application Rates

- Target rates for Scrub Seals
  - #7 – 0.33 ± 0.03 gal/yd^2
  - #89 – 0.30 ± 0.03 gal/yd2
- 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

Emulsion Wave



Emulsion Wave

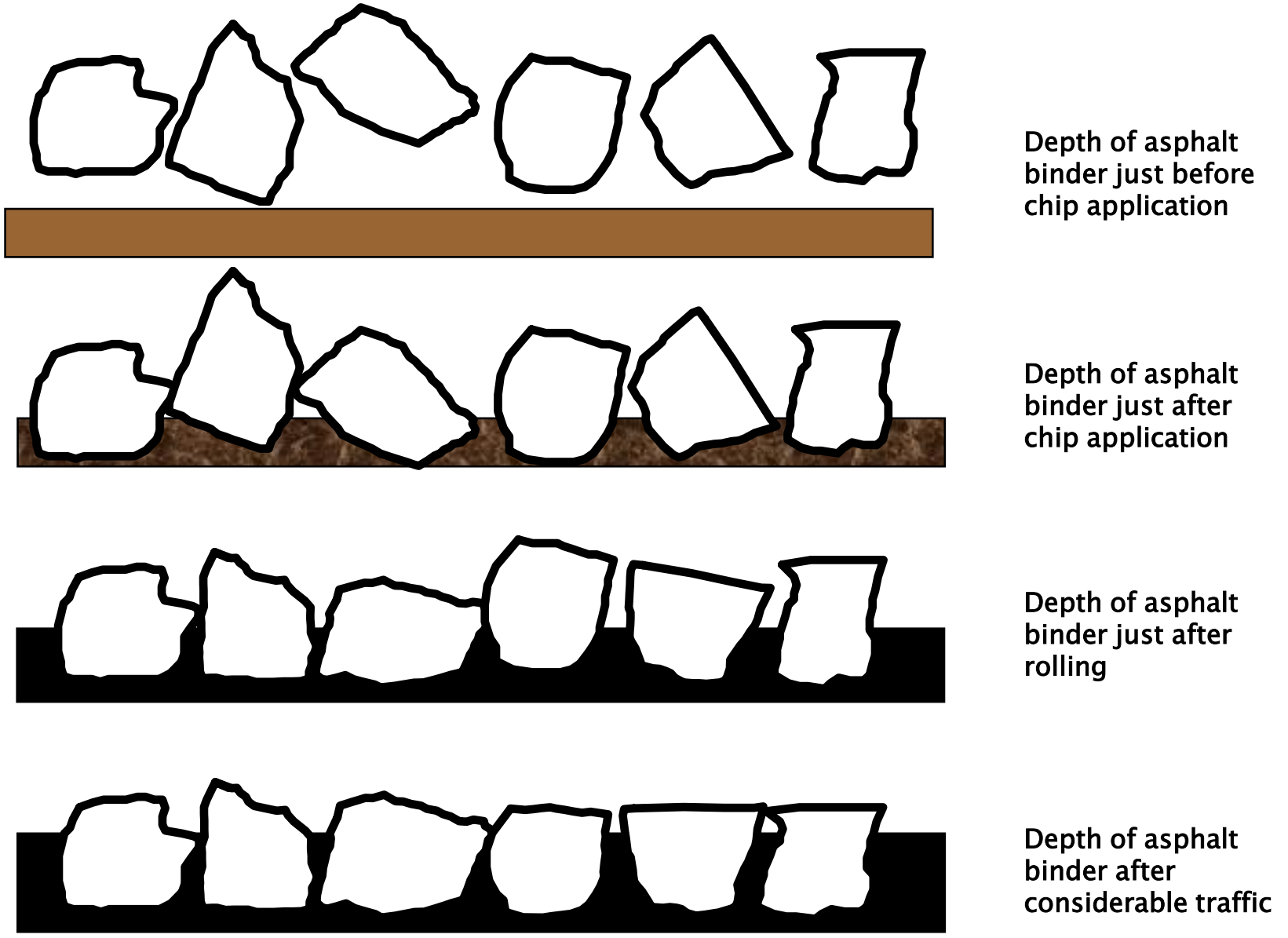
Aggregate Application

Aggregate Application

Aggregate Application

Design

- Chip Embedment at Least ½ of Chip in the Emulsion, After Rolling



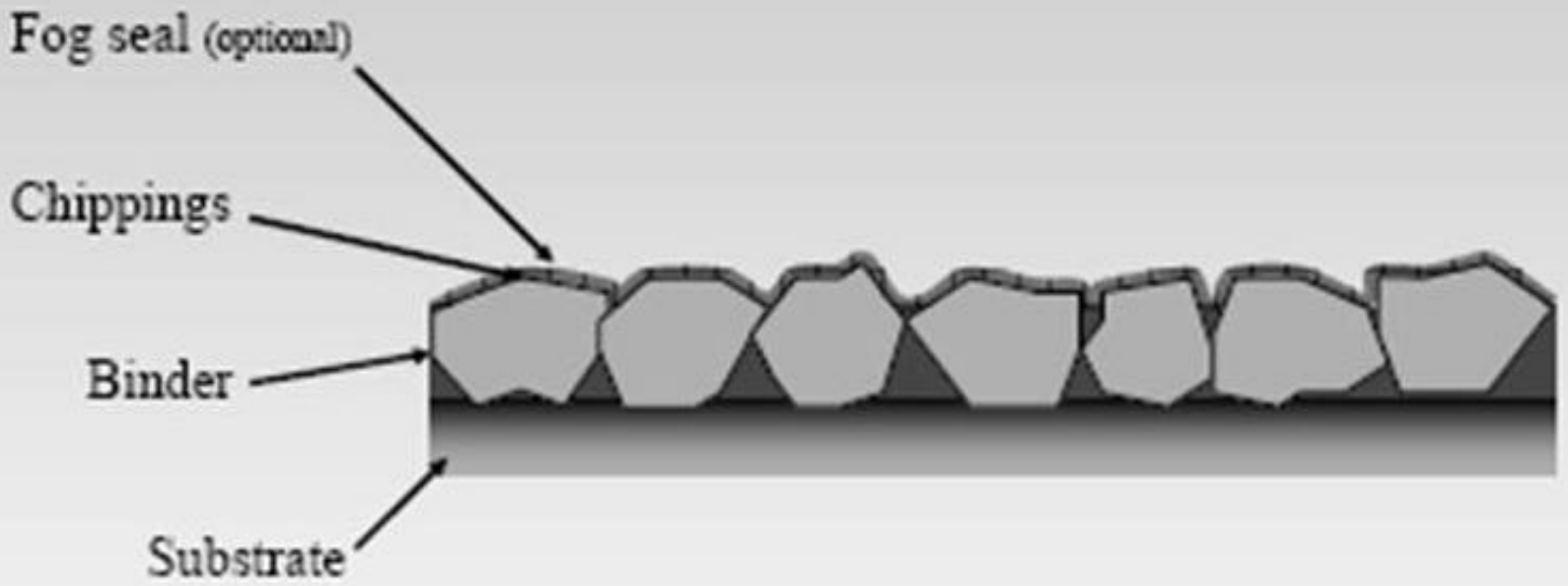
Depth of asphalt binder just before chip application

Depth of asphalt binder just after chip application

Depth of asphalt binder just after rolling

Depth of asphalt binder after considerable traffic

Chip Seals



Single Chip Seal

Aggregate Application & Rates

- Uniform distribution
- Confirm Aggregate rates
- Calibrate chip spreader
- Only need a SINGLE layer
  - Rock on top will roll
  - Should have salt & pepper look

Spread immediately behind distributor

Aggregate Application & Rates

Excess Aggregate

- Waste of money
- Safety hazard
- Detrimental to new surface

Good Stockpile Maintenance is Necessary

Chips should be “surface damp”

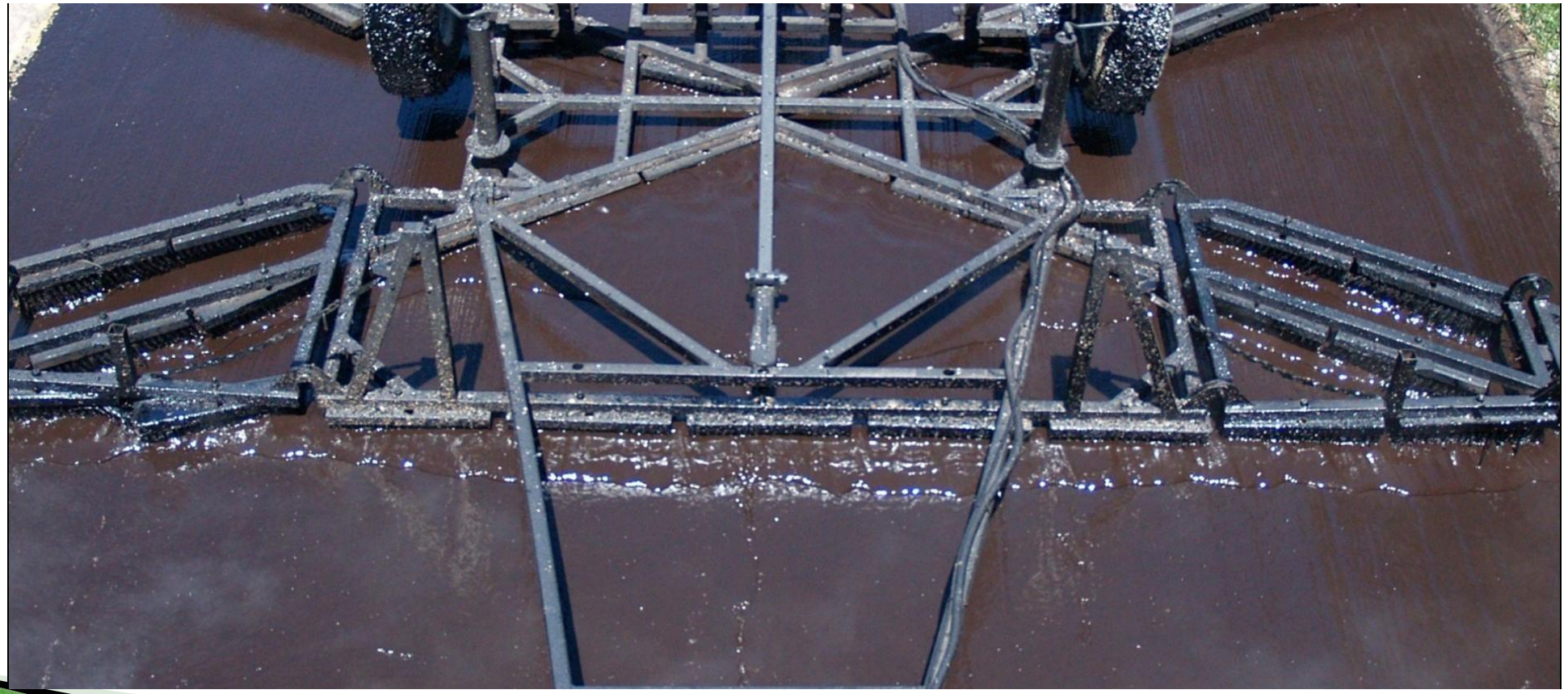
Too Dusty

Too Wet

Application Tips

- Spreader right behind distributor
- Control chip spreader speed
  - Not too much rock, should be one stone thick
  - Should be a nice salt and pepper look
- Rollers should follow right behind spreader for proper embedment and orientation
- Sweeping should occur at end of the day (preferably the next morning)
- Do not apply material at least 2 hours before dusk.

Equipment



Equipment

- Distributor
- Haul Trucks/ Loader
- Aggregate Spreader
- Roller
- Power Broom
- Traffic Control

Distributor

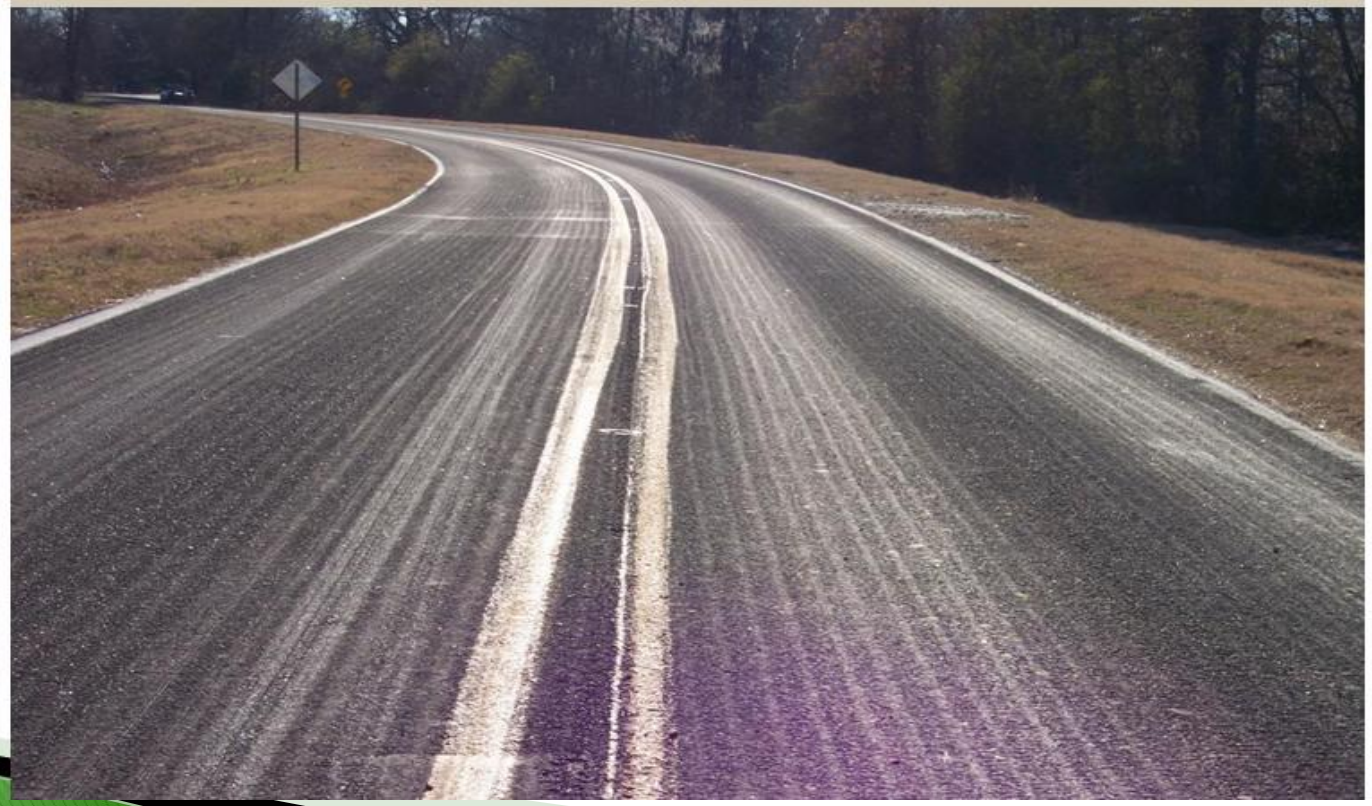
Distributor Check List

- 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

Calibrate Equipment

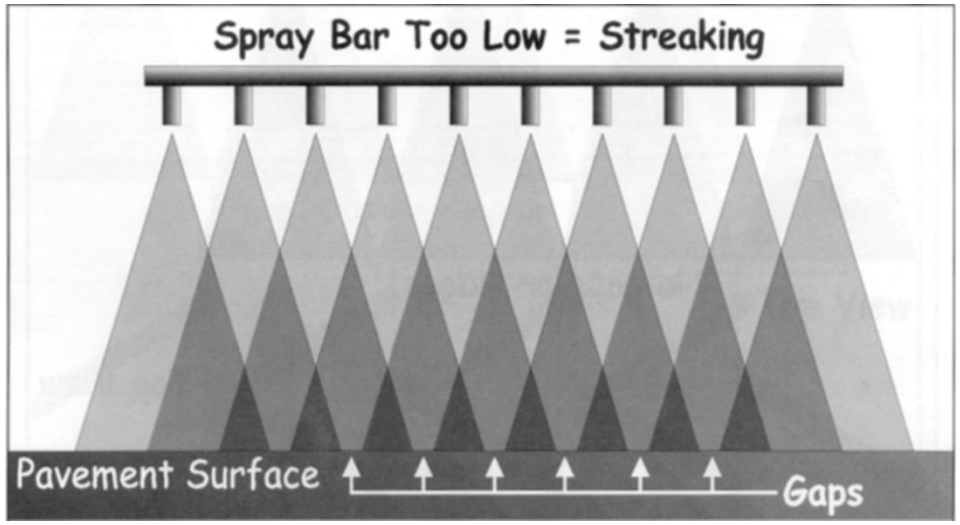
Distributor Checklist

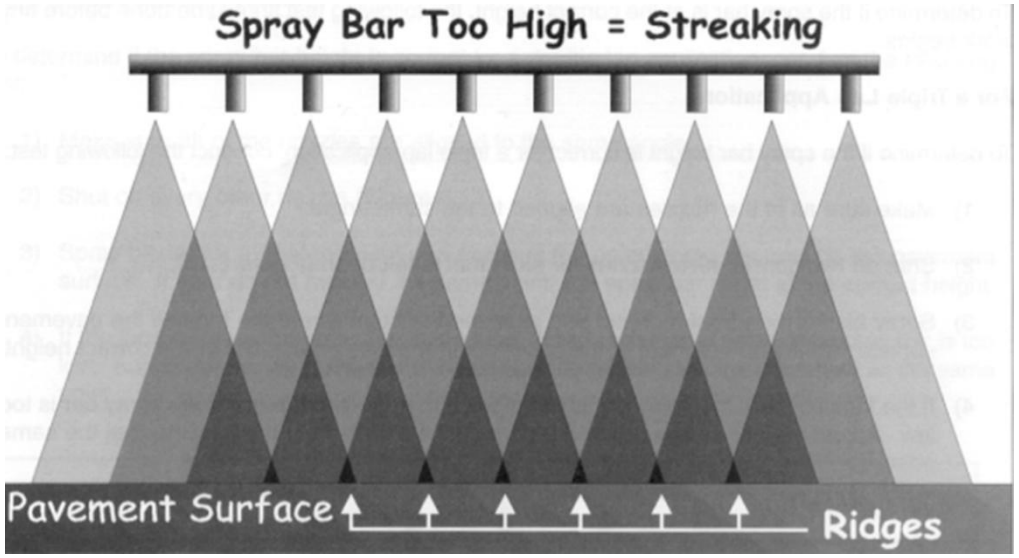
Improper Spray Bar Height



Calibrate Equipment

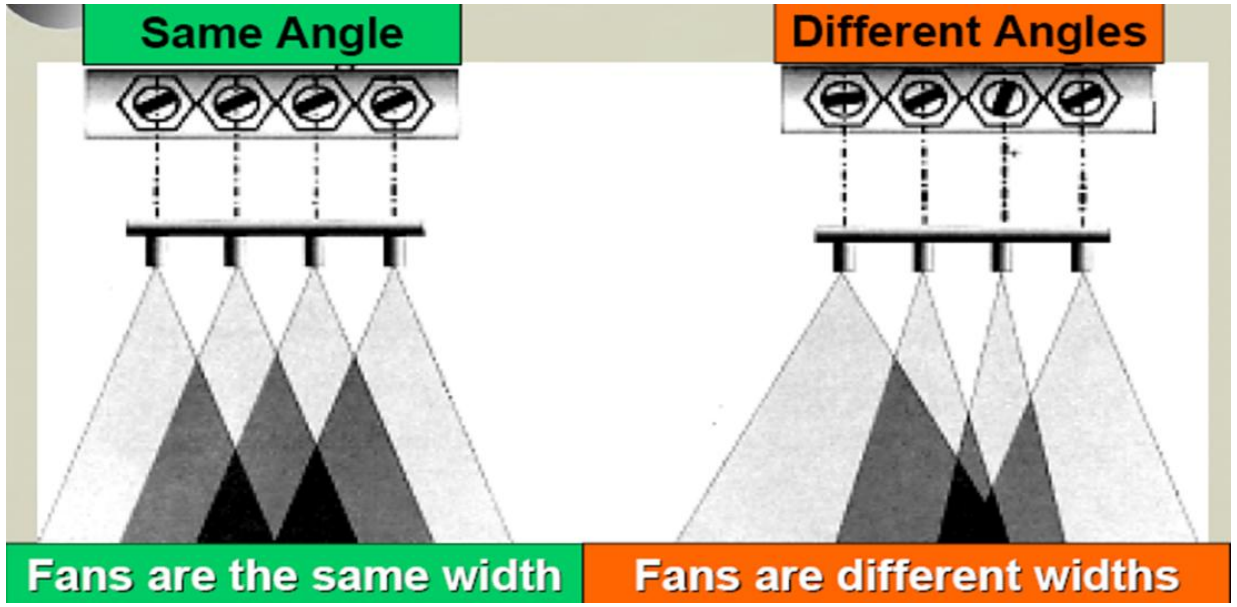
- **Spray bar height**
  - Nozzle angle
  - Nozzle Size
  - Spray bar pressure
  - Proper rate

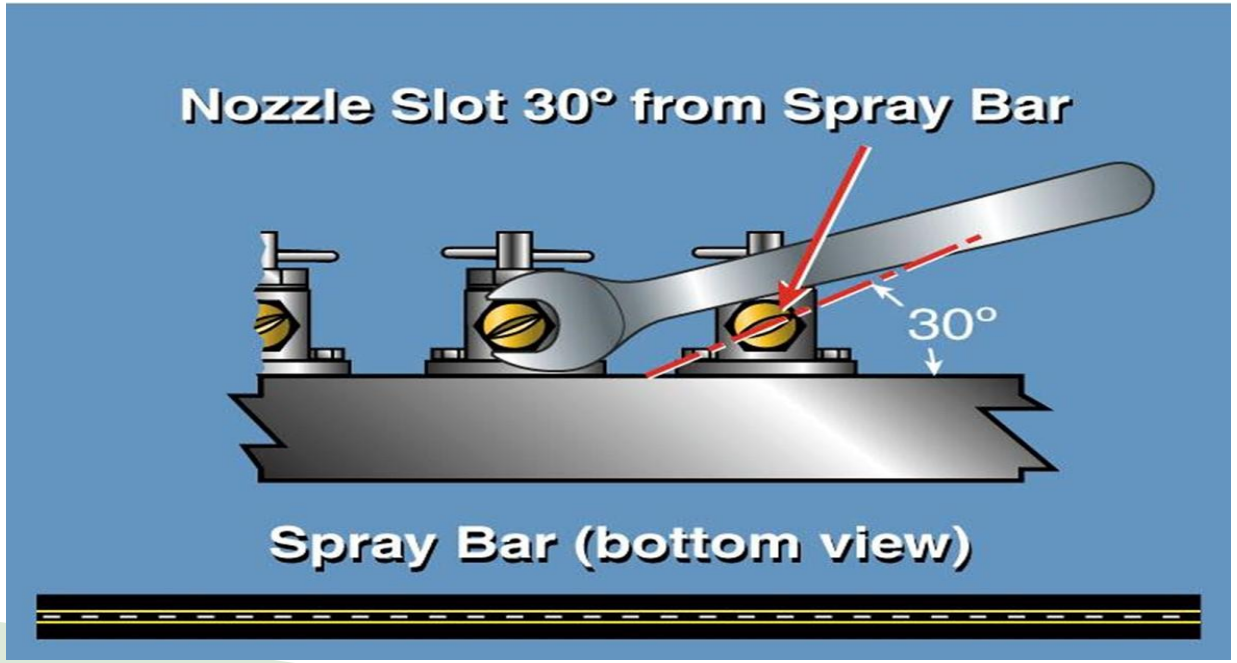




Calibrate Equipment

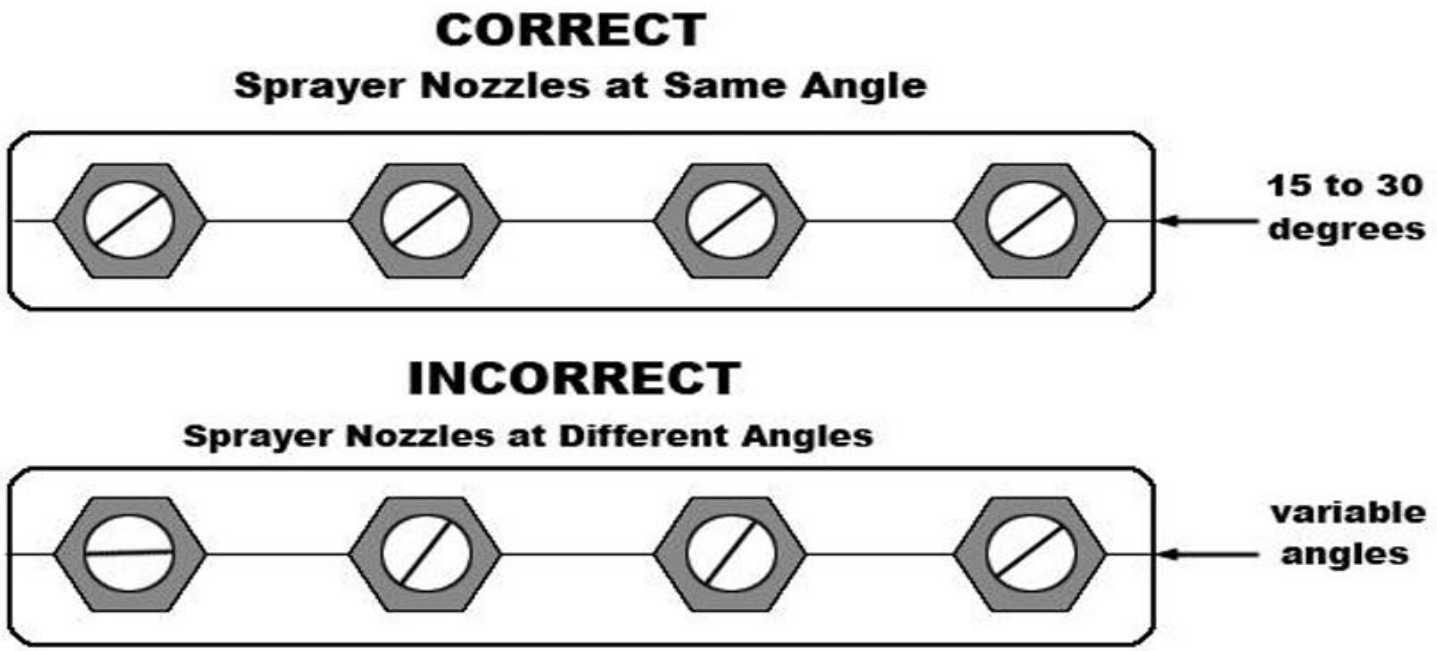
- Spray bar height
- **Nozzle angle**
- Nozzle Size
- Spray bar pressure
- Proper rate





Calibrate Equipment

Distributor Checklist

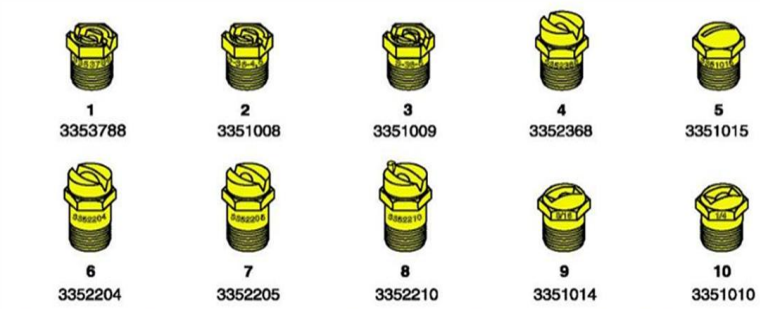


Spray Bar Nozzle Alignment

Calibrate Equipment

- Spray bar height
- Nozzle angle
- **Nozzle Size**
- Spray bar pressure
- Proper rate

Distributor Checklist



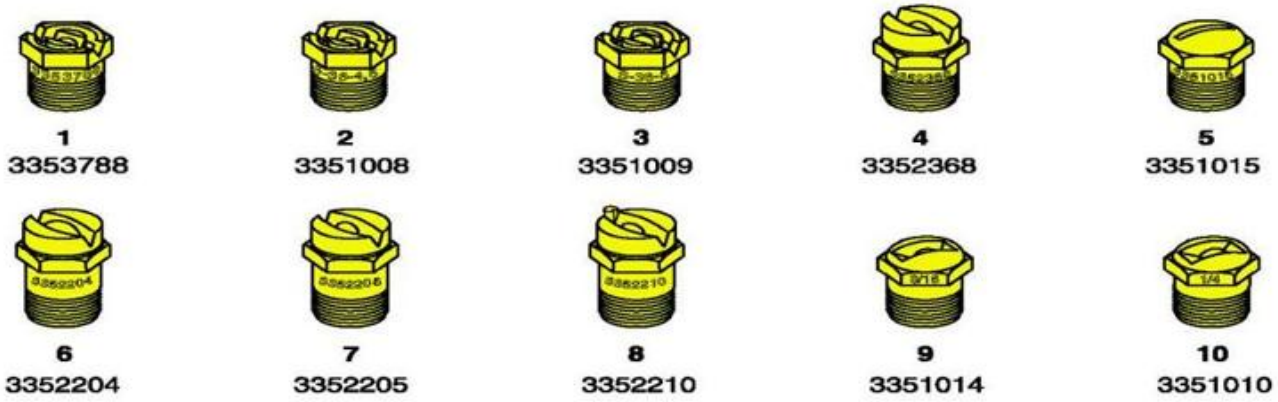
Ref.	Part No.	Description	Application Per Square Yard	Application (Metric) Liters Per Square Meter	Flow Gallons Per Minute Per Foot
1	3353788	V Slot Tack Nozzle	.05 - .20	.19 - .75	3.0 to 4.5
2	3351008	S36-4 V Slot	.10 - .35	.38 - 1.30	4.0 to 7.5
3	3351009	S36-5 V Slot	.18 - .45		7.0 to 10.0
4	3352368	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

Calibrate Equipment

Distributor Checklist



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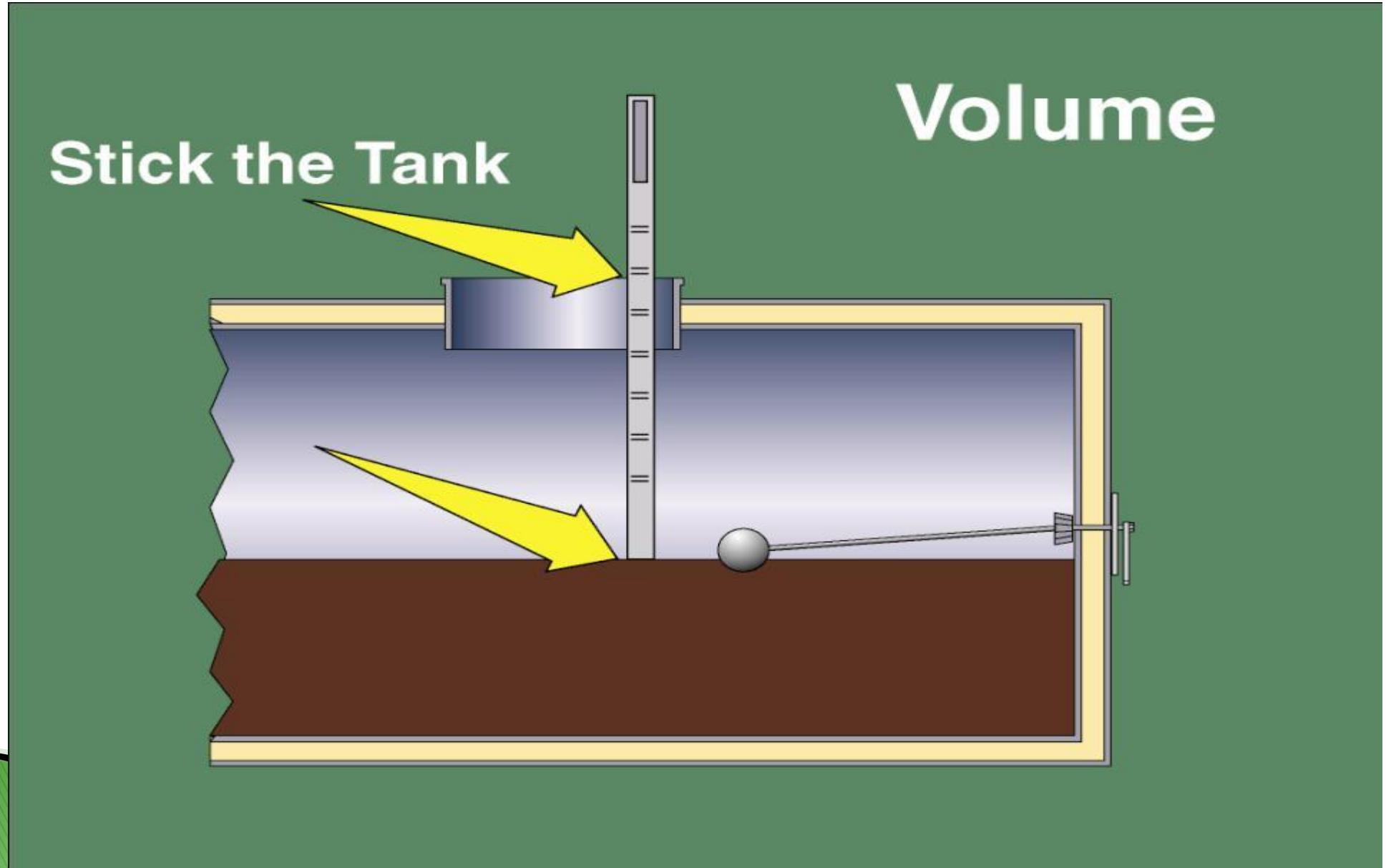
#6 Recommended for Chip Seals

Match Nozzles to Application

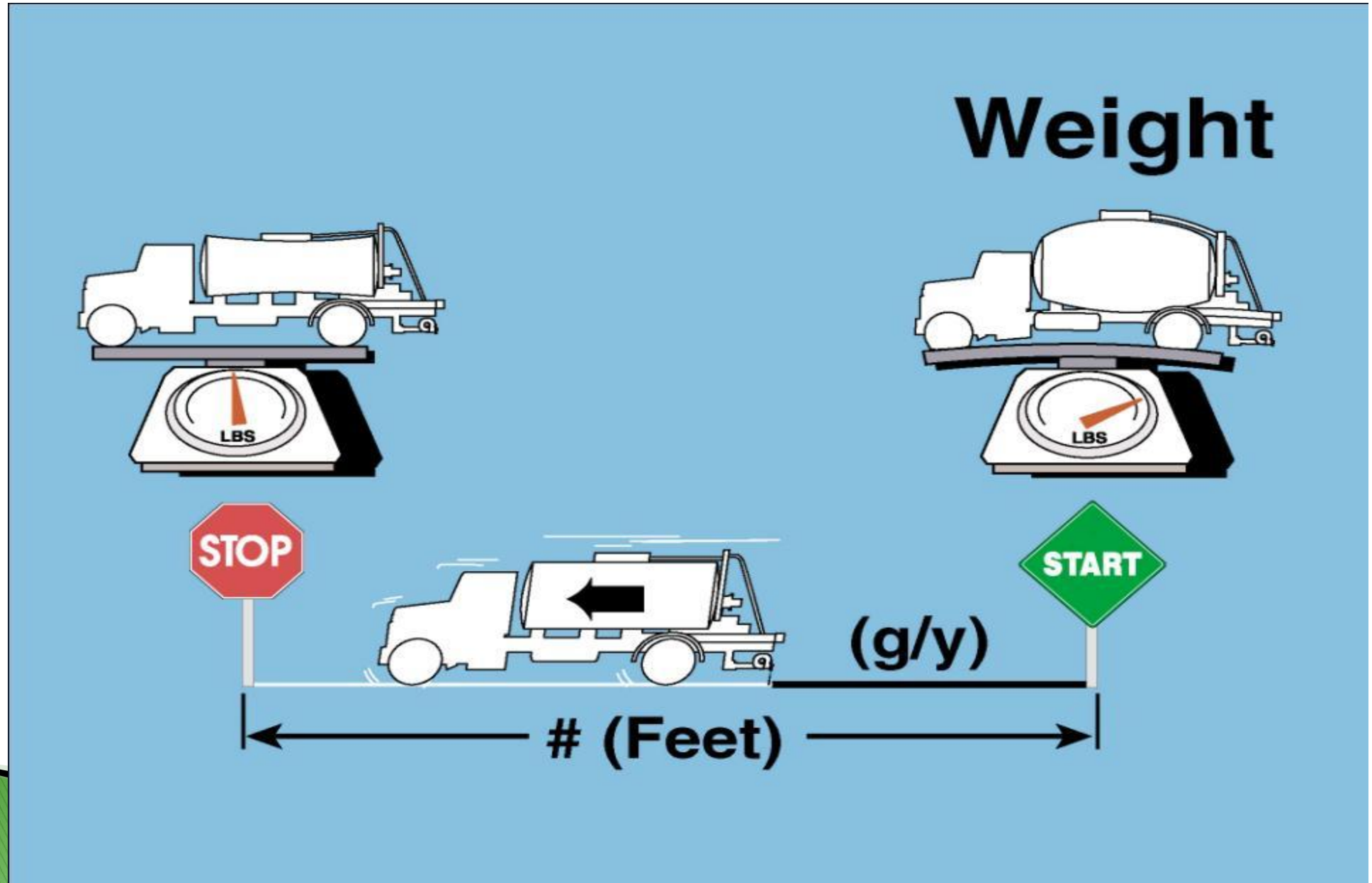
Calibrate



Calibrate

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

Calibrate



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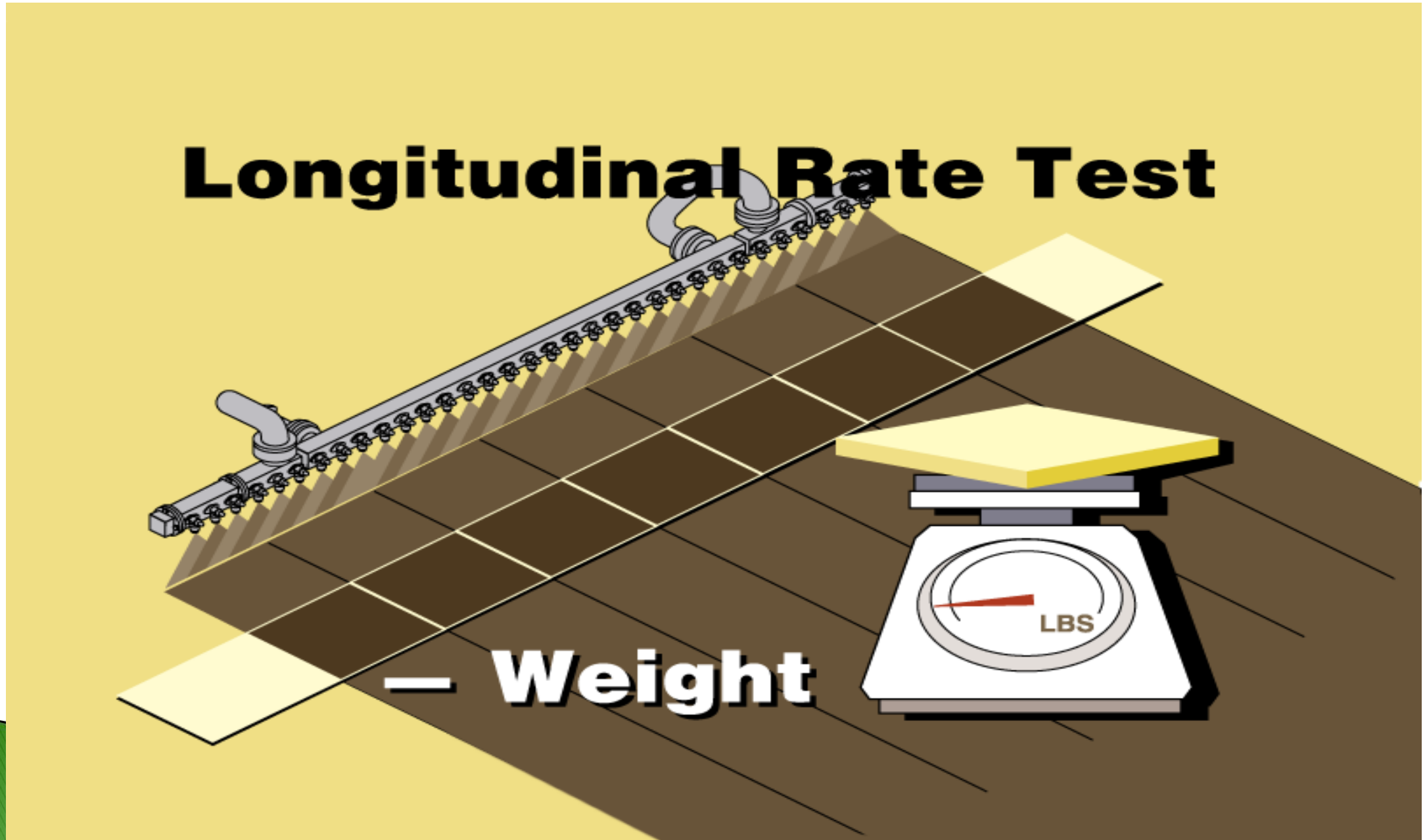
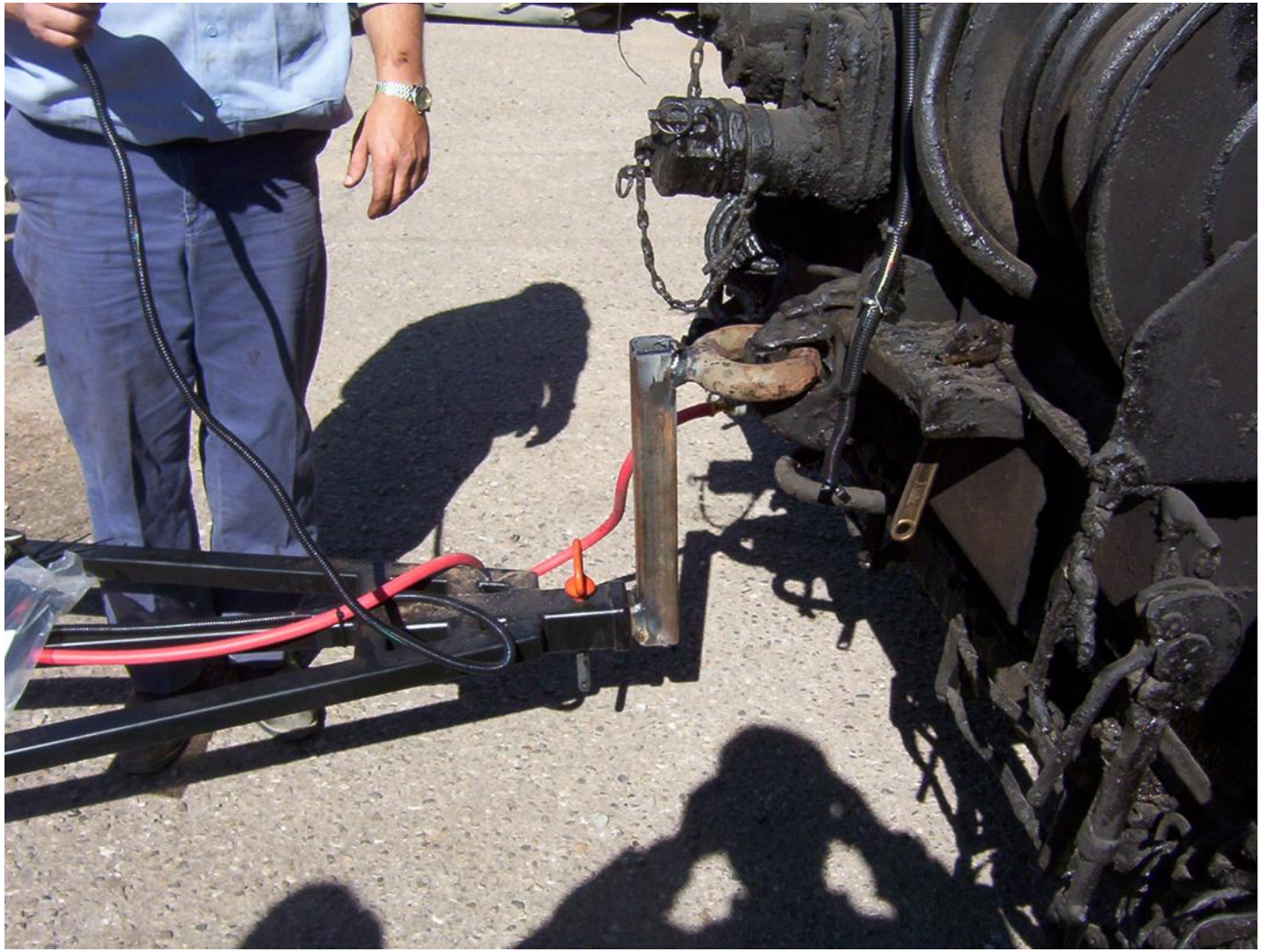
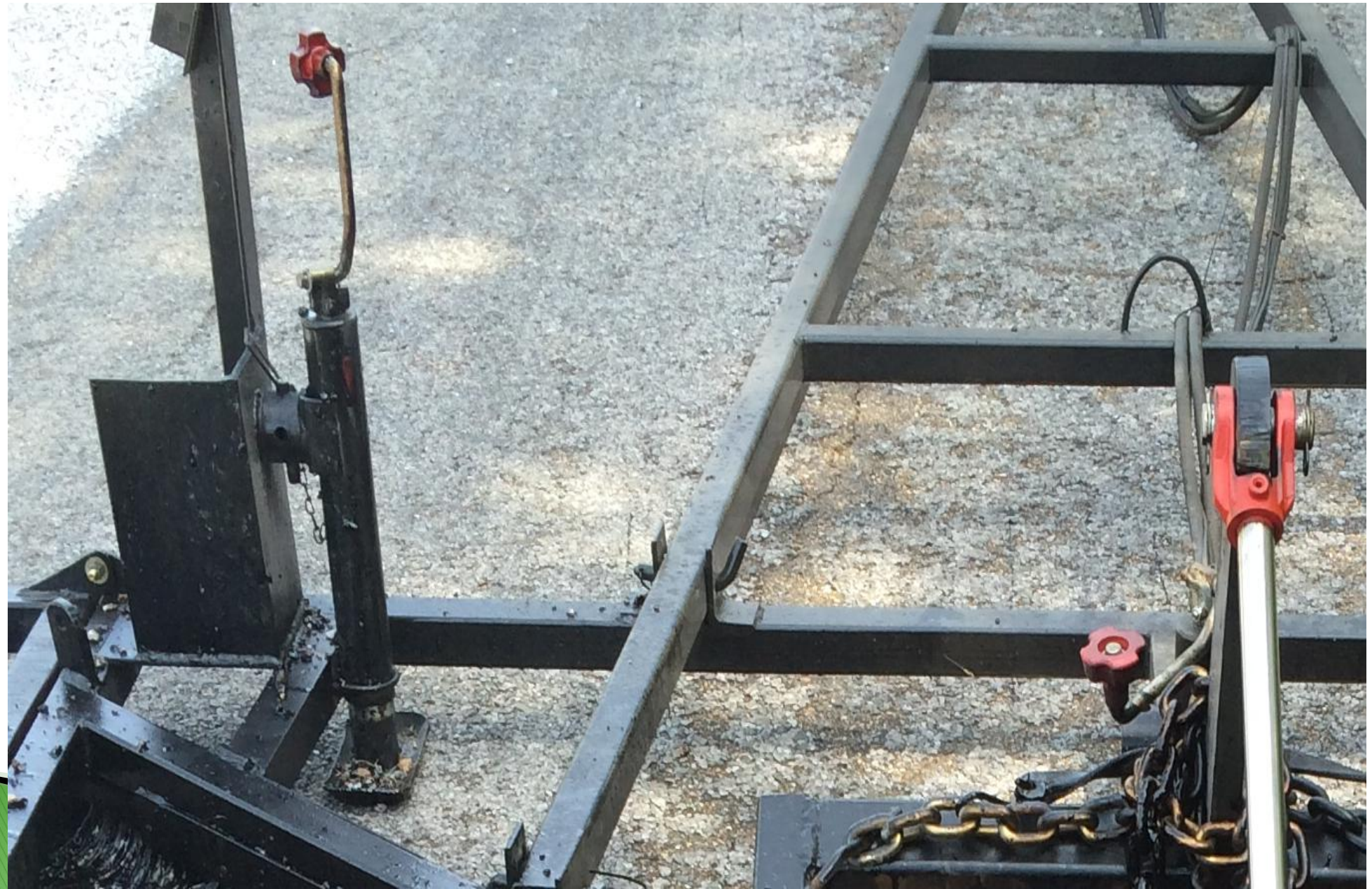


Keep Broom Level with Road Surface

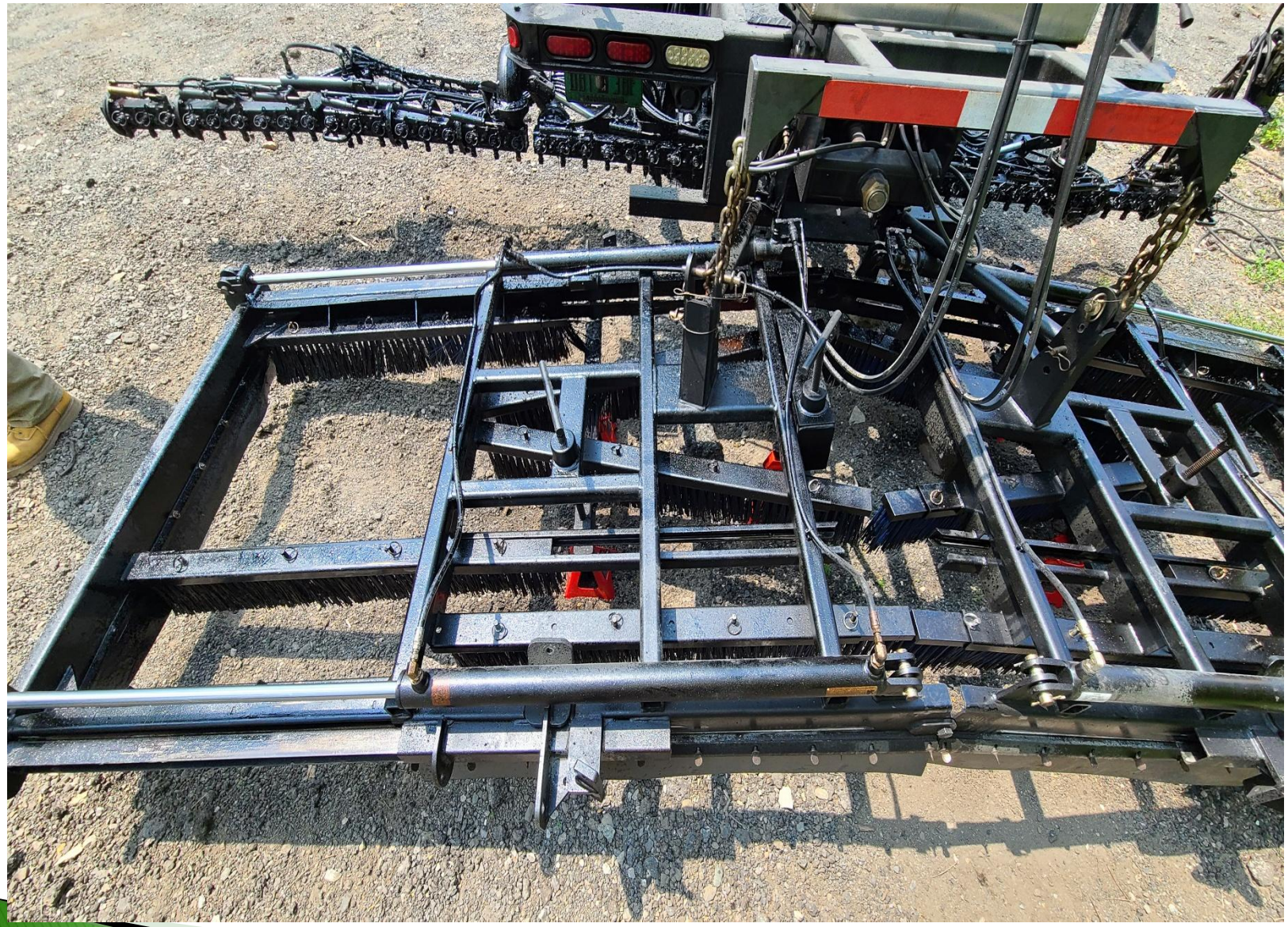




Too MUCH weight on broom heads.

Brushes barely touching the pavement.

Picture of a Broom Box



Picture of a Broom Box

Things We Have Learned Before Job Ever Starts

- Do a training for the Inspectors and contractors!
- Things to check for on the broom
  - Make sure air is working to the broom
  - Make sure the broom heads are clean!
  - Broom heads are touching surface
  - If Broom has skis that they are functioning & on the surface

Things We Have Learned Before Job Ever Starts

- If broom has metal wheels instead of skis, make sure they are functioning.
- Do a dry run with the broom to get acquainted.
- Cleaning off your broom heads at the end of the day will significantly extend the life of them.
- Do a test section

Broom

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?

Broom

- 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.


MAY 7 2004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Chip Spreaders

Chip Spreaders

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.

Chip Spreader

Tire Pressure

Radial Tire

Will Bounce

If Pressure To High

(Rub Board)

Gate Opening

Calibrating Rate

Calibration

- Aggregate Spreader
  - Check each foot (not necessarily consistent)
  - Based on
    - Machine speed
    - Gate opening

Tarp and Scale

Rolling

- Immediately after chipping
  - Orients chips on their flat side
- Two Pneumatic Rollers
- ~~5~~ 6-8 ton minimum
- Stop after set
- Moderate speed
- Stagger rollers

How many roller passes are required by Mississippi spec's?

How many roller passes are required by Mississippi spec's?

907.414.03.5.2 States;

Pneumatic rollers shall be used in the sequence that will provide the rolling pattern that results in the best adhesion of the aggregate to the bituminous material and the best surface qualities.

In all cases, there shall be at least five complete coverages of the entire surface of the treatment with a pneumatic-tire roller.

The first rollers –– the trucks!

Broom and/or Vacuum Truck

Brooming or Sweeping

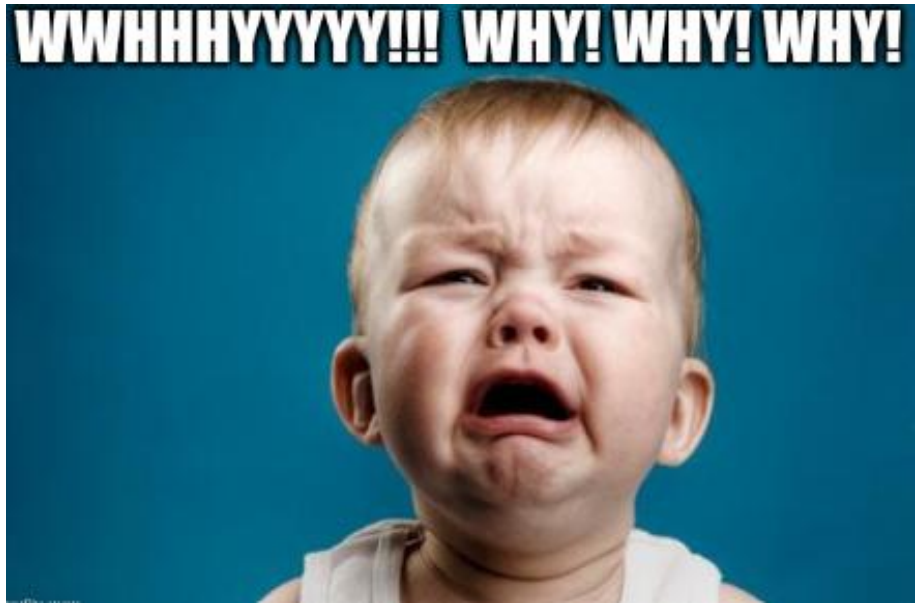
- Light brooming removes excess chips
- Time before brooming varies
  - Minimum of One Hour or LONGER
- Excess chips can dislodge other chips
- Can also damage windshields
- Joint may need to be broomed before next pass
- Next Morning Remove Loose Chips
  - Early Morning When Binder is Tougher

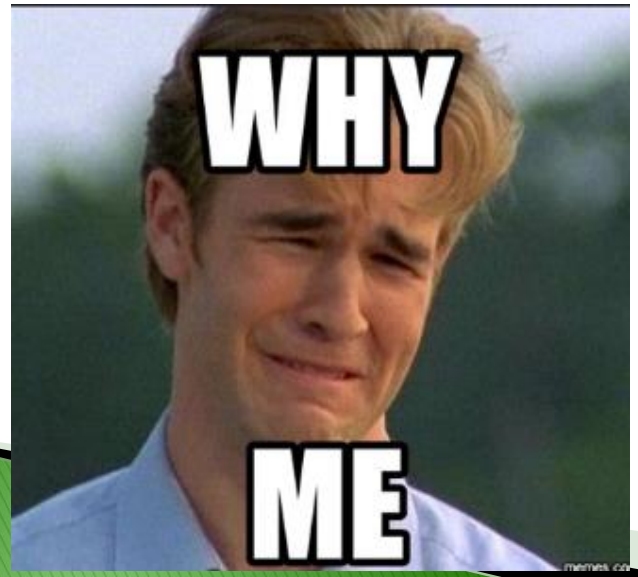
Traffic Control

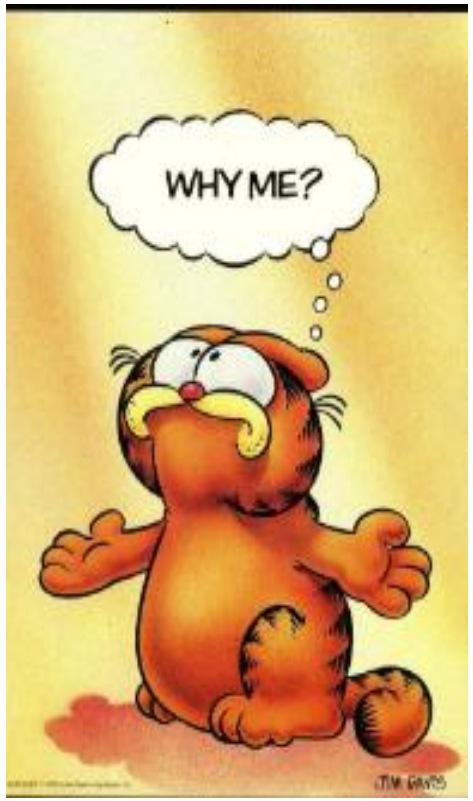
Traffic Control

- Low speed (20 to 30 mph) traffic after rolling is completed. Open to traffic 1 to 3 hours depending on weather and traffic volumes
- Keep Traffic off fresh chip seal as long as possible
- Never allow start/stop traffic or sharp turning traffic on newly completed chip seal
- Pilot car recommended for traffic control
- Apply Pavement markings – 48 to 72 hours after chip seal application is completed

The Little Things Usually….







WHY?

Loss of Cover Aggregate

WHY?

Loss of Cover Aggregate

- Dirty aggregate
- Insufficient asphalt
- Chips spread too late
- Unequal spray bar distribution
- Too Much Aggregate

WHY?

WHY?

Bleeding / Flushing

WHY?

Bleeding / Flushing

- Over-application of binder
- Dense graded screenings
- Pre-existing rutting

WHY?

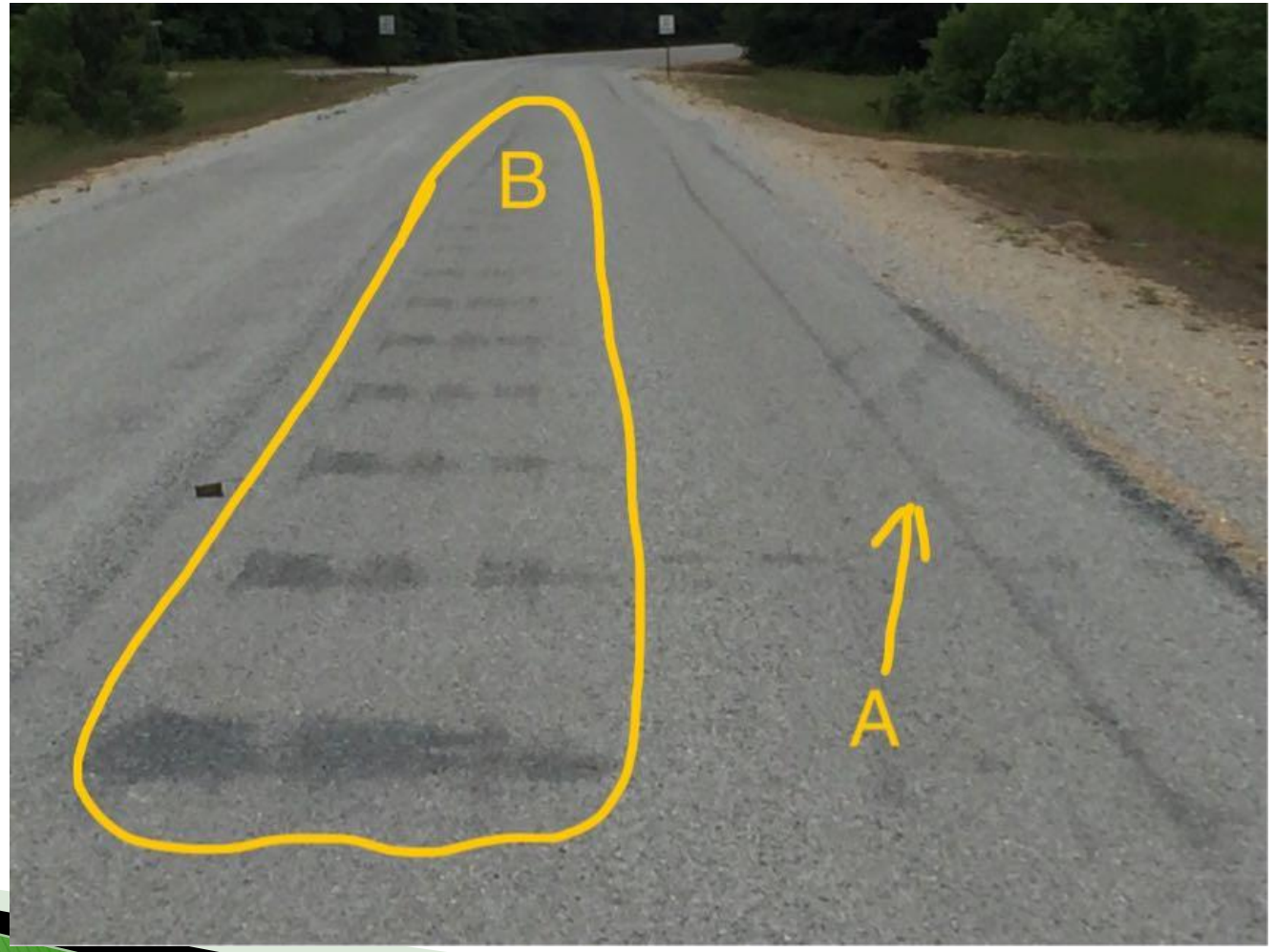
Stripping /Drilling

WHY?

Stripping /Drilling

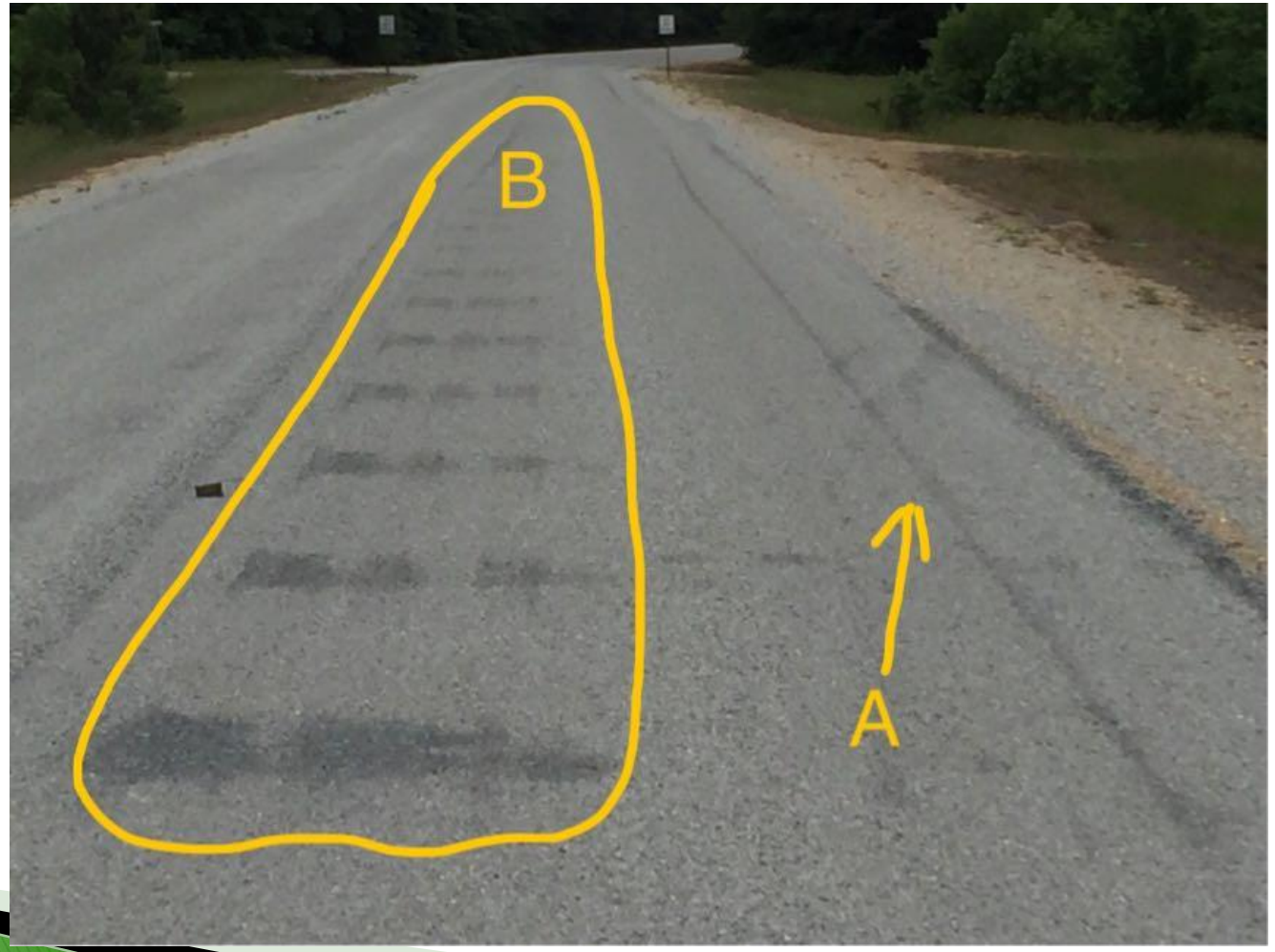
- Too little binder applied
- Dirty aggregate
- Poor weather
- Poor rolling
- Cold binder or high viscosity

WHY?



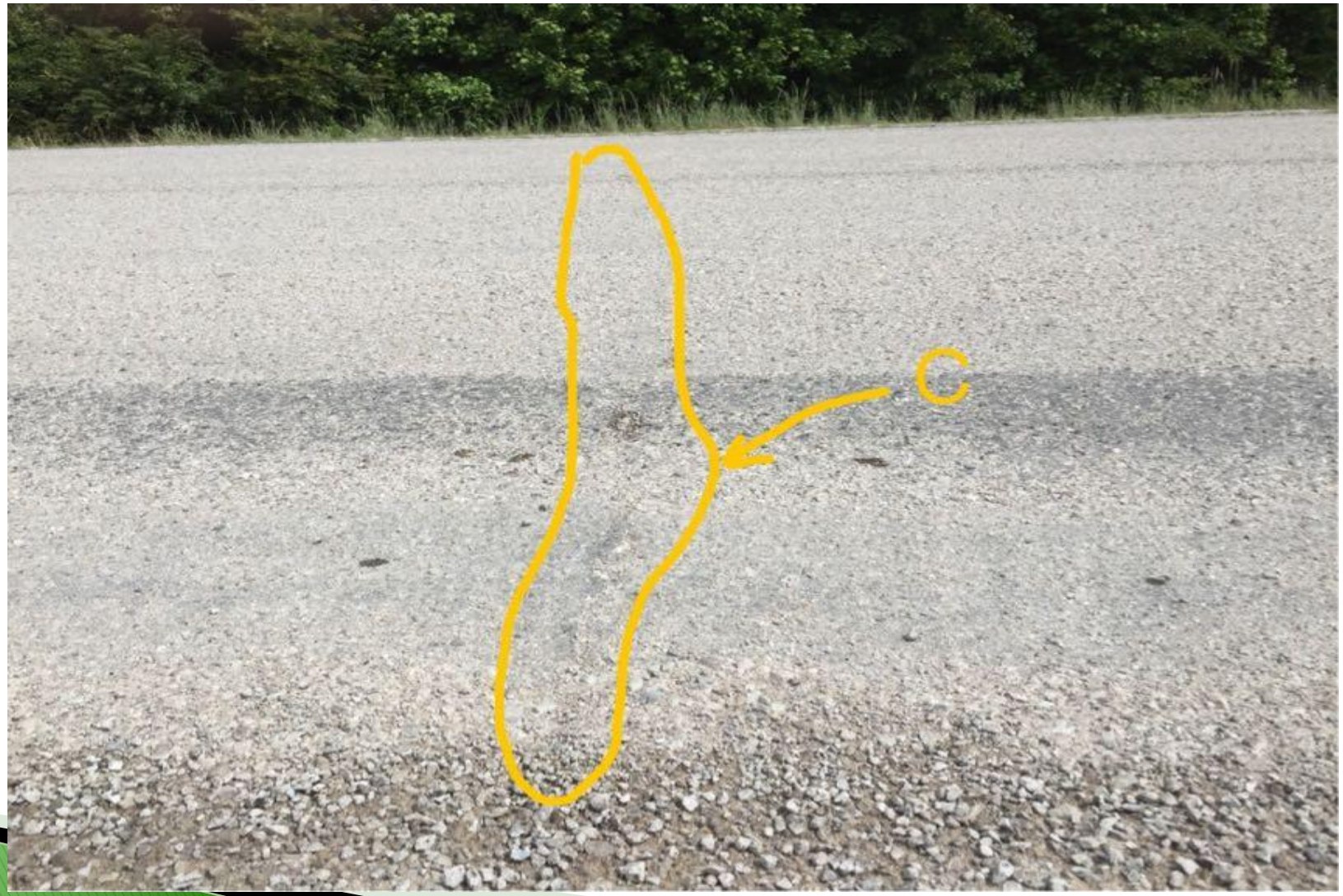
WHY?

Improper Broom Maintenance

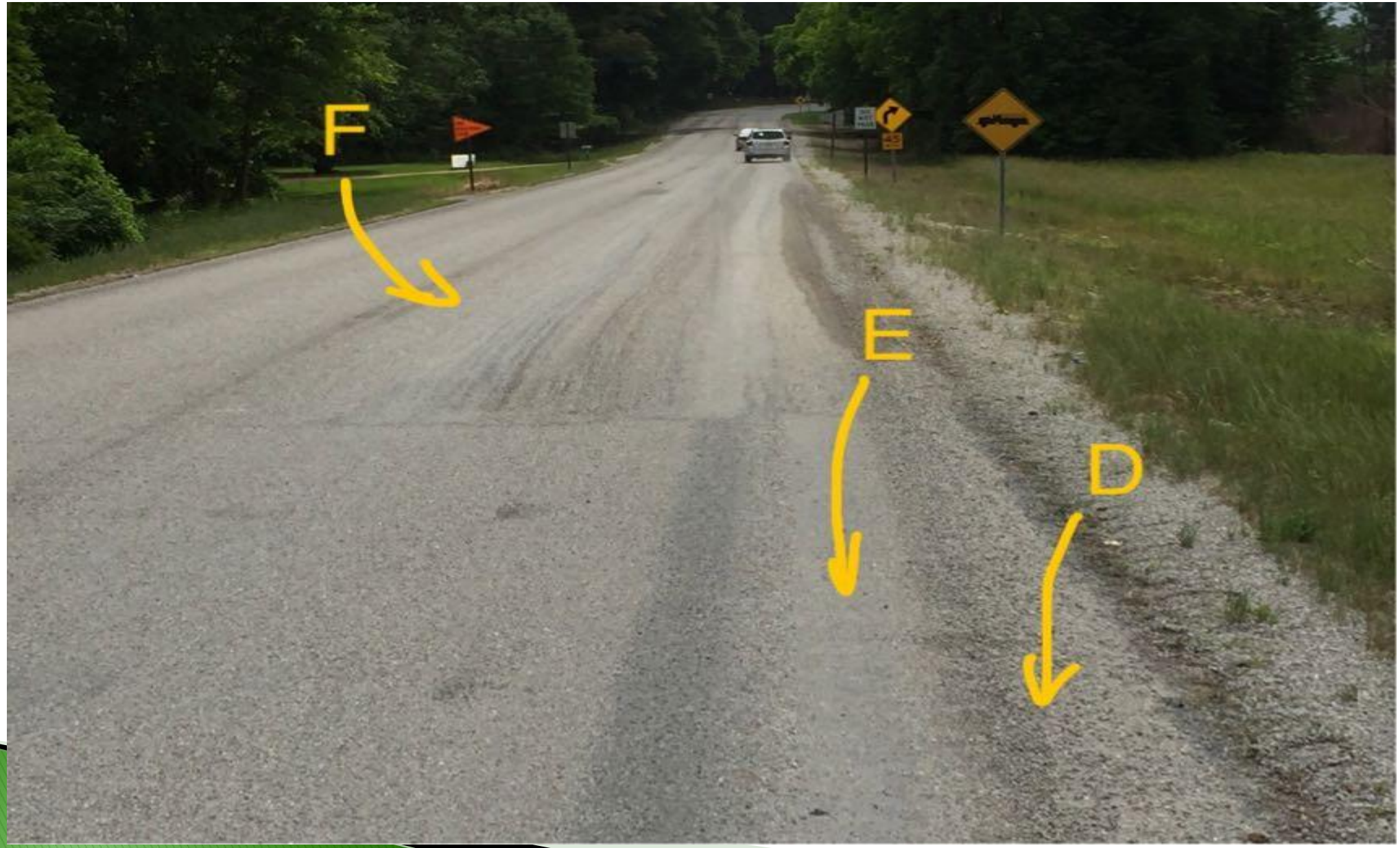


WHY?

Improper Broom Maintenance



WHY?



Changing Conditions

- Patches
- Rutting
- Surface Texture Changes

What's wrong with this picture?

What's wrong with these pictures?

Questions!