



# TACERA Annual Conference

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# Seal Coat Equipment and Construction Process



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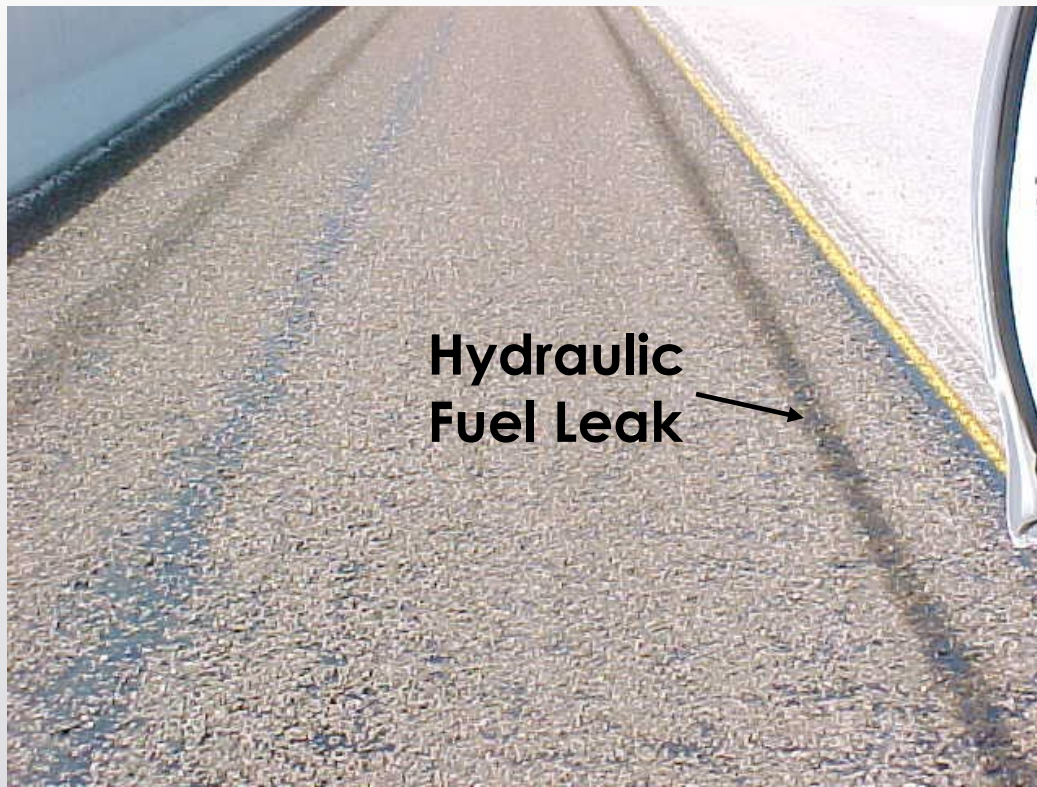
Research Engineer



# Seal Coat Construction Equipment

- Rotary Broom
- Asphalt Distributor
- Aggregate Spreader
- Haul Trucks
- Rollers
- Front-End Loader
- Heater and Storage Unit

# Check All Equipment for Leaks





# Safety

- Follow the manufacturer's safety procedures for inspection and operation of all equipment.
- Heating asphalt binder always constitutes some degree of hazard, with the exception perhaps of emulsions.
- The most hazardous are cutback asphalts because of the highly volatile solvents used.
- Extreme care must be taken not to allow open flames to come in contact with the asphalt or the gases from hot asphalt.
- Asphalt cement at 300°F can cause very severe burns. Avoid standing near the asphalt distributor during heating and operation unless necessary.
- It is recommended that a copy of the Material Safety Data Sheet (MSDS) for the binder being used be kept with the asphalt distributor truck.

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# Rotary Broom

- Used to sweep pavement prior to seal coat
- Used to broom excess aggregate from finished seal coat



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# Asphalt Distributor

## Major components:

- Asphalt tank
- Heating system
- Circulating and pumping system
- Filter Screens
- Spray bar
- Hand sprayer
- Controls and gauges

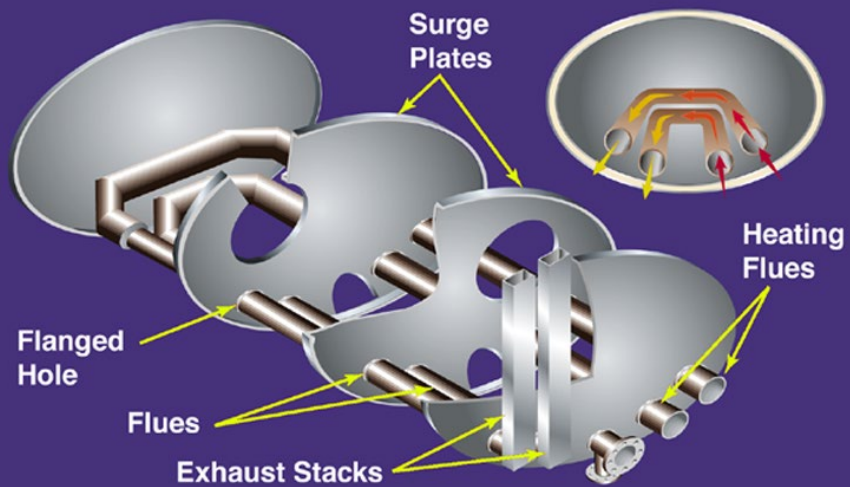


# Asphalt Binder Tank

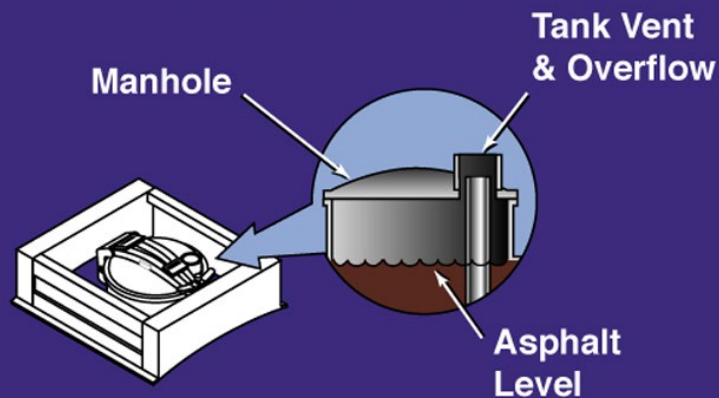
- Must have current calibration certificate.
- The tank should be equipped with a thermometer.
  - Range from below 100°F to at least 400°F.
  - Some models of distributors use a dial-type thermometer mounted outside the tank. These use a thermocouple that is mounted inside the tank.
- Asphalt temperature is a critical factor.
- Tank should be calibrated.



# Asphalt Binder Tank



## TANK VENT





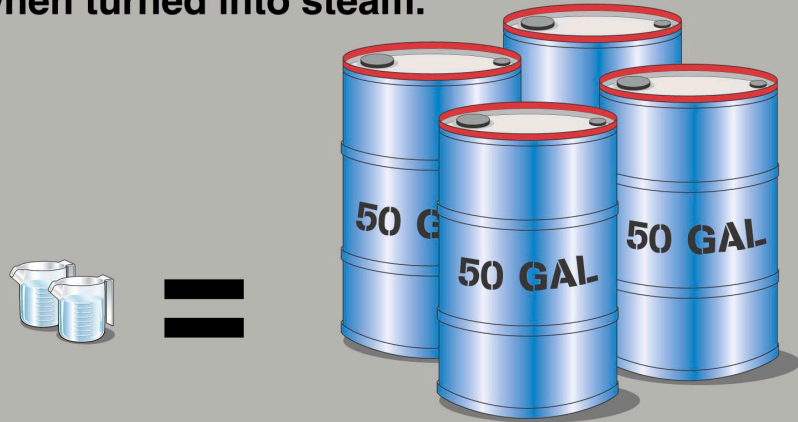


# Distributor Heating System

- Emulsion Application Temperature
  - 120°F to 160°F
- Asphalt Cement Temperature
  - 275°F to 375°F
- Cutback Asphalts Application
  - 125°F to 275°F

# Safety

Water expands to 1600 times its volume when turned into steam.



2 Cups  
**Water** = **200 Gallons**  
**Steam**

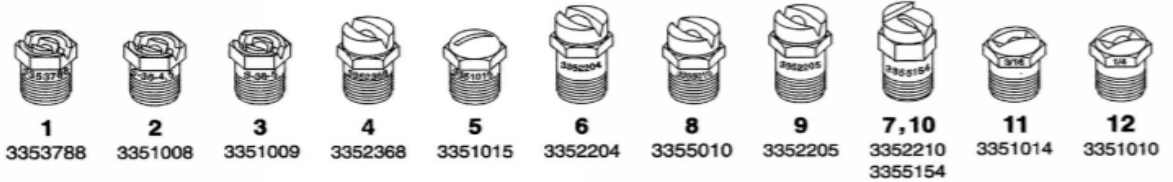
## Distributor Spray Bar & Nozzles

- The spray bar and spray nozzles regulate the amount of asphalt sprayed on the roadway and regulate the spray pattern.
- Nozzles manufactured with different size openings.
- Creates a fan shaped application.





# Nozzles



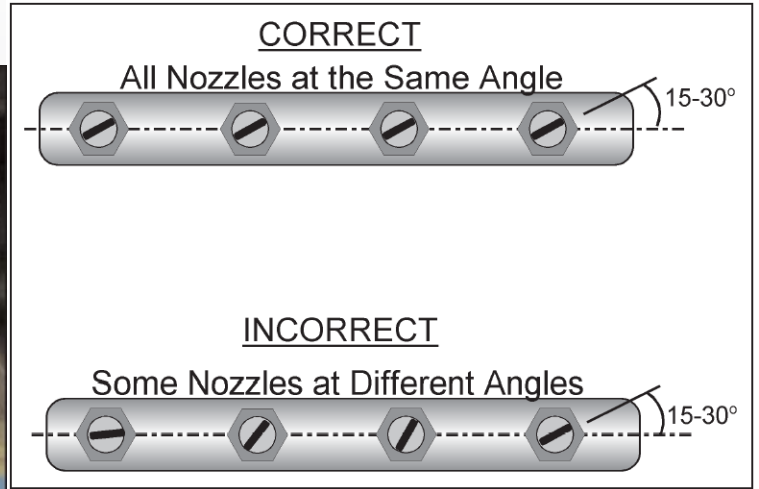
Ref.	Part No.	Description	Application Gallons Per Square Yard	Application (Metric) Liters Per Square Meter	US Flow Gallons Per Minute Per Foot
1	3353788	V Slot Tack Nozzle 1/8" Rifle Bored	.05 – .20	.23 – 0.91	3.0 – 4.5
	3351013*	V Slot Tack Nozzle 1/16" Coin Slot	.05 – .20	.23 – 0.91	3.0 – 4.5
	3354904	V Slot Tack Nozzle 1/8" Counterbored	.05 – .20	.23 – 0.91	3.0 – 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	3355154	<b>End Nozzle</b> (use with 3352204 nozzle)	.35 – .95	1.58 – 4.30	12.0 to 21.0
8	3355010	Multi-Material V Slot	.29 – .72	1.31 – 3.26	10.0 – 16.5
9	3352205	Multi-Material V Slot	.20 – .55	.91 – 2.49	7.5 to 12.0
10	3352210	<b>End Nozzle</b> (use with 3352205 nozzle)	.20 – .55	.91 – 2.49	7.5 to 12.0
11	3351014	3/16" Coin Slot	.35 – .95	1.58 – 4.30	12.0 to 21.0
12	3351010	1/4" Coin Slot	.40 – 1.10	1.81 – 4.98	15.0 to 24.0



# Nozzle Alignment



**Correct Nozzle Alignment**

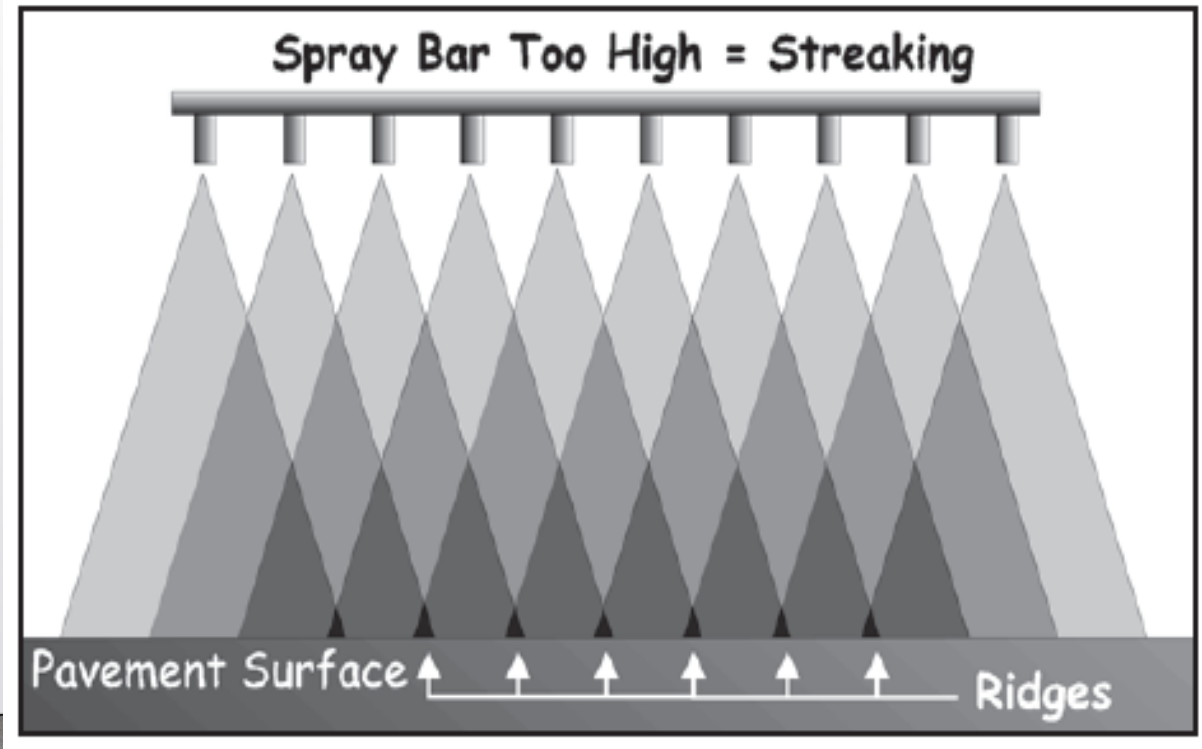


**Incorrect Nozzle Alignment**

# Spray Bar Inspection

## Fan Width:

In addition to the nozzle angle, the height of the spray bar is critical to obtaining a correct spray pattern. The height of the bar above the surface of the roadway determines how wide the fan spreads.



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# Hand Sprayer

All distributors should be equipped with a hand sprayer for use in narrow, irregular shaped areas that are inaccessible to the spray bar.



# Aggregate Spreader

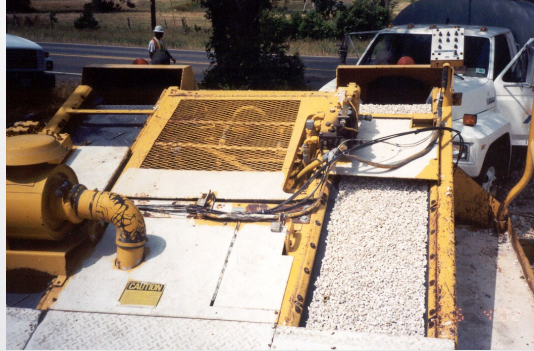
## Major components:

- Truck hitch;
- Receiving hopper;
- Belt conveyors;
- Spreading hopper;
- Discharge gates;
- Discharge roller.

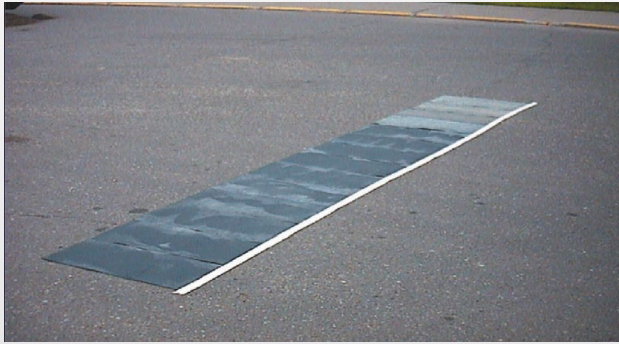




# Aggregate Spreader



# Chip Spreader Calibration



- Adjust gates.
- Repeat test until all gates place same amount of aggregate  $\pm 1$  lb/sy.
- Then adjust main feed until correct quantity is placed.
- Can be done offsite the day before.



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# Haul Trucks

- Size of the truck bed expressed in cubic yards
- All trucks should be in reasonably good mechanical condition
- Must have a hoist mechanism
- Must be equipped with hitch that is compatible with the one on the spreader box



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# Rollers

- A pneumatic roller is recommended for all seal coat and surface treatment work.
- A steel-wheel roller is not recommended because the flat, steel drum will tend to crush the aggregate, especially on the high spots.

## Wheels

- The roller shall provide a uniform compression under all wheels. Specifications require that all tires be inflated so that there is not more than 5 psi variation from one tire to the next.
- The wheels must not wobble when the roller is in operation. This can cause aggregate to be displaced.



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# Front End Loader

- Used to move aggregate from the stockpile into the haul truck.





# Seal Coat Application Process



# Application Process

- Weather
- Traffic Control
- Removing Pavement Markers
- Cleaning the Pavement
- Placing Temporary Tabs
- Setting the Rock Lands
- Setting the Asphalt Shots
- Checking the Loader
- Operation
- Placing Paper Joints
- Shooting the Asphalt
- Strapping the Distributor
- Spreading the Aggregate
- Timing for Aggregate Application
- Rolling the Aggregate
- Patching or Hand Work
- Irregular Shapes
- Brooming Excess Aggregate
- Opening to Traffic
- Temporary Pavement Marking
- Permanent Pavement Marking
- Clean-Up

# Weather



## Ideal Conditions

- High temperature
- Low humidity
- Little or no wind
- ~June to September
- Check extended forecast.
- Review specs for temperature requirements.
- For emulsions, it is best if humidity less than 50%.
- Never apply asphalt during rain.

## TxDOT Specifications

- Standard Temperature Limitations:
  - Apply when air temp 50°F and rising.
  - Do not apply when air temp is 60°F and falling.
  - Surface temperature must be 60°F or greater.
- For “Polymer Modified Asphalt Cement”
  - Air temp 70°F and rising.
  - Do not apply when air temp is 80°F and falling.
  - Surface temperature must be 70°F or greater.



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# Traffic Control

- All traffic control devices should conform to the details shown on the plans or those indicated in the Texas Manual on Uniform Traffic Control Devices (TMUTCD).
- One person should have full responsibility for traffic control.





## Removing Pavement Markers & Placing Temporary Tabs

- Remove early in the day.
- Ensure minimal pavement damage occurs.
- Prior to shooting asphalt, temporary flexible-reflective roadway marker tabs should be placed to designate lane lines in accordance with applicable traffic control plan.

# Cleaning Pavement

- Sweep prior to asphalt application.
- Normally the sweeper will require 2 to 3 passes to adequately prepare a 12-foot lane.
- Additional sweeping may be required where dust or dirt is tracked onto the pavement from side roads or private access roads.



# Rock Land and Binder Shot Length

Description	Formula Symbol	QTY	Units	Comments / Formulas
Width to be Sealed	w	<b>12</b>	ft	From Plans
Distributor Capacity	D	<b>2000</b>	gal	Contractor Provides
Haul Truck Capacity	H	<b>14</b>	cy	Contractor Provides
Binder Rate	A	<b>0.36</b>	gal/sy	From Your Design
Aggregate Rate	S	<b>125</b>	sy/cy	
<ol style="list-style-type: none"> <li>1. Calculate the               <ol style="list-style-type: none"> <li>a. area covered by 1 load of aggregate and</li> <li>b. amount of binder needed for 1 load of aggregate.</li> </ol> </li> <li>2. Check the Number of trucks needed based on the distributor capacity.</li> </ol>				



# Rock Land and Binder Shot Length

Description	Formula Symbol	QTY	Units	Comments / Formulas
Rock Land, (Area for 1 Truck)	$R_a$	1750	sy	$R_a = H \times S$
<b>Rock Land, (Length for 1 Truck)</b>	$R_L$	1313	<b>Ft</b>	$R_L = 9 \times R_a \div w$
Quantity Binder per Rock Land	Q	630	Gal/ RockLand	$Q = A \times R_a$
No. Haul Trucks per Distributor Shot	$H_D$	3.17	No. Trucks	$H_D = D \div Q$
1. Check number of trucks available on project. 2. Round trucks down to whole number or a maximum of the number of trucks available on the project, whichever is smaller.				
No. of Haul Trucks	T	3	No. Trucks	$H_D$ , Rounded Down to Whole number

## Rock Land and Binder Shot Length

Description	Formula Symbol	QTY	Units	Comments / Formulas
1. Calculate the quantity of binder needed in the Distributor. 2. Check to see that at least 100 gallons (may need more for larger distributors) of binder remains in the distributor. Shot length must be in full rock lands and should leave at least 100 gallons of AC in the distributor. If not, use 1 less haul truck and verify AC Quantity remaining in Distributor. When $D_R > 100$ gal, calculate shot length				
AC quantity per Shot	$A_Q$	<b>1890</b>	gal	$A_Q = T \times Q$
AC Quantity remaining in Distributor	$D_R$	<b>110</b>	gal	$D_R = D - A_Q$
<b>Length of Asphalt Shot</b>	L	<b>3939</b>	<b>Lf</b>	$L = T \times R_L$

# Checking the Loader Operation



## Contamination

- Check loader operation for contamination of grass or soil.

## Gradation

- The loader operator should take a representative scoop of aggregate with each bucket.
- Graded aggregate will tend to segregate somewhat when it is stockpiled.
- Finer particles tend to sift between the coarse particles, making the stockpile show a greater content of coarse particles near the top and outside.

## Degradation

- The loader should be operated carefully to avoid degradation of the aggregate.
- The operator should *not* operate the equipment in such a manner that causes the front wheels to roll over any of the stockpile.

## Excessive Dust

- If a cloud of dust occurs with every bucket load that is placed in the trucks, the dust may be detrimental to the seal coat performance.
- If dust is a problem, it may be reduced by lightly sprinkling the stockpile with water.
- Only enough water should be used to reduce the dust and this is only recommended when emulsions are being used.

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# Dusty Aggregate





# Placing Paper Joints

- To ensure an even, straight, and sharp beginning and end of each asphalt shot, paper joints should be placed.





# Distributor

Common Binders	Application Temperature Range (°F)	Maximum Allowed (°F)	Storage Maximum (°F)
HFRS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CHFRS-2P	120-160	180	180
AC-15P, AC-10-2TR, AC-20XP, AC 20-5TR	300-375	375	360

# Placing Paper Joints



## Paper Joints – Start and Stop





# Construction Problems

What happens without paper joint?



Not enough Asphalt for shot length.



# Spreading the Aggregate

- For best results, aggregate should be applied on any type of asphalt binder as soon as possible without causing the rocks to roll over or the asphalt to be picked up on spreader box, haul truck or roller tires.
- The aggregate spreader should follow closely behind the asphalt distributor.





## Check – Aggregate Rate: Rock Land Marker

- After hooking up with the second truck and resuming the spreading, the spreader should pass the marker for the end of the first rock land.
- The end of the first rock land should be slightly farther than the second truck hook up because there should be some aggregate in the spreader remaining from the first truckload.
- If the spreader passes the first rock land marker before the first truck is empty, the aggregate is being applied too thinly.
- If the second truck is hooked up more than 25 feet before the first rock land marker, the aggregate is being applied too heavy. In either case, gate openings must be adjusted accordingly.

# Visual Checks

- Behind the spreader, the pavement surface should be checked for contaminants and streaking of thin or thick rows of aggregates.
- If there is evidence of thick and thin alternating streaks running transversely (a ripple effect), it indicates that the spreader speed is too high.



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## Problems – Aggregate Spreader



Contamination from poorly maintained stockpiles or poor loader operation

Windrow of Aggregate



# Rock Rate Examples

## Good Rate before Rolling

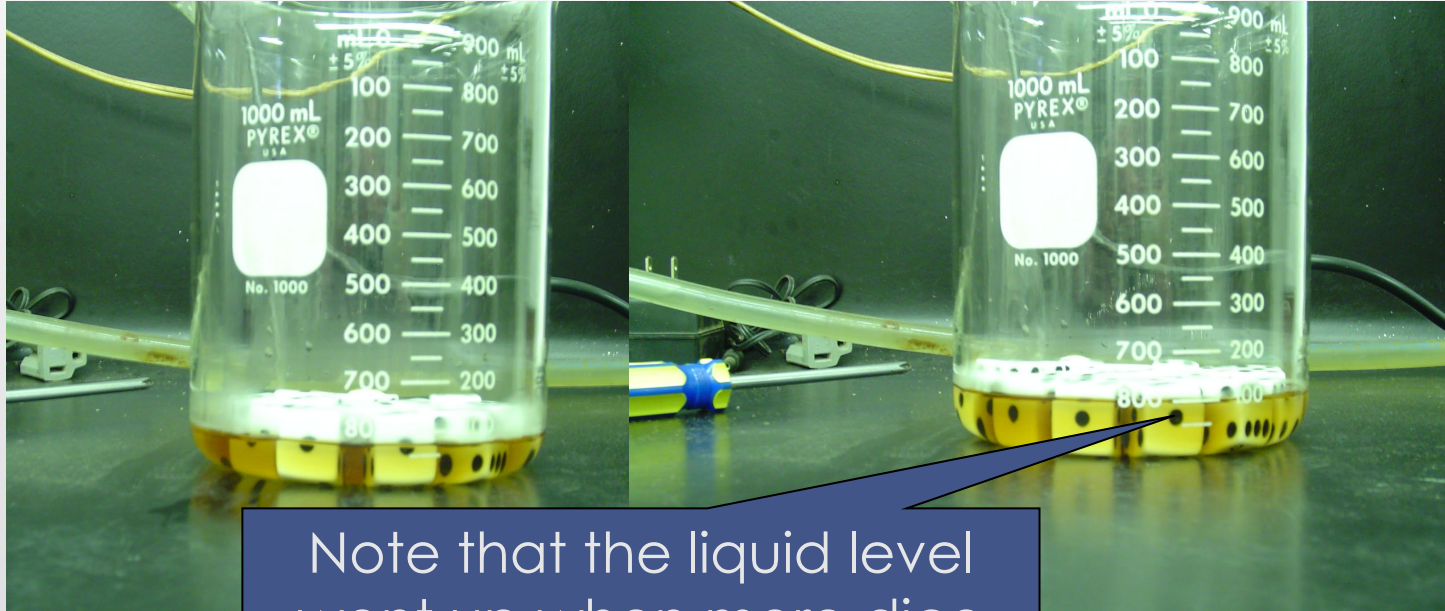


## Heavy Rock Rate

- Rock on rock contact can and will eventually dislodge or damage other rock particles.
- This can contribute to eventual asphalt flushing and/or bleeding and ultimately loss of skid resistance



# Rates



Note that the liquid level went up when more dice were added

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# Aggregate Application

## Note!

When you reduce the aggregate spread rate in order to increase the % voids, it is very likely that you will need to increase your asphalt rate in order to achieve the desired embedment %. The opposite effect applies if you are increasing the aggregate spread rate.



# Tire Pick-Up



## What can cause Tire Pick-up

- Detouring traffic onto the fresh seal.
- Construction and other traffic accelerating, turning, and braking abruptly on the fresh seal can dislodge aggregate.
- Improper tire inflation pressures on construction vehicles.
- Aggregate is rolling over causing asphalt to be exposed to tires.
- Too much asphalt has been applied.
- A puddle of asphalt may have leaked or spilled onto the pavement.
- One of the discharge gates on the spreader may have clogged momentarily, preventing the aggregate from covering the asphalt.
- Failure to use deflector nozzles and overlapping the shot in the second lane causes an excess of asphalt.

## If tires pick up asphalt:

- The seal patching crew should repair the spot before rolling.
- Tires should be cleaned immediately, and the condition remedied before the situation gets worse.

# Stagger Trucks





# Timing for Aggregate Application

- For best results, aggregate should be applied to emulsified asphalt or hot AC immediately.
- Maximizes embedment.
- Improves adhesion.



# Emulsion Application

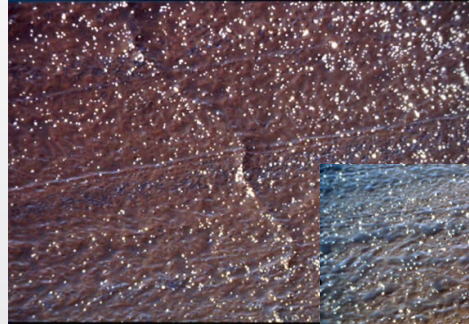
- Apply aggregate to emulsion binders while the emulsion is in “water phase” or still brown
- If it begins to track immediately, back off slightly or consider a slight **AGGREGATE** rate reduction
- If it still tracks, you may need to reduce the asphalt rate slightly
- It is NOT necessary to consider ionic (+/-) compatibility between emulsions and aggregates for seal coats!

# Emulsion Break Time

## Can Depend on:

- Evaporation
- Chemical
- Surface contact
- Temperature
- Humidity

Emulsion



Starting to Break



Broken







## Application of Hot AC

- Hot AC is applied at 320-350°F.
- Hot AC loses 150-200°F in the first 30-45 seconds after application.
- Applying the aggregate on the AC while it is hot and liquid is imperative as the initial locking of the aggregate occurs when the AC begins to cool.

# Adjustment Factors – Traffic and Surface Condition

Adjust Aggregate Rates as needed to achieve the proper rate.

Asphalt Adjustment Factors						
Traffic Correction		Surface Condition Adjustment				
v/d/l	gal/sy	Surface Type	Surface Condition	GR 3	Gr 4	Gr 5
SHLD	0.05	Asphalt Concrete	Very dry with many cracks	0.08	0.06	0.05
50-100	0.05		Dry with some cracks	0.05	0.04	0.03
100-250	0.04		Good condition with few cracks	0.02	0.02	0.1
250-400	0.03		Flushed	-0.02	-0.02	-0.01
400-500	0.02		Bleeding	-0.04	-0.04	-0.03
500-650	0.01	Seal Coat	Very dry with many cracks	0.06	0.06	0.04
650-900	0		Dry with some cracks	0.03	0.03	0.02
900-1100	-0.01		Good condition with few cracks	0	0	0
1100-1500	-0.02		Flushed	-0.02	-0.02	-0.01
1500-2000	-0.03		Bleeding	-0.04	-0.04	-0.02
>2000	-0.04	Patch	Dry or fresh patch	0.03	0.03	0.02
			Fogged patch	0	0	0
			Flushed patch	-0.03	-0.03	-0.03
		Prime	Dry surface, lightly primed	0.02	0.02	0.02
			Good prime rate, well penetrated	0	0	0
			Waxy and wet, not well penetrated	-0.03	-0.03	-0.02

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# Rolling

- Immediately after spreading of aggregate.
- Pneumatic tires only.
- The slower the better.
- Always moving.





# Patch Truck





## Brooming Excess Aggregate

- After the aggregate is spread and rolled, there will be some loose aggregate.
- This excess aggregate should be removed to prevent it from being whipped up by vehicle tires.
- The excess aggregate should *not* be broomed off the roadway as soon as the rolling is finished.

# Opening to Traffic



*Traffic should be kept off the fresh seal coat as long as possible.*

## Traffic Volume:

- Roadways with a low-traffic volume may be opened to traffic sooner than high-traffic volume roadways.

## Truck Traffic:

- On roadways with a high volume of truck traffic, hot asphalt need to cool (and stiffen) and emulsions need to cure so that trucks will not damage the surface.

## Asphalt Cement (AC):

- Asphalt cements stiffen and bind the aggregate quicker than asphalt emulsions, and thus may be opened to traffic sooner.

## Asphalt Emulsions:

- Emulsions are typically shot at about 150°F which is near the pavement temperature during the summer, so there is little loss of binder temperature.
- However, high humidity requires more time for emulsions to break. When humidity is greater than 50 percent, traffic should be kept off the seal as long as possible.
- If it rains and emulsions are in use, traffic must be kept off the fresh seal or it is likely that most of the aggregate and much of the binder will be lost.



# Clean-Up

- Joint Paper
- Spilled Asphalt
- Stockpile Area
- Signs and Barricades
- Repairs to Damaged Property

# Questions?

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