MnDOT Scrub Cape
Micro surfacing and Demo Day

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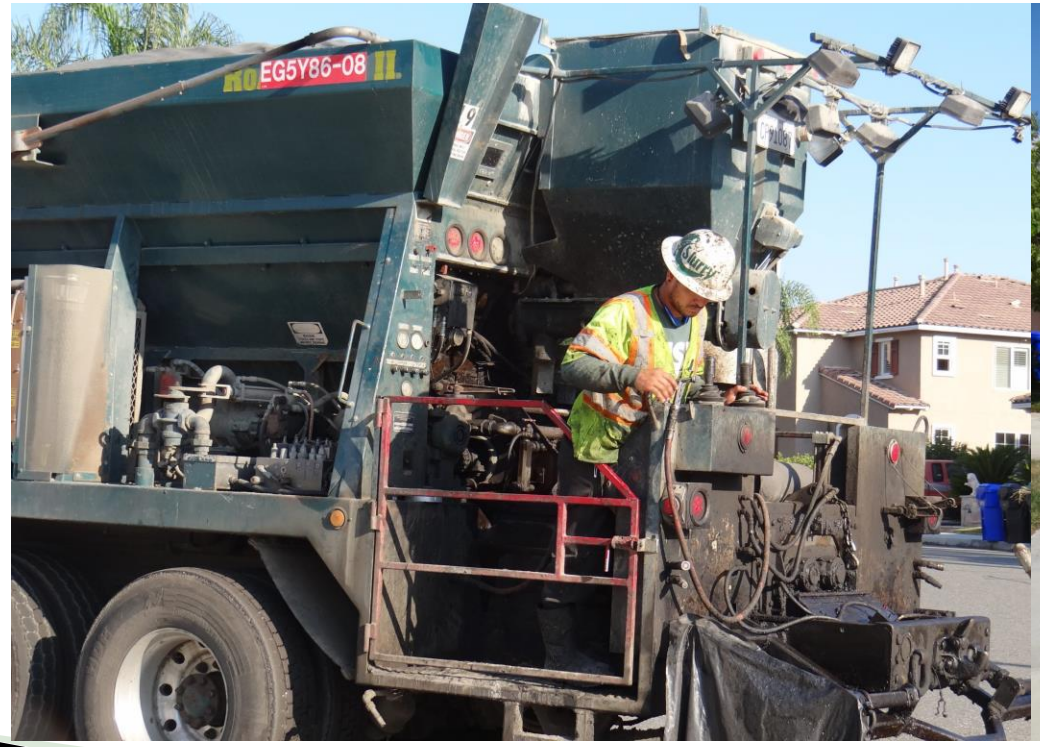
UNIVERSITY

Why do we apply Micro surfacing to the road?

- Benefits of Slurry Systems
  - Covers surface defects such as raveling
  - Protects Asphalt Surface and extends the life of the pavement
    - Water Intrusion
    - Oxidation
      - Sun
      - Water
      - Chemicals
  - Provides Transverse Leveling – rut fill / leveling course
    - Does not generally improve longitudinal ride quality
  - Provides Skid Resistant / High Friction Surface
    - Dependent on Aggregate Quality and Gradation
      - Type 3FA Generally provides the best skid resistance

What is Slurry Seal?

- A slurry seal is a homogenous mixture of emulsified asphalt, water, well-graded fine aggregate and mineral filler that has a creamy fluid-like appearance when applied. Slurry seals are used to fill existing pavement surface defects as either a preparatory treatment for other maintenance treatments or as a wearing course.



What is Micro Surfacing?

- A designed mixture of:
  - polymer modified emulsified asphalt
  - 100% Crushed Aggregate
  - mineral filler
  - water
  - other additives
- Proportioned, mixed & uniformly spread over a properly prepared surface
  - ISSA A-143
  - MDOT Sec. 504
  - ASTM D-6372

How is Micro surfacing different from Slurry Seal?

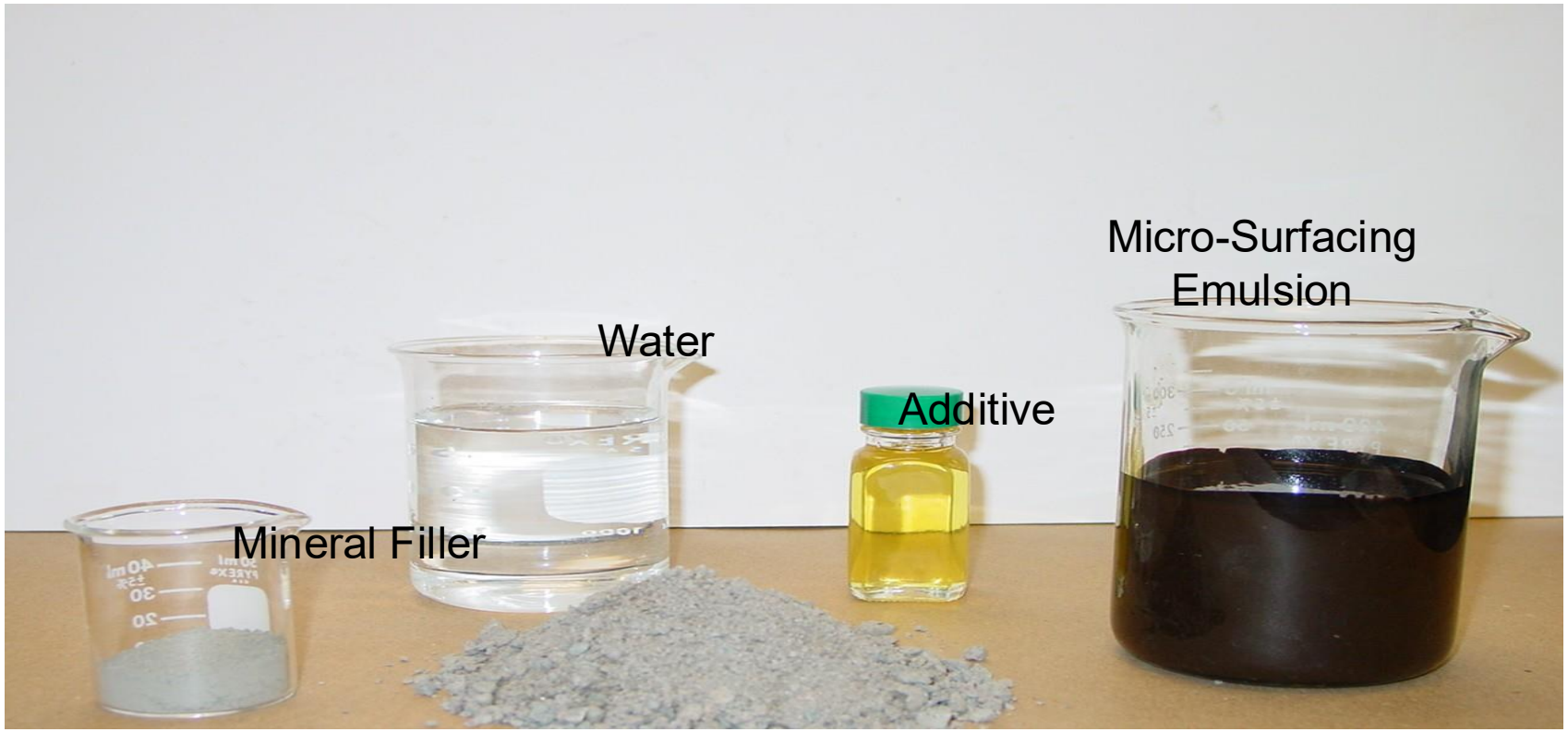
- Slurry Seal
- Cures (Expels Water) by Evaporation.
- Emulsion may or may not be polymer(latex) modified.
- Aggregate can be natural sand (un-crushed)
- Slurry can only be laid 1-Stone thick.
- Slurry can be laid with a Slurry Box or a Hydraulic Auger Box.

- Micro surfacing
- Cures Chemically
- Emulsion is always modified with at least 3% polymer (latex)
- Aggregate is always 100% crushed, clean, hard aggregate.
- Requires Cement to Start Breaking Process
- Micro surfacing can be laid multiple stones deep. Up to 1 ½ inches in a rut.
- Micro surfacing must be laid with a Hydraulic Auger Box or Rut Box.

Polymer Modified Slurry Seal (ISSA A-115)

- Polymer Modified Slurry Seal (PMSS) provides many of the benefits of Micro surfacing without triggering ADA requirements.
- PMSS requires 100% Crushed Aggregate and 3 % Polymer.
- PMSS cannot be used for leveling or rut filling and must NOT be laid over 1.5 stones thick.
  - PMSS will not pass the Loaded Wheel Test,
- PMSS is perfect for:
  - Preservation Seals on streets and roadways up to and including rural interstates.
    - Higher traffic volumes and night work should call for Micro surfacing

Microsurfacing and Slurry Seal Component Materials



Mineral Filler – Type I Cement

- Cement has two major functions in the Micro surfacing mix
  - The addition of cement starts the chemical reaction that causes the emulsion to become traffic ready within an hour.
  - Cement also acts as a thickening agent that helps hold the mix liquids together with the solids.
- Cement does <u>not</u> make Micro surfacing brittle or add strength.

Mineral Filler – Type I Cement

- The contractor may adjust the percentage of cement in the mix as needed to adjust break / set / cure time of the mix without needing to change the JMF.
  - % of Cement must stay within the specification limits of 0.25 – 3.0%
- Note – The JMF allows a minimum of 0.25% cement, but Micro surfacing pavers are generally not capable of consistently feeding that small of an amount.

Table 504-2:
JMF Limits

Test Method	Specification
Asphalt binder content (residual)	7.5%–9.0%, dry weight, 2FA aggregate 7.0%–8.5%, dry weight, 3FA aggregate
Mineral filler	0.25%–3.0%, dry weight aggregate

Micro surfacing Mix Design

- The Mix Design is usually done well in advance of the project by a qualified laboratory.
- The Mix Design is a laboratory model meant to simulate field conditions.
- The Mix Design must use the same materials that are going to be on the project.
- The design goal is to determine the combination / proportioning of materials that provides the best performance result in the field.

Main Mix Design Tests for Micro surfacing

- Wet Track Abrasion of Slurry Surface (ASTM D3910)
- Measurement of Excess Asphalt by Use of Loaded Wheel Tester (ISSA TB-109
- Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement (ISSA TB-144
- Classification by Modified Cohesion Tester of Set and Cure (ASTM 3910
- Wet Stripping Test for Cured Slurry Seal (ISSA TB-114)

HERITAGE RESEARCH GROUP

MICROSURFACING MIX DESIGN

6320 Intech Way
Indianapolis, IN 46278

DATE: 3/16/2023
PROJECT: 214018
EMULSION: CSS-1hM
ASPHALT SOURCE: Oregon

CONTRACTOR: Pavement Maintenance Solutions
AGGREGATE: Bay 2FA
SPECIFICATION: Michigan DOT 2020 Standard Specifications for Construction

Aggregate Testing

Aggregate Gradation

Sieve Size	Spec	Lab % Passing	Quarry %
3/8"	100 - 100	100	
No. 4	90 - 100	99	
No. 8	65 - 90	80	
No. 16	45 - 70	52	
No. 30	30 - 50	34	
No. 50	18 - 30	23	
No. 100	10 - 21	16	
No. 200	5 - 15	9.4	

Test	Spec	Result
Moisture Content	Report	3.1
Sand Equivalency	60% Min	80
LA Abrasion	NA	
Soundness Na2SO4	NA	
Soundness MgSO4	NA	

Bulking Effect of Moisture

Moisture	Wt of Aggregate		Wet Unit Wt		Dry Unit Wt	
%	lb	kg	lb/ft3	kg/m3	lb/ft3	kg/m3
0%	4.84	2.20	112.4	1801	112.4	1801
1%	4.82	2.19	112.1	1795	111.0	1777
2%	4.64	2.11	107.9	1728	105.8	1694
3%	4.55	2.07	105.8	1694	102.7	1645
4%	4.52	2.05	105.1	1684	101.1	1619
5%	4.54	2.06	105.5	1689	100.5	1609
6%	4.57	2.07	106.2	1701	100.2	1604

RECOMMENDED MIXED DESIGN

Portland Cement		Water		Emulsion	Residual Asphalt		Residual Asphalt in Mix	
	Required		Required			Required		Required
1.0	0.25%-3.0%	7.1	As Needed	12.0	65.0	62% Min	7.8	7.5%-9.0%

Tolerance:

Mix Testing

TEST			REQUIRMENT	RESULT
TB 113	Mixing Time	25°C	120 Sec Min	153
		40°C	35 Sec Min	72
TB 139	Wet Cohesion, kg-cm, 25°C	30	NA	14 N
		60	NA	15 S

TEST			REQUIRMENT	RESULT
TB 114	Wet Stripping, %		≥90%	>90%
TB 100	West Track Abrasion Loss	1 Hr	≤50g/ft2	5.4
		6 Day	≤75g/ft2	47.8
TB 144	Grams Lost		≤3 g loss	0.7421

This mix design was performed in accordance with the referenced specification by AASHTO re:source accredited laboratory using samples of the specific emulsion and aggregate products and sources listed. HRG assumes no responsibility in furnishing this data other than to warrant that they represent reliable measurements of the properties of the samples as received and tested. Adjustments required because of field conditions should be made at the discretion of the contractor within the tolerances specified. These results are believed to be true and accurate to the best of my knowledge.

Chris Hollenback
Chris.Hollenback@hrglab.com

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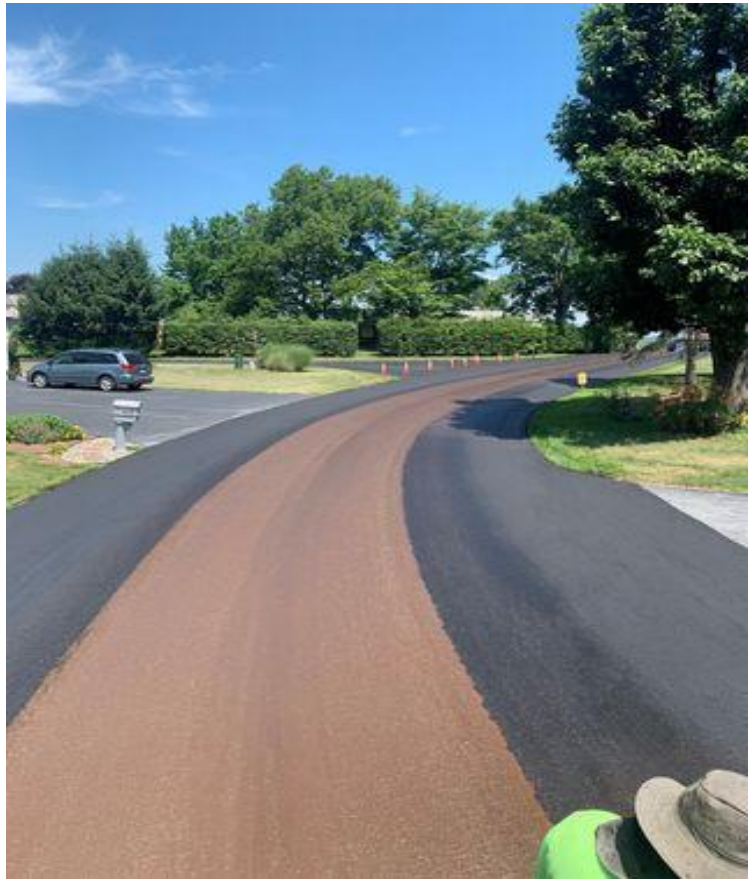
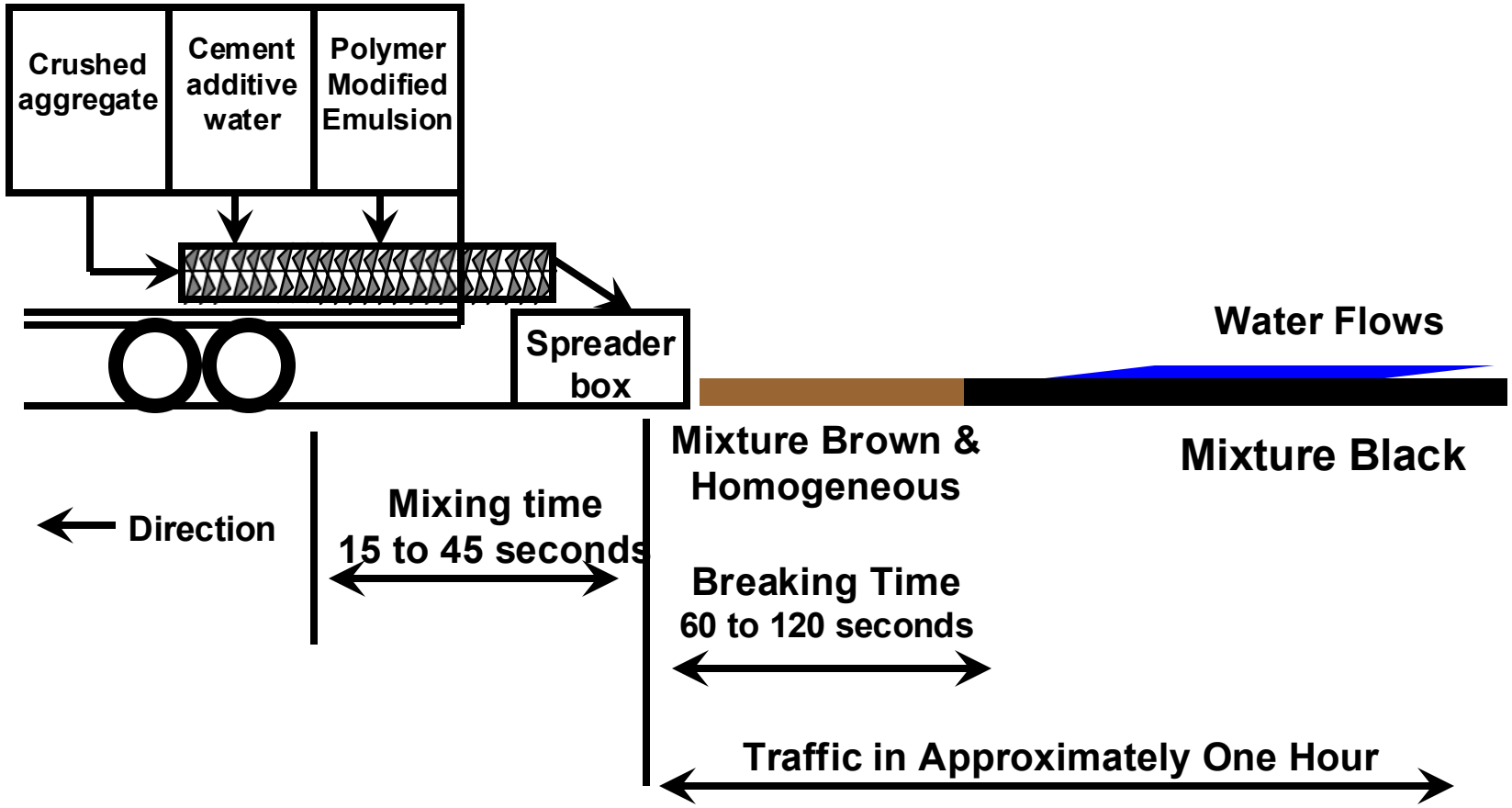
Tolerance:

Micro surfacing Emulsion Break / Set / Cure

- Break
  - The Emulsion Aggregate Mixture is initially brown. It starts turning black as the emulsion “breaks”.
  - The asphalt is migrating to the rock.
- Set
  - Almost all the asphalt has separated from the water and is attached to the rock.
  - The mix is no longer in a liquid state, but it is not tough.
- Cure
  - Virtually all the water is out of the mix and straight rolling traffic will not damage the surface.




Crushed aggregate
Cement additive water
Polymer Modified Emulsion
Spreader box
Water Flows
Mixture Brown & Homogeneous
Mixture Black
Direction
Mixing time
15 to 45 seconds
Breaking Time
60 to 120 seconds
Traffic in Approximately One Hour

Slurry/Micro Equipment

- What is a Micro surfacing Paver ????

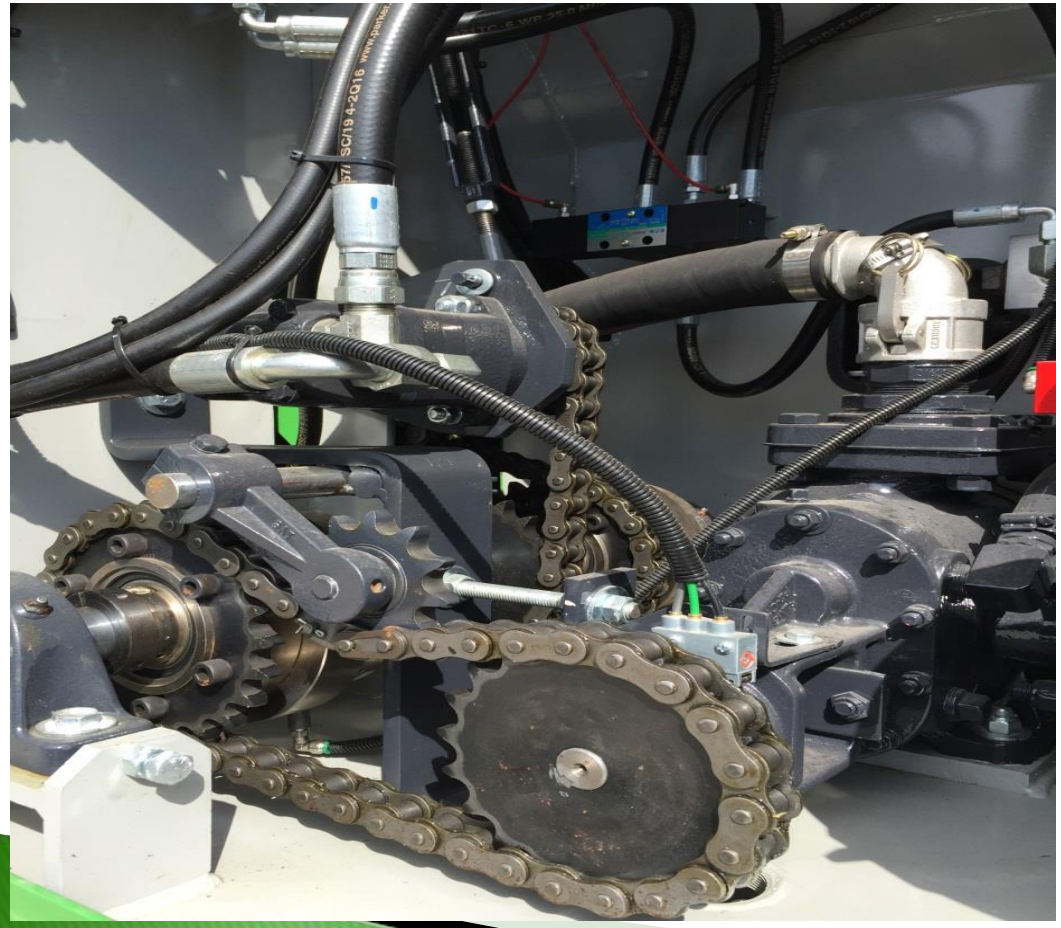
All in One Package

Truck Mount Pavers

Continuous Pavers

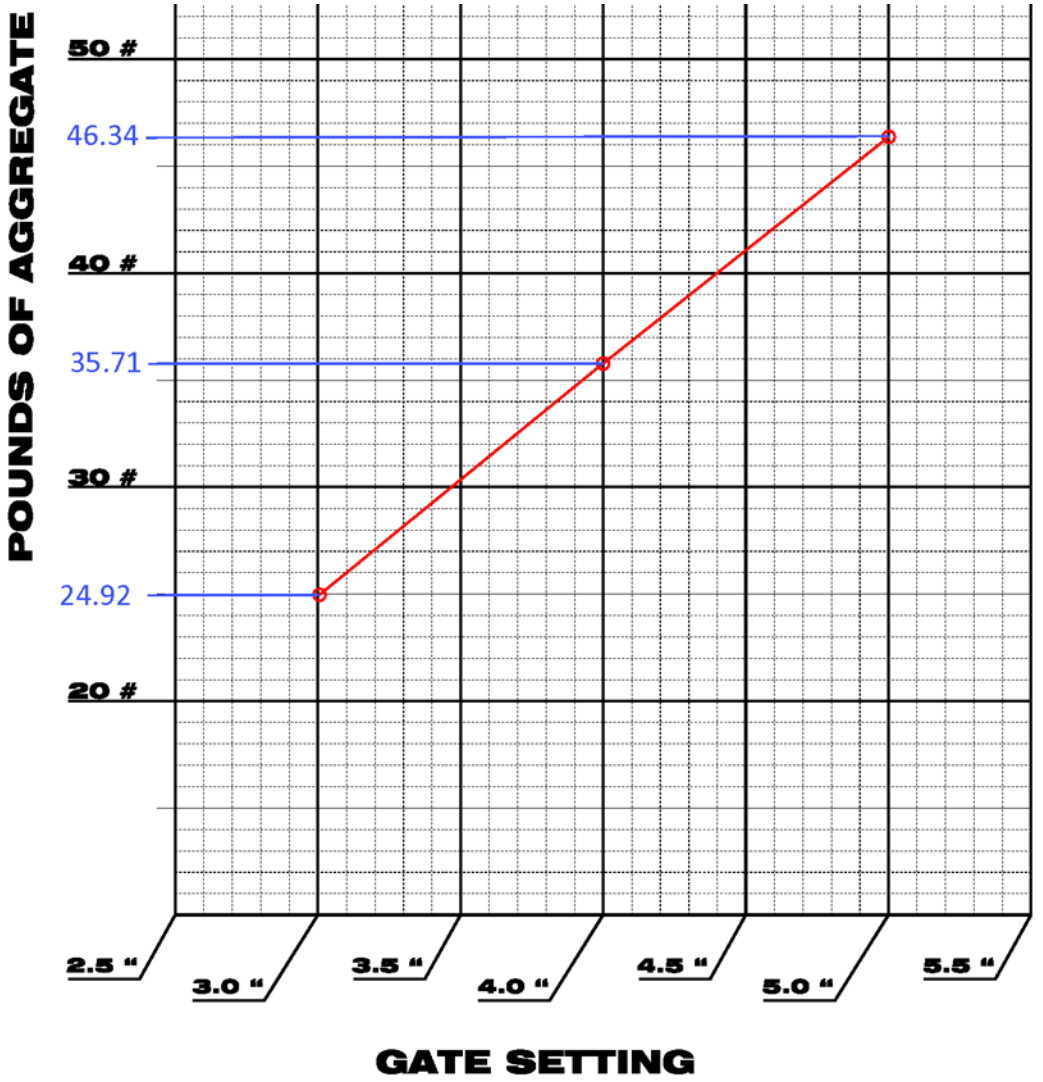
Paver Types –

- Mechanical

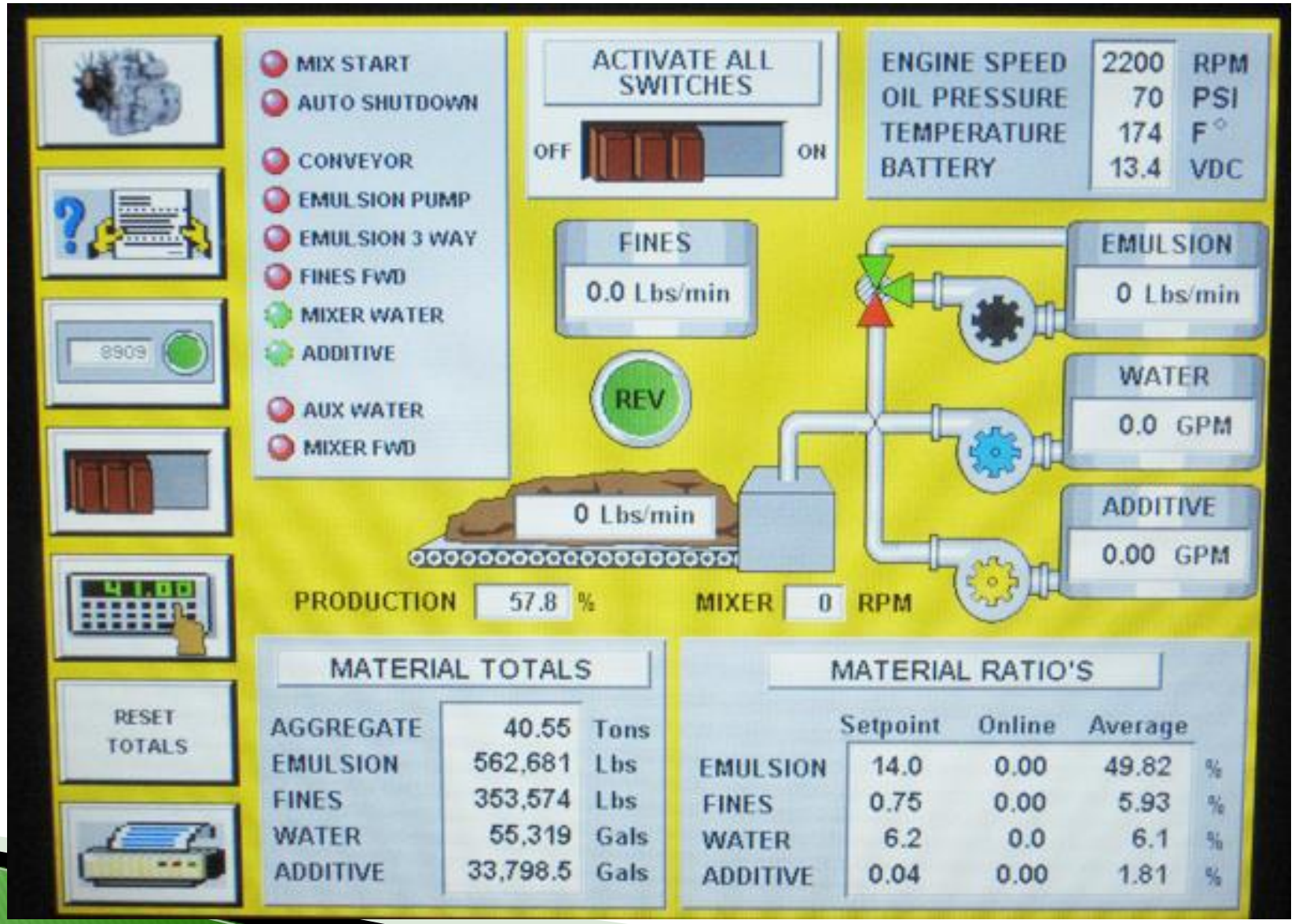


- Electronic – All Hydraulic Drive

Mechanical Paver



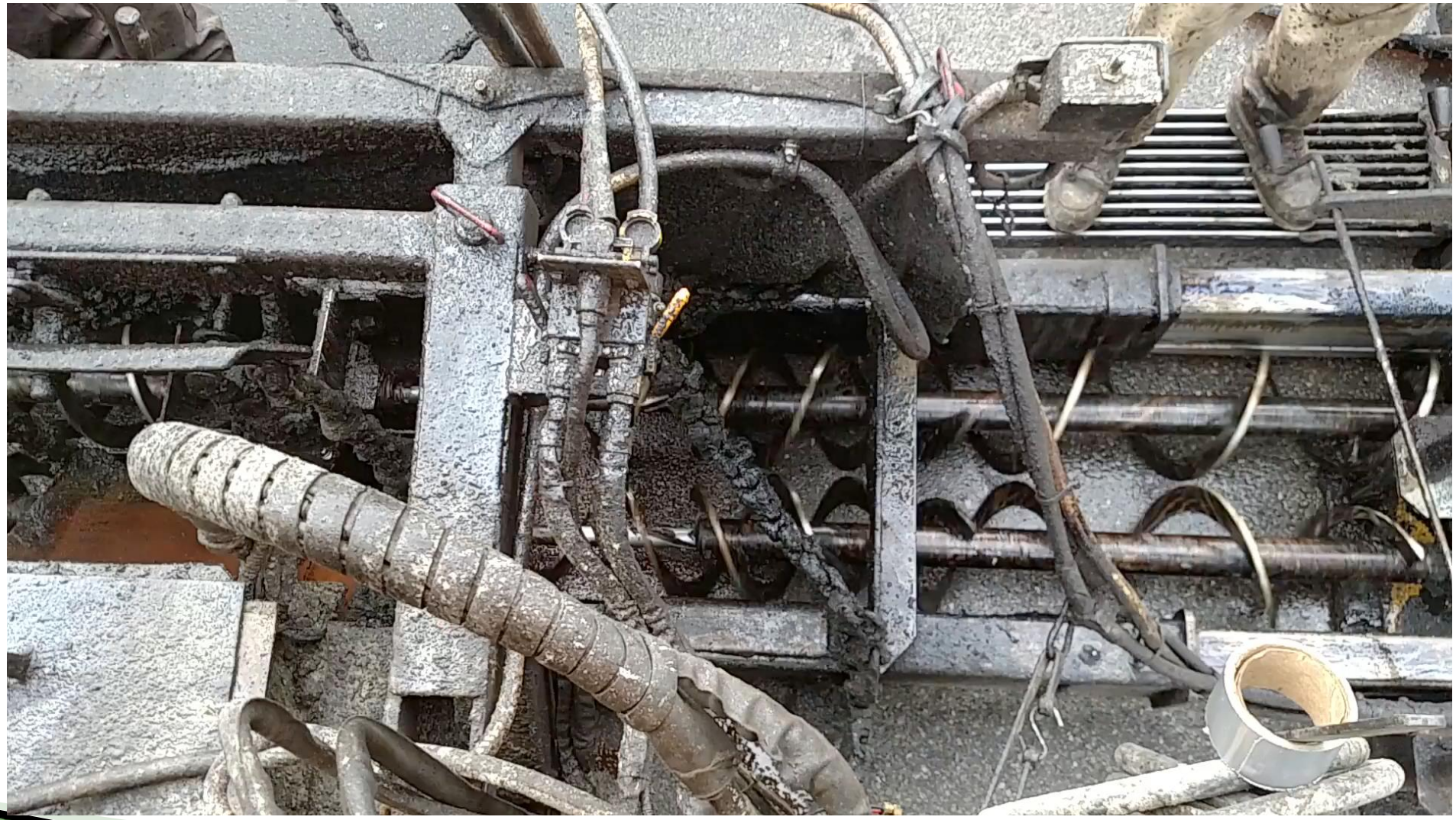
Electronic Paver Mix Control



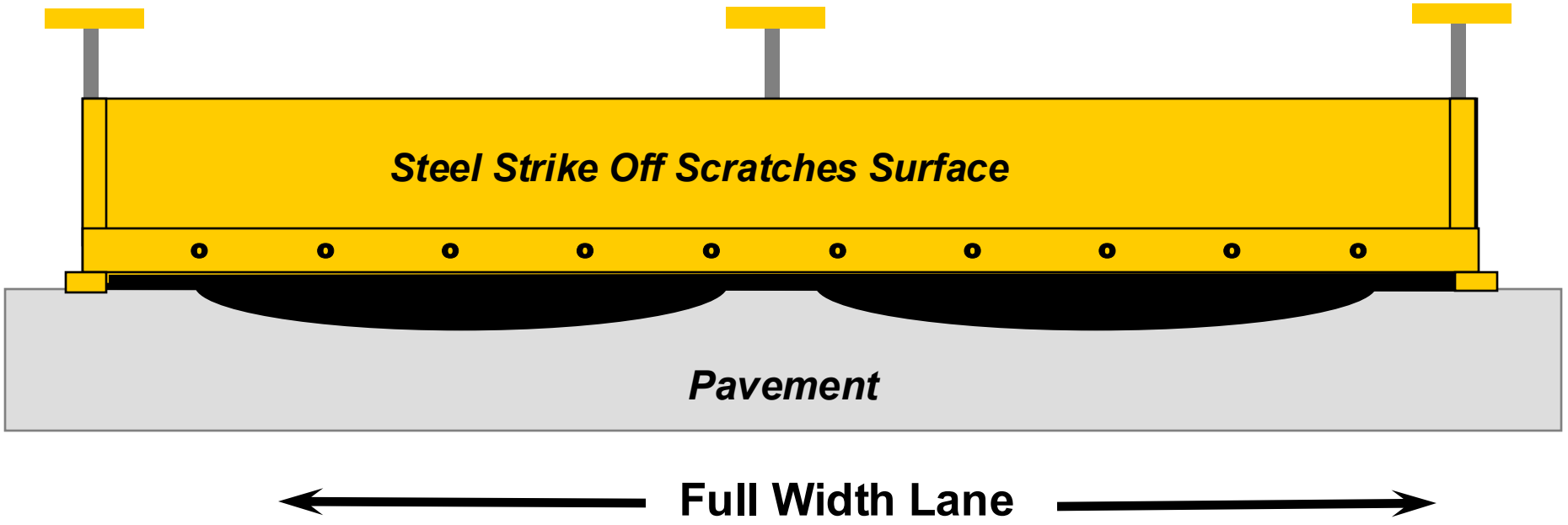
Multi-Bladed Pug mill

Variable Width Spreader Box

Spreader Box Operation



Ruts < ½” May Be Filled With Scratch Course



The scratch coat is generally 6” less than the width of the lane to preserve lane lines.

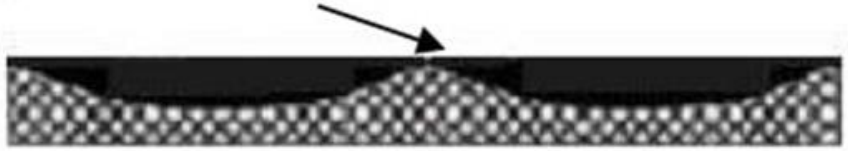
Rut Box

Rut Filling

Re-profiling Wheel Ruts
with
Micro surfacing

For each inch of applied micro-surface rut fill mix add 1/8" to 1/4" crown to compensate for return traffic compaction.

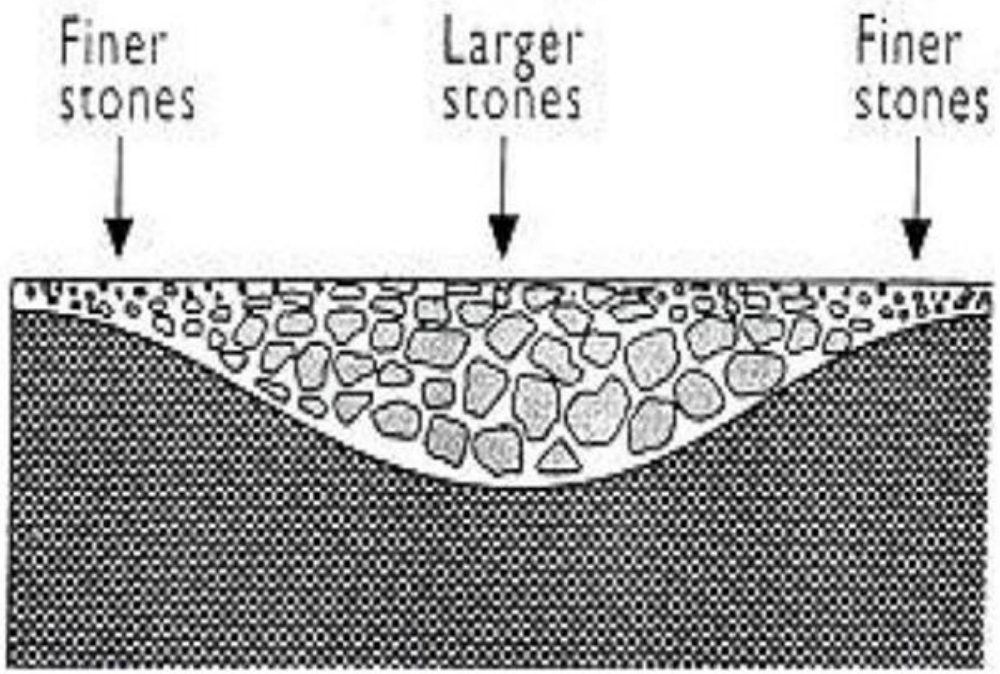
Original Pavement Cross Section



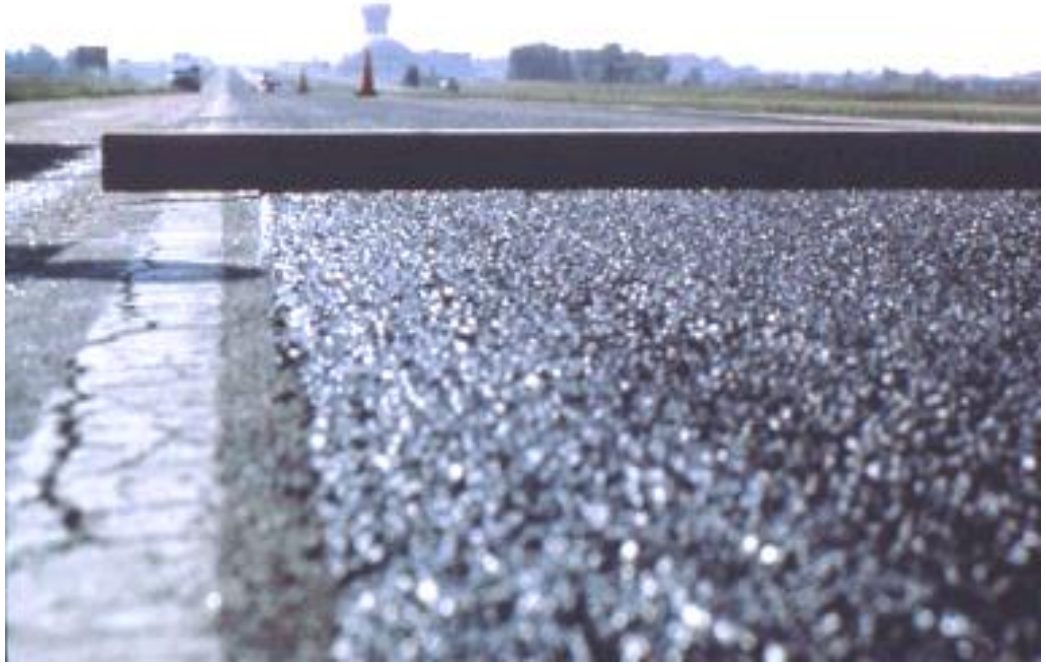
Ruts in Wheelpaths

Ruts ½" & Over
Must Use the Rut Box

Cross Section of a Rut



Rut-filling



Surface Course


hudson

Materials and Calibration

- Micro surfacing is a chemical system. Each component has an important function in the system and when any component fails to meet the design parameters the system breaks down.
- Components Include:
  - Aggregate
  - Emulsion
  - Cement
  - Additives
  - Mix Design
  - Paver Calibration

Why do we calibrate?

- Calibration sets the paver, so the ratios of material stay inline with the mix design
- Calibration will ensure quality control of the Micro surfacing system for the contractor and buying agency
- Calibration serves as a basis for recording amount of materials used.

Why Do We Calibrate?

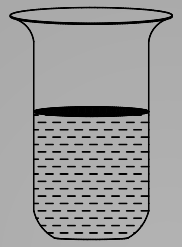
- Slurry/Micro Pavers must be calibrated to make sure the mix matches the Mix Design.
- Must be calibrated using the aggregate and emulsion type to be used on the project.
- Must be re-calibrated if:
  - Material Change
  - Pump Repair or Change
  - Replacement of Conveyor Skirt Rubbers.
- Emulsion should be calibrated every job* or at least once per month.

Paver Calibration

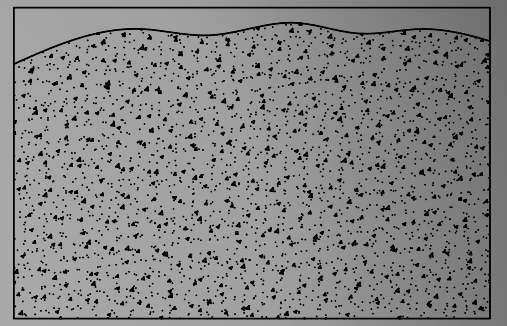
- Calibration converts Volumetric Batch Mix Design into a Continuous Feed Process.
- Aggregate and Emulsion are mechanically or electronically connected to maintain Mix Design Ratios.
- In most pavers the emulsion rate is fixed and the aggregate is adjustable by raising or lowering a rock gate.

If we mixed in a batch:

10%

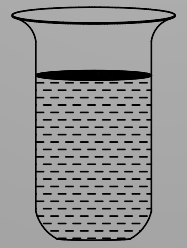


Emulsion – 10 lbs

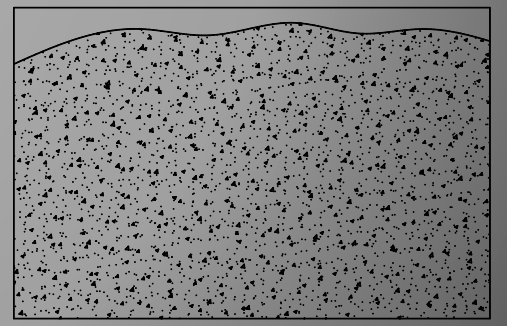


Rock – 100 lbs

12%



Emulsion – 12 lbs



Rock – 100 lbs

Aggregate

+

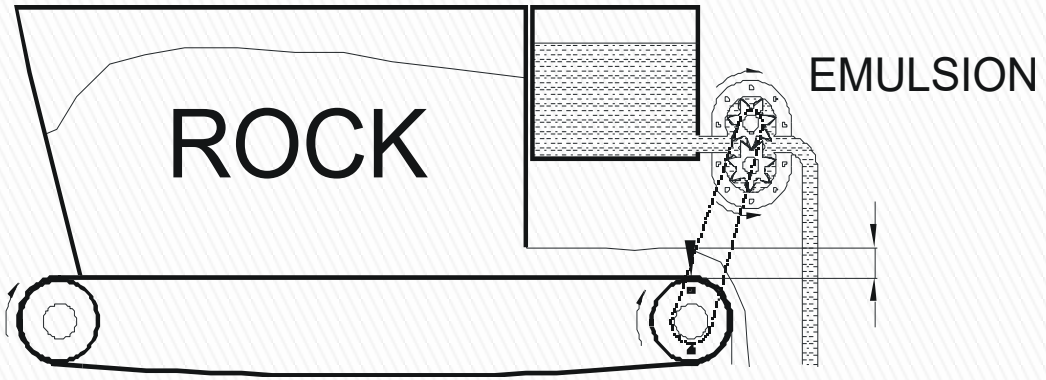
% Emulsion

+

% Water

+

% Additives



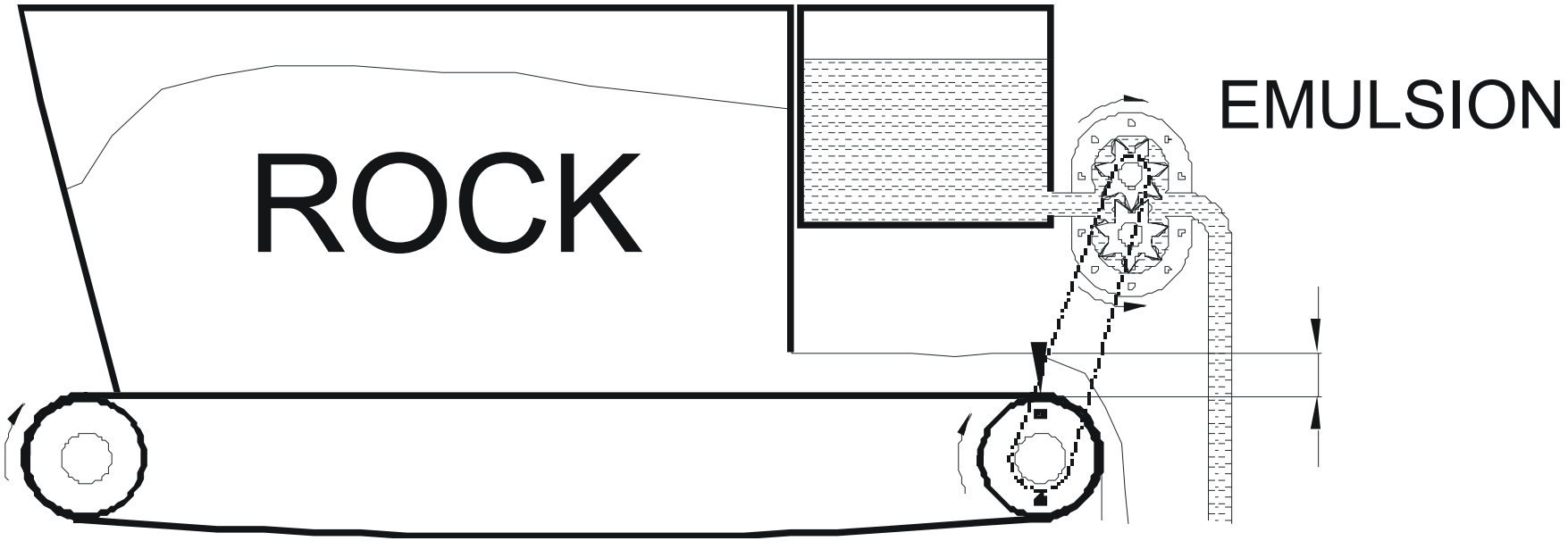
Batch Mix Design VS. Continuous Flow Mixing

What is calibration?

- **Calibration is the process of measuring by weight the:**
  - Aggregate
  - Emulsion
  - Mineral Filler

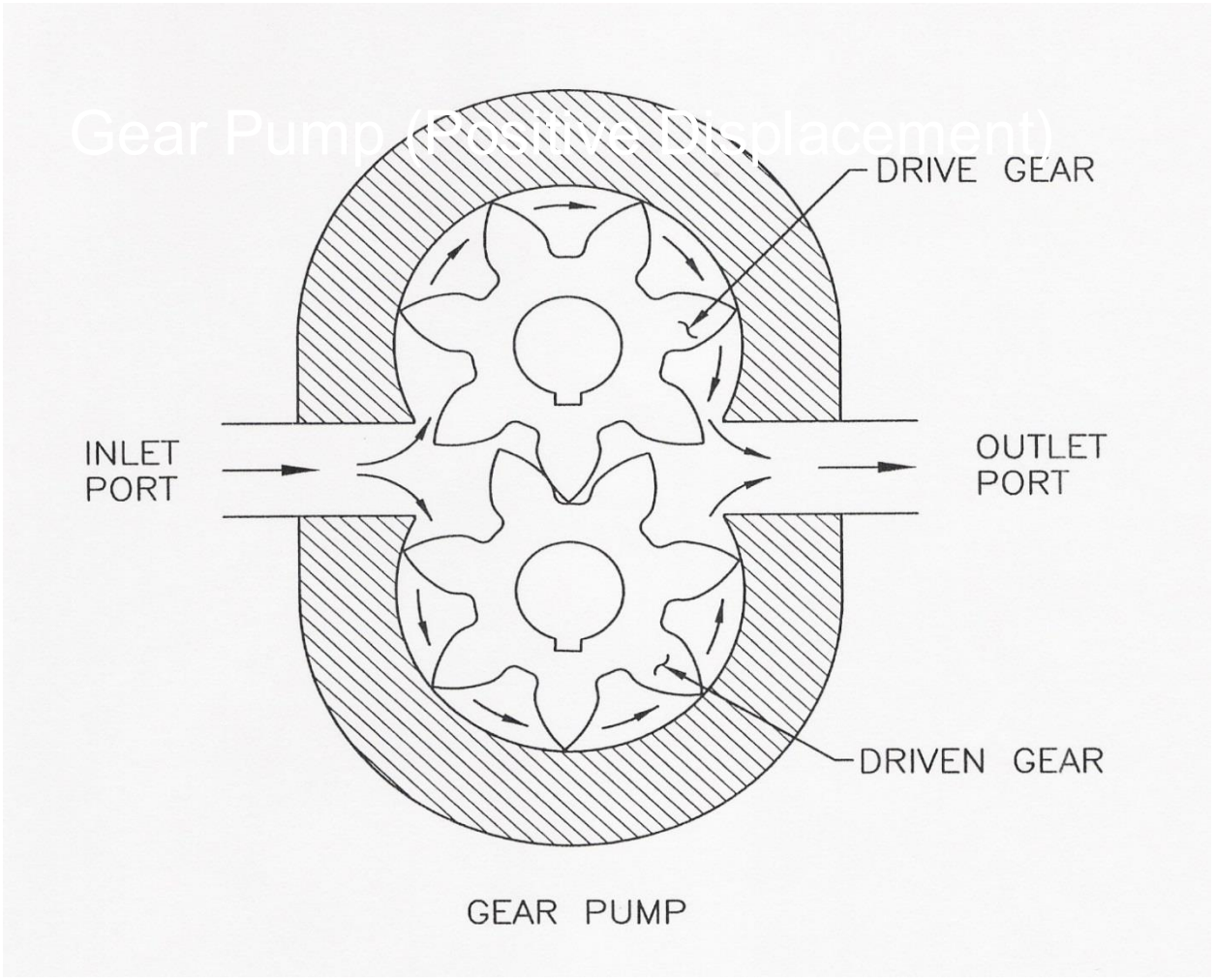
  Then correlating the weight to revolutions of the aggregate conveyor recorded by a counter. The goal is to obtain a weight per count.

Aggregate Conveyor



The aggregate is delivered by a conveyor, delivering a consistent amount of aggregate (at a given gate setting) from the hopper into the pugmill.

Emulsion Pump

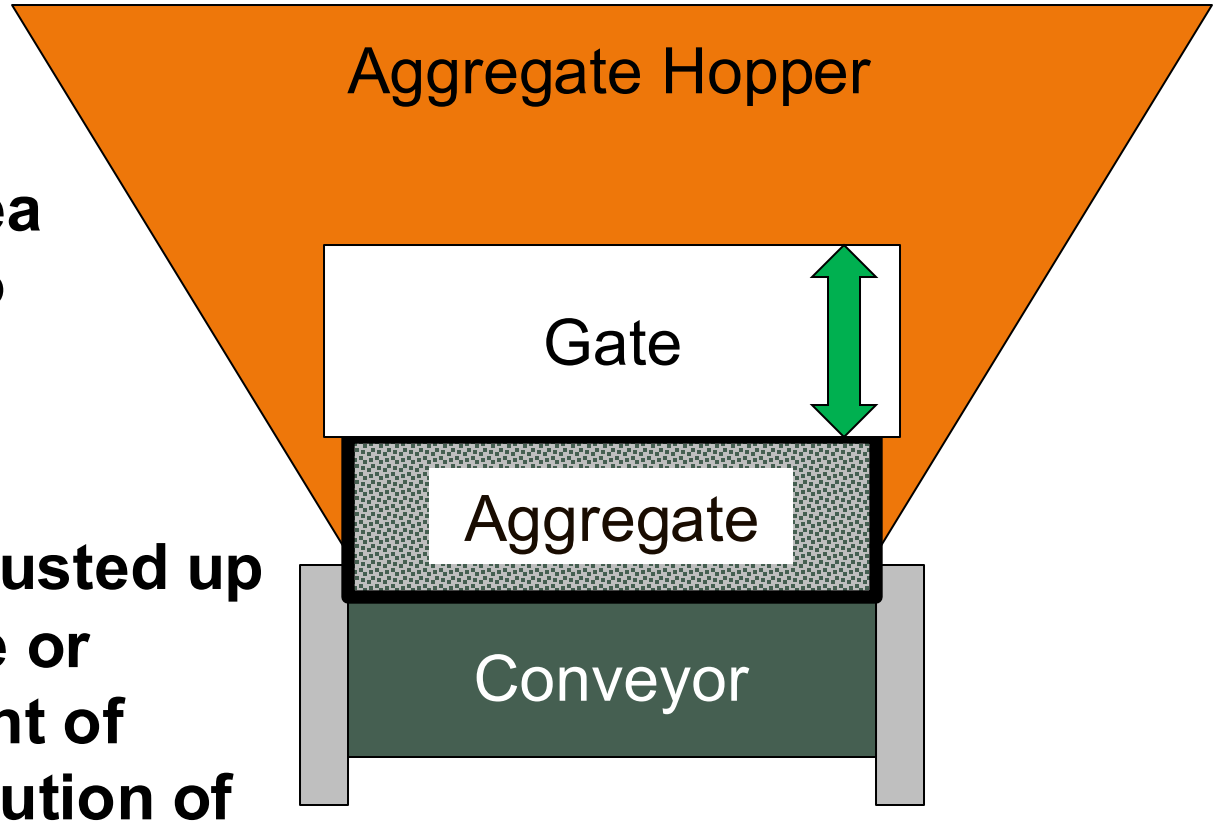


Aggregate Gate

The outlet of the aggregate hopper provides a fixed area for the aggregate to flow through

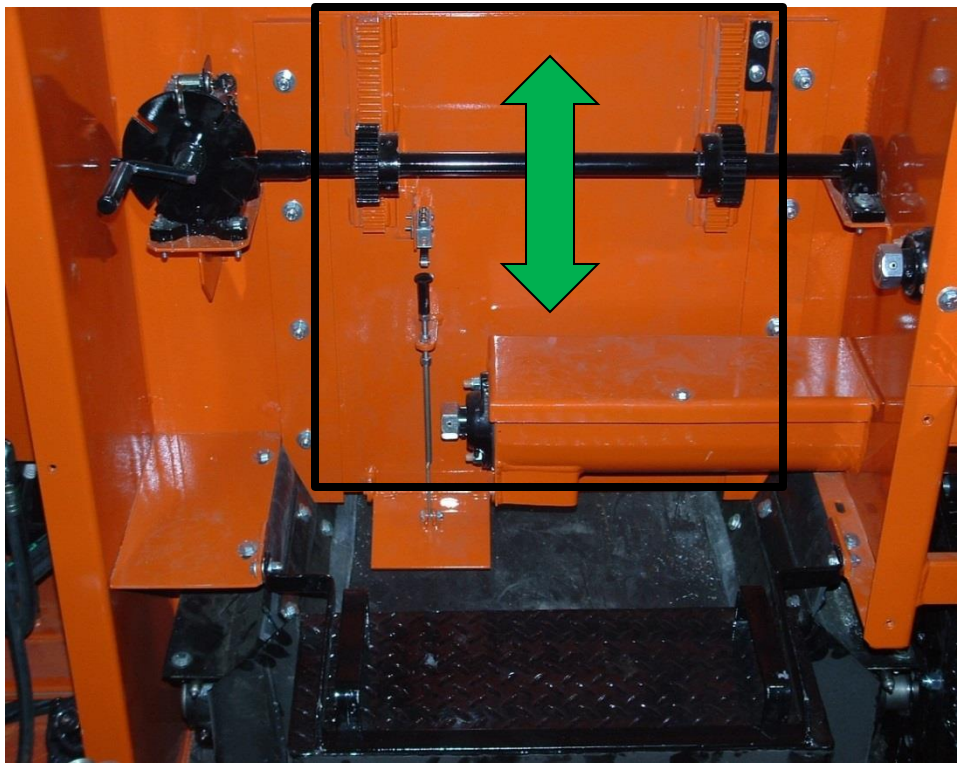
The gate can be adjusted up or down to increase or decrease the amount of aggregate per revolution of the conveyor pulley

End View of Paver



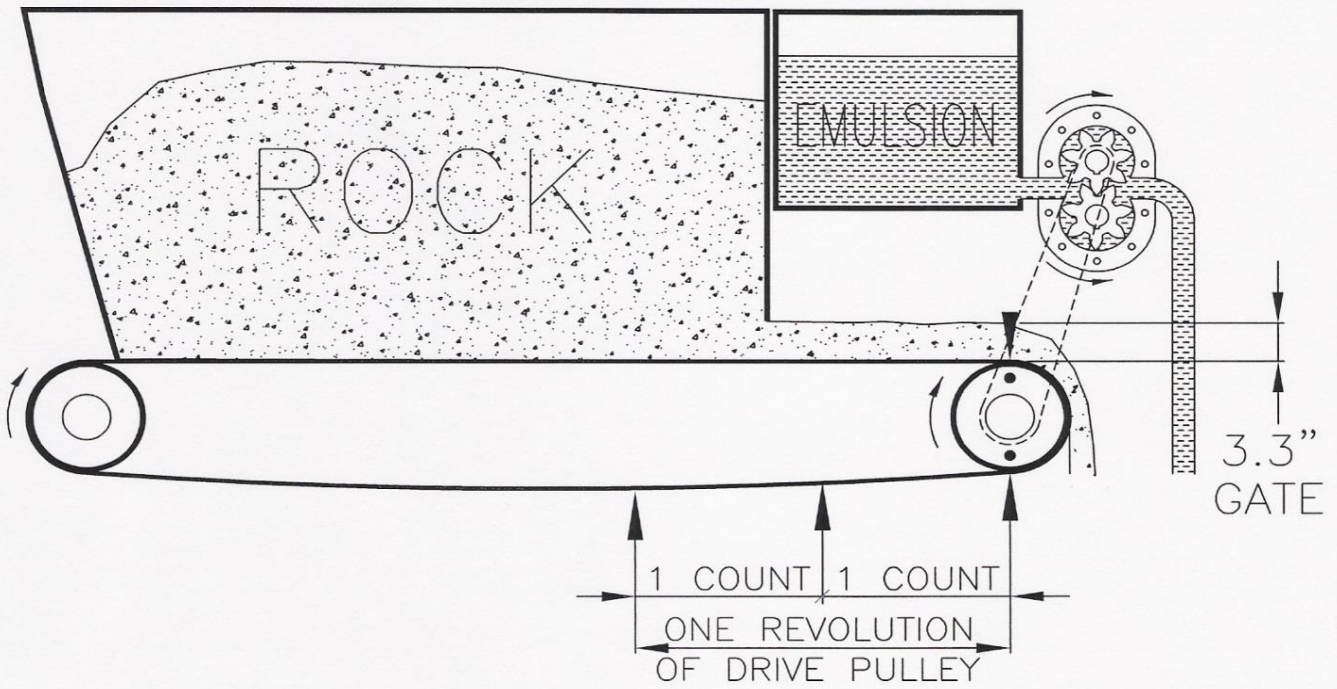
Systems with positive displacement pumps:

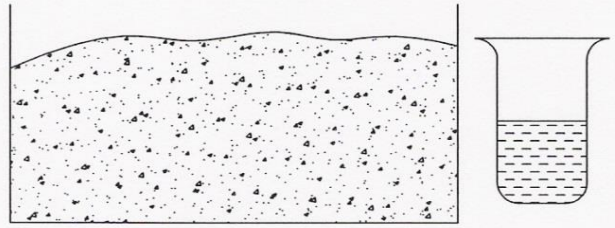
Gate setting of the hopper is varied to achieve different emulsion/aggregate ratios.



Lower gate to increase emulsion %

Raise gate to decrease emulsion %

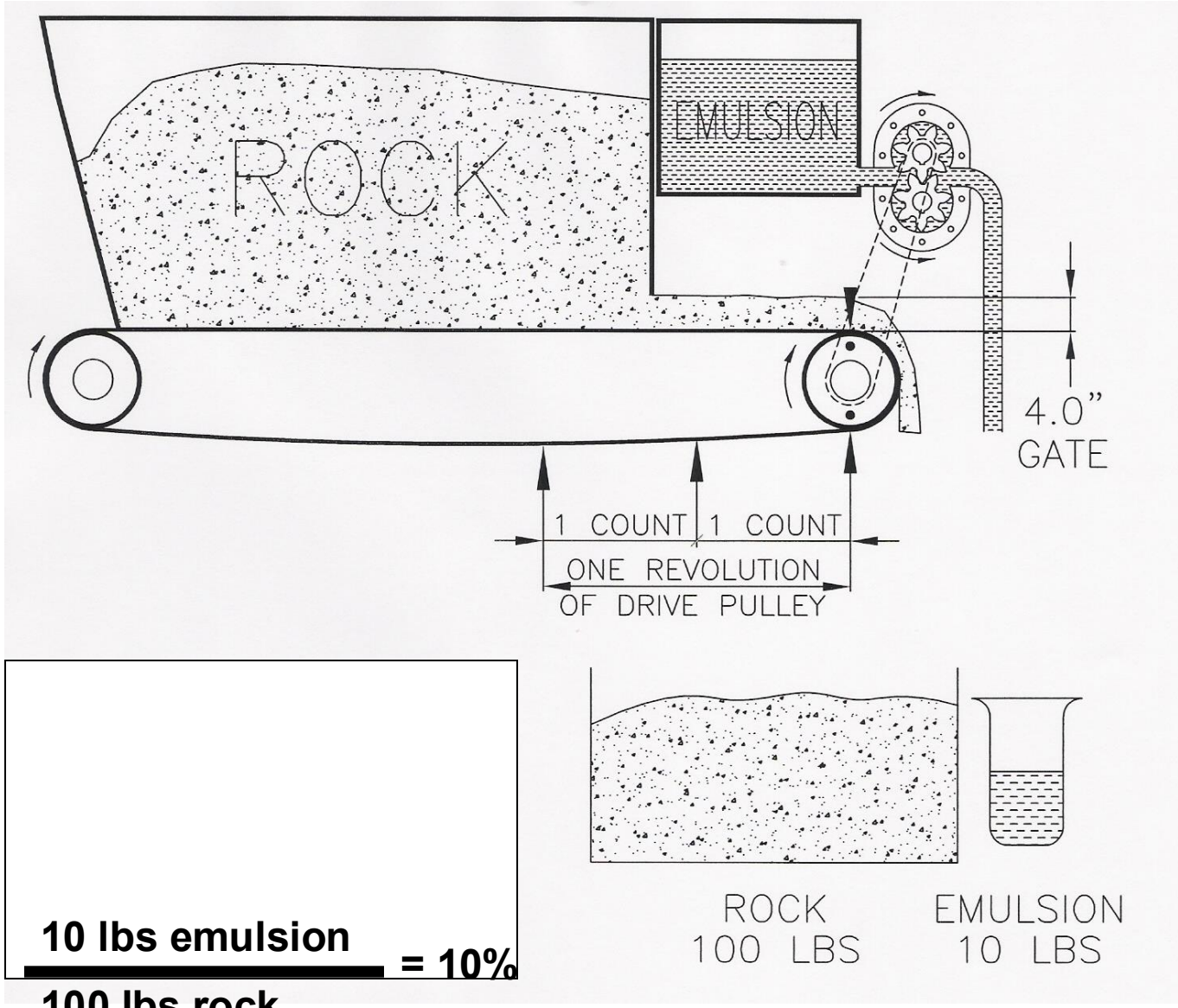




ROCK
83.3 LBS

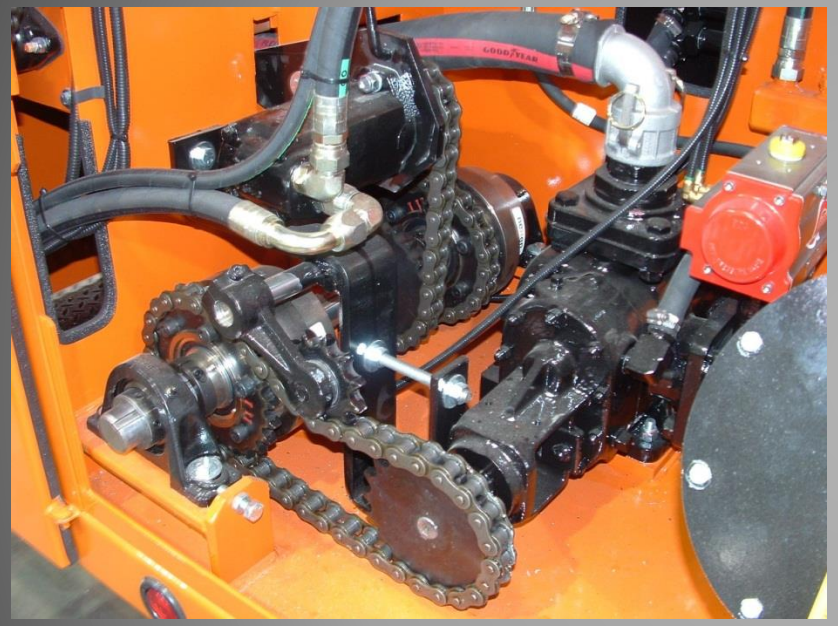
EMULSION
10 LBS

83.3 lbs rock



$$\frac{\text{10 lbs emulsion}}{\text{100 lbs rock}} = 10\%$$

of rock.



- Pavers constantly process the materials (not a batch process)
- Emulsion delivery is matched to Aggregate delivery
- Measured with counters or totalizers

What prep work is required before a slurry / micro project?

- Crack Treatments
- Structural Leveling
- Full Depth Repairs
- Tree Trimming
- Herbicide Treatment

- Surface Cleaning
- Structure and Casting Protection
- Pavement Marking Removal
  - Thermoplastic and Buttons
  - Paint is not generally removed unless it is very thick.
- Gutter Protection
- Railroad Crossing Protection

Early or Initial Stage

Final Stage

Surface Preparation
What to Watch For

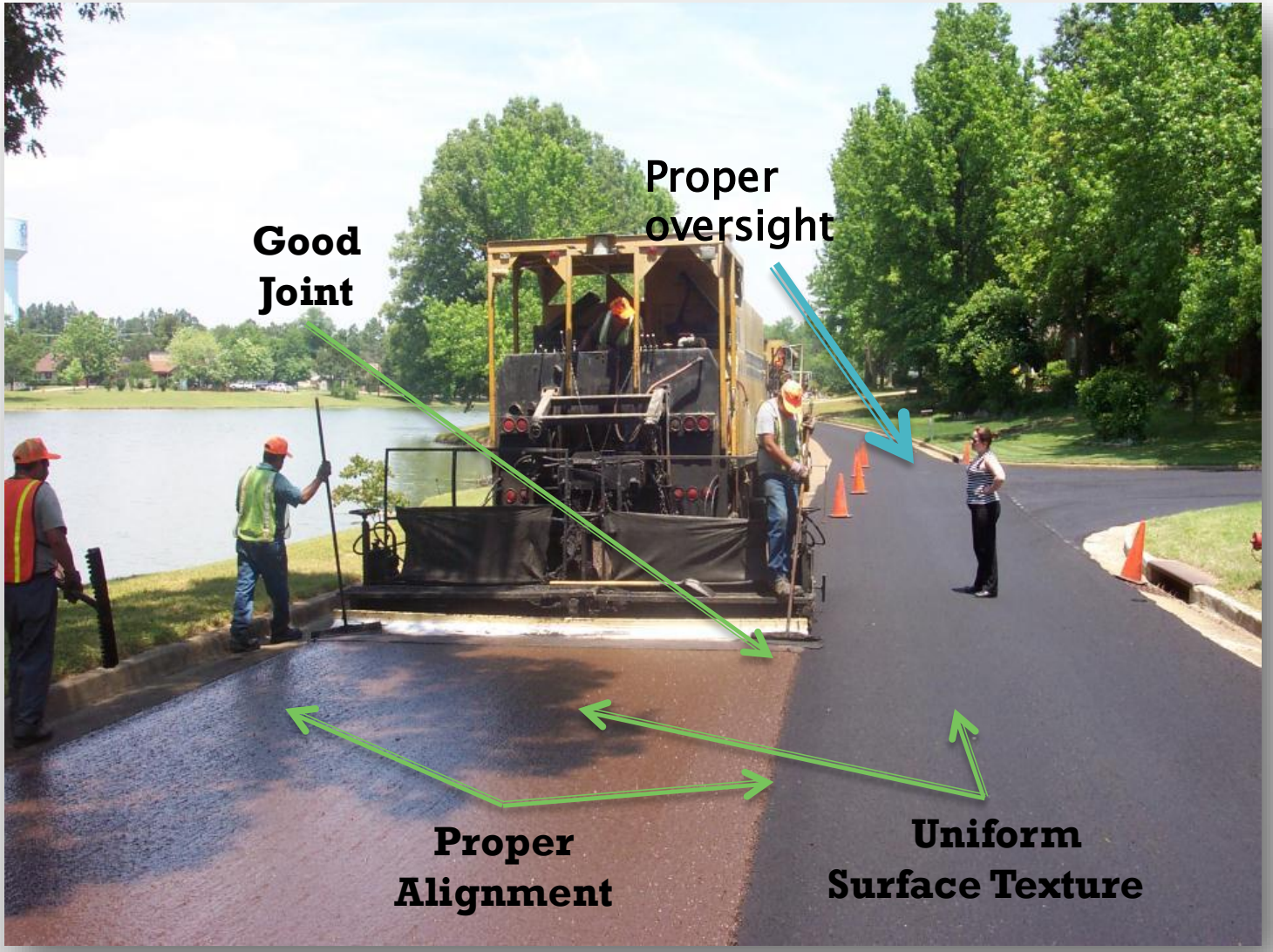
- Crack Sealing
  - Sealant should be kept flush with minimal over banding. Thick over bands will get caught by the box runners.
  - It is best to seal at least 30 days prior to surfacing.
- Patching
  - Make sure patches are kept at or below the road surface. Remember – Micro surfacing does a great job of filling low areas. Bumps will be Bumps.
  - Cold Mix patches should “cure” at least 30 days prior to Micro surfacing.
- Micro milling
  - MnDOT and other states are having good success by Micro milling ahead of Micro surfacing.
  - Smooths the road and the texture increases adhesion of the Micro surface.

Surface Preparation
What to Watch For

- Cleaning
  - On of the most important steps in the process but often the first to be overlooked.
  - Watch out for:
    - Field Entrances
    - Rock Shoulders
    - Areas around the loading site.

Paving Techniques

Performing A Great Job



Longitudinal Joints

- Should be straight on tangent lines
- Uniformly follow the traffic lane
- Should be constructed as an overlap or butt joint
- If the overlap method is used it should be kept to a minimum (3” maximum)
- Should be smooth and neat in appearance
- Excessive buildup or uncovered areas should not be permitted

Longitudinal Joints

Acceptable Joints

Unacceptable Joints

Unacceptable Joints

Transverse Joints

- Should be smooth and neat in appearance
- Hand work should be kept to a minimum
- Excessive buildup or uncovered areas should not be permitted
- Should be constructed as a butt joint
- Use of roofing felt may assist contractor in construction of acceptable transverse joints

Unacceptable transverse joint

Edge Lines

- Straight and clean
- Use string line or pilot line
- Mixture consistency

Edge Lines

Unacceptable

Acceptable

Surface Texture

- Factors that influence final surface texture are:
  - Existing pavement surface texture
  - Mix consistency (accurate calibration)
  - Adherence to JMF
  - Type of screed rubber used
  - Spreader box maintenance
  - Use of drags or secondary strike off
  - Application rate
  - Speed of application machine (too fast may cause wash boarding)
  - Opening to traffic too early
  - Rolling (if required)

Surface Texture Uniformity

Surface Texture Uniformity

- Slurry systems have an aggressive surface texture and when applied properly can maintain a high friction surface for the duration of their useful life.

Possible Quality Issues

- Bleeding Flushing
  - Excess asphalt binder that creates a shiny tacky surface.
- Surface Loss – Debonding
  - Due to traffic wear, debonding or delamination.
- Raveling
  - Loose Aggregate
- Rutting
  - ¼" Rutting

Bleeding

- Bleeding can be caused by:
  - Excess asphalt in mix
    - Check Calibration against Mix Design
    - Paver Issue
  - Lack of fines in mix
    - If aggregate is too clean their may not be enough surface area for the amount of emulsion in the mix.
  - Application rate too high for gradation
    - Aggregate can settle to bottom leaving asphalt and fines on the surface
  - Incorrect emulsion supplied to project
    - Lack of Polymer Modification

Surface Loss

- Debonding or Delamination is usually caused by:
  - Poor Surface Preparation
  - Contamination from Paving Process
  - Mixture that is Breaking and Curing too Quickly
  - Debonding or Deterioration of Original Surface

Surface Loss

- Bond with Existing Pavement

Problem:

The slurry seal debonds from the underlying pavement.

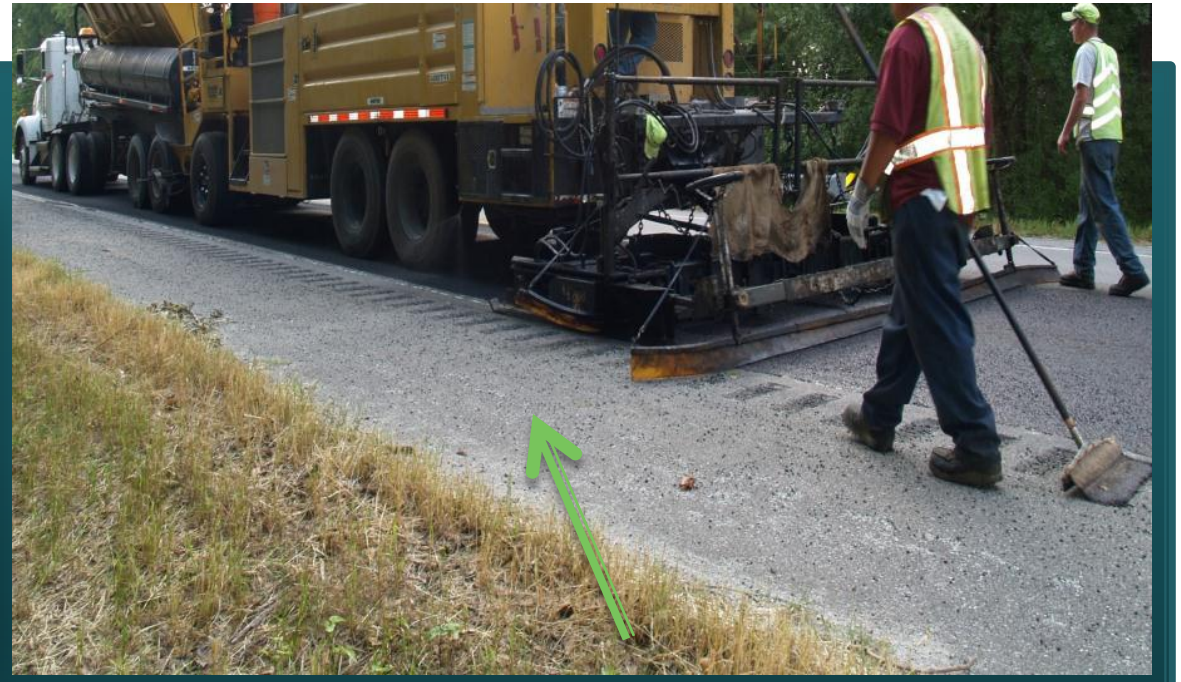
Raveling

- A slight amount of raveling is normal within the first day or two.
  - You should NOT hear loose rock when driving over the surface.
  - The shoulders should not be black
- A Level Up or Scratch Course will be ravel more than a Surface Course.
- Raveling is more common in cooler temperatures.

Raveling

Problem:

Traffic dislodges larger aggregate particles from the finished surface.



Loose Aggregate Particles

Raveling

- • The aggregate lacks sufficient embedment in the matrix caused from insufficient asphalt quantity to hold the larger aggregate;
- • Poor quality aggregates may debond from the matrix;
- • The application rate was too thin to hold larger aggregates;
- • The matrix has a lack of fines to fill voids between larger aggregates;
- • Cooler temperatures may result in slowing of the cure necessary for traffic;
- • Premature opening to traffic; and
- • Slurry system was exposed to rain before final cure was achieved.

Rutting

- True Rutting of a Micro surfacing is Rare.
  - Was the Micro surfacing level at completion?
    - Should the road have been leveled?
    - Did the contractor put the rut into the mat?
  - Is the underlying surface continuing to rut?
  - Did the Micro surfacing not meet the JMF?
  - Did the Aggregate and Emulsion Match the Mix Design.

2354 MICRO-SURFACING

2354.1 DESCRIPTION

This Work consists of constructing micro-surfacing on a prepared pavement.

Micro-surfacing is a mixture of polymer modified asphalt emulsion, well-graded crushed mineral Aggregate, mineral filler, water, and other additives.

2354.2 MATERIALS

A Bituminous Material

A.1 Micro-surfacing Emulsified Asphalt: Polymer modified CQS-1hP for rut filling or CQS-1P for non-rut filling applications 3151.2H

A.2 Bituminous Emulsion for Fog Seal 3151.2D.1.b

B Aggregate 3139.2D

If no Aggregate is specified use Class A per 3139, "Graded Aggregate for Bituminous Mixtures" and Type 2 per 3139.2D, "Micro-Surfacing."

C Mineral Filler

C.1 Portland cement, Type I 3101

C.2 Hydrated lime 3106

D Water 3906

Table 2354.2-1
Mix Design Test Requirements

Test	Description	Specification
ISSA TB-114	Wet stripping	≥ 90
ISSA TB-100	Wet track abrasion loss, 1 hour soak	≤ 1.8 ounce/square feet
ISSA TB-100	Wet track abrasion loss, 6 Calendar Day soak	≤ 2.6 ounce/square feet *
ISSA TB-144	Saturated abrasion compatibility	≤ 3 g loss
ISSA TB-113	Mix time at 77°F	Controllable to ≥120 s
ISSA TB-113	Mix time at 100°F	Controllable to ≥35 s
* The requirement is for CQS-1hP only, report only for CQS-1P and other emulsions.		

Provide a Job Mix Formula (JMF) containing from 5.5 percent to 10.5 percent of residual asphalt by dry weight of Aggregate and 0.25 percent to 3.0 percent mineral filler by dry weight of Aggregate.

Submit a new mix design to the Engineer, if Aggregate source, Aggregate blend, or asphalt emulsion sources are changed.

E.2 Mix Design Format

Submit the final mix design that includes the following information:

(1) Source of each individual Material

(2) Aggregate:

- (a) Gradation
- (b) Sand equivalent
- (c) Abrasion resistance
- (d) Soundness

(3) Field simulation tests:

- (a) Wet stripping test
- (b) Wet track abrasion loss (1 hour & 6 Calendar Days)
- (c) Saturated abrasion compatibility
- (d) Trial mix time at 77°F and 100°F

(4) Interpretation of results and the determination of a JMF:

- (a) Minimum and maximum percentage of mineral filler
- (b) Minimum and maximum percentage of water, including Aggregate moisture
- (c) Percentage of mix set additive (if necessary)
- (d) Percentage of modified emulsion
- (e) Residual asphalt content of modified emulsion
- (f) Percentage of residual asphalt

(5) Signature and date

2354.3 CONSTRUCTION REQUIREMENTS

A Equipment

A.1 Mixing Machine

Provide a continuous micro-surfacing lay down machine. Provide a positive connection conveyer belt Aggregate delivery system and an inter-connected positive displacement, water-jacketed gear pump to accurately proportion Aggregate and asphalt emulsion. Locate the mineral filler feed to ensure that the proper amount of mineral filler drops on the Aggregate before discharging into the pugmill. Provide a pugmill meeting the following characteristics:

(1) Capable of providing a continuous flow
(2) Twin shaft
(3) Multi-blade
(4) At least 4 feet long
(5) Blade size and side clearance meeting the Equipment manufacturer's recommendations

Introduce the asphalt emulsion within the first third of the mixer length to ensure proper mixing of Materials before exiting from the pugmill.

Use a self-propelled front feed and continuous loading machine with dual driving stations. Provide a remote forward speed control at the back mixing platform for the back operator to control forward speed and the level of mixture in the spreader box. Use sufficient transport units to assure a continuous operation during mix production and application.

Provide individual volume or weight controls for proportioning each Material. Position the controls for access at any time. Use the controls to calibrate the operation before production and to determine the amount of each Material used at any time.

Provide a water pressure system and nozzle type spray bar to spray water ahead of and outside the spreader box, if necessary. Dampen the surface. Do not create free flowing water ahead of the spreader box.

A.2 Spreader Box

Spread the mix uniformly, using a mechanical type spreader box, attached to the mixer and equipped with spiral augers mounted on adjustable shafts. Continually agitate and distribute the mixture to prevent stagnation, excessive Material build-up, or lumps. Equip the spreader box with front and rear flexible seals to achieve direct contact with the surface of the Road. Use a secondary strike off attached to the spreader box to provide a smooth finished surface texture. Do not use burlap drags.

A.3 Rut Filling Box

Provide a rut filling box meeting the following characteristics:

(1) Steel V-configuration screed rut box
(2) Commercially designed and manufactured to fill ruts
(3) Capable of spreading the mixture at a width from 5 feet to 6 feet
(4) Strike off to control crown

A.4 Weighing Equipment

Use portable Scales to weigh Material certified in accordance with 1901.8, "Mass," and as modified as follows:

(1) Recertify the Scale after any change in location

(3) Type of mineral filler
(4) The lay down machine

Allow traffic on the test strip within 1 hour after application; the Engineer will evaluate whether any damage occurs. The Engineer will inspect the completed test strip again after 12 hours of traffic to determine if it is acceptable. The Contractor may begin full production after the Engineer accepts a test strip.

The Engineer may waive the test strip requirement, if the Contractor submits evidence of the successful construction of a test strip on another project constructed during the same construction season, using the same mix design.

B.5 Surface Preparation

Clean the surface immediately before placing the micro-surfacing.

B.6 Fog Seal

Apply fog seal to concrete surfaces and bituminous surfaces if required by the Engineer before the first course of micro-surfacing. Provide and apply CSS-1h emulsion in accordance with 2355, "Bituminous Fog Seal," and the following:

(1) Apply the diluted emulsion at a rate of 0.05 gallons per square yard to 0.10 gallons per square yard. Limit the daily application of fog seal to the pavement area receiving micro-surfacing that day. Do not open fog sealed areas to traffic until after applying and curing the first course of micro-surfacing. Allow the fog seal to cure before applying micro-surfacing.
(2) Protect drainage Structures, monument boxes, and water shut-offs during the application of the fog seal and during micro-surfacing.

B.7 Surface Quality

Construct the surface course without excessive scratch marks, tears, rippling, and other surface irregularities. Repair tear marks wider than 1/2 inch and longer than 4 inches. Repair transverse ripples or streaks deeper than 1/4 inch if measured by a 10 foot straightedge.

Construct longitudinal joints with no greater than 1/4 inch overlap thickness if measured with a 10 foot straightedge, and less than 3 inch overlap on adjacent passes. Locate longitudinal construction joints and lane edges to coincide with the proposed painted lane lines shown on the Plans. Place overlapping passes on the uphill side to prevent water from ponding.

Construct transverse joints with no greater than 1/8 inch difference in elevation across the joint if measured with a 10 foot straightedge.

Construct edgelines along curbs and Shoulders, with no greater than 2 inches of width variance in any 100 foot length. Do not allow runoff in these areas.

Stop micro-surfacing work, if requirements of this section are not being met. Make corrections as approved by the Engineer before restarting Work.

Protect drainage Structures, monument boxes, water shut-offs, and any other utility Structures within the Project or staging areas.

Make repairs to micro-surfacing defects to the full width of paving pass with spreader box. Do not perform hand repairs after micro-surfacing mix has set.

B.8 Open to Traffic

Do not open the micro-surface to traffic until the micro-surface cures sufficiently to prevent pickup by vehicle tires. The Department considers properly constructed micro-surface as micro-surface capable of carrying normal traffic within 1-hour of application without damage. Protect the new surface from potential damage at Intersections and driveways. Repair damage to the surface caused by traffic at no additional cost to the Department.

Confirm that the micro-surface cured within 1-hour on the first day of production, after the construction of the test strip. The Engineer will conduct three 1-hour spot checks. If a spot check fails, stop Work and construct a new test strip. The Department will consider any spot check or test strip failure as unacceptable Work in accordance with 1512, "Unacceptable and Unauthorized Work."

After successful completion of three, 1-hour spot checks on the first day of production, the Engineer will perform spot checks once a day. If a 1-hour spot check fails, the Department will require the construction of a new test strip. After a test strip, the Engineer will perform the first day of production procedure.

B.9 Weather and Time Limitations

Begin construction when the air and pavement surface temperatures are at least 50°F and rising. Do not place micro-surfacing during rain, or if the forecast indicates a temperature below 32°F within 48 hours of the planned micro-surfacing. Do not start Work after September 15.

C Contractor Sampling, Testing, and Documentation

Perform Quality Control (QC) sampling and testing.

C.1 Emulsion

Provide a Material Bill of Lading (BOL) for each batch of emulsion used. Include the supplier's name, plant location, emulsion grade, residual asphalt content, volume (gross and net, gallons), and batch number.

C.2 Aggregate

Sample and test according to the *Schedule of Materials Control*. Provide daily QC test results to the Engineer and a summary upon completion of the Work.

C.2.a Gradation and JMF Tolerance

Provide companion samples to the Engineer. The QC tolerances for the JMF are listed in Table 3139.2-10. The tolerance range may not exceed the limits set per 3139.2D, "Micro-surfacing."

C.2.b Sand Equivalent Test

The sand equivalent Quality Control tolerance is ±7 percent of the value established in the mix design (60 percent minimum). Run the sand equivalent test at the stockpile site.

C.2.c Moisture Content

Determine the moisture content of the Aggregate. Perform additional testing upon a visible change in moisture. Use the average daily moisture to calculate the oven dry weight of the Aggregate.

C.3 Asphalt Binder Application Rate

Randomly calculate and record the percent asphalt content of the mixture from the Equipment counter readings. The asphalt tolerance is ±0.5 percent residual asphalt.

C.4 Design Application Rate

The design application rate shall be the total amount of micro-surfacing Material placed to meet the requirements for cross-section and surfacing. This amount will be the combination of all courses placed.

C.5 Documentation

Provide a daily report containing the following information to the Engineer within one Working Day:

(1) Date and air temperature at Work start up
(2) Beginning and ending locations for the day's Work
(3) Length, width, and total area (square yard) covered for the day
(4) Application rate (pounds per square yard) of Aggregate
(5) Daily asphalt spot check reports (gallons of emulsion)
(6) Asphalt emulsion bill of lading
(7) Beginning, ending, and total counter readings
(8) Control settings, calibration values, and percent residue in emulsion
(9) Percent of each Material, percent of asphalt cement
(10) Calibration forms
(11) Sand equivalence
(12) Aggregate certification or shipment of tested stock report
(13) Contractor's authorized signature

2354.4 METHOD OF MEASUREMENT

The Engineer will measure the Bituminous Material for Micro-Surfacing and undiluted Bituminous Material for Fog Seal by volume at 60°F.

The Engineer will measure the Micro-Surfacing Rut Fill, Micro-Surfacing Scratch Course, and Micro-Surfacing Surface Course by weight of oven dry weight of Aggregate.

2354.5 BASIS OF PAYMENT

The Contract gallon price for the accepted quantity of Bituminous Material for Micro-surfacing includes the costs of additives as indicated above, constructing the micro-surfacing as shown in the Plans, and all testing.

The Department will pay for bituminous Material for fog seal in accordance with 2355.5, "Bituminous Fog Seal, Basis of Payment."

Questions?

What Is This Study All About?

- The Transportation Pooled Funding program (TPF) was first defined in 1977, per Title 23 Code of Federal Regulations (CFR) § 560.3, as a Federal Highway Administration (FHWA) administered program in coordination with State departments of transportation (DOT).

- TPF program creates an opportunity for partners to pool their funds, subject matter expertise, and resources to conduct high-priority research. As part of the Transportation Pooled Funding (TPF) program, TPF-5(522) (commonly known as PG3) was created and awarded to a National Partnership to Improve the Quality of Pavement Preservation Treatment Construction & Data Collection Practices.
- PG1 was to construct the Lee County Road 59 and US 280 test sites near NCAT.
- PG2 was to construct the Minnesota test facility.
- National Partnership consist of MnDOT, NCPP, FP2, NCAT, and essentially each participating State.

What Is This Study All About?

- The pooled fund is focused on implementation of pavement preservation treatment implementation. There are 19 states involved. As each state selects and applies a treatment, there is preconstruction review of the State's specifications by both the NCPP and the FP2.
- This MnDOT project will be placing a Scrub Cape Seal on US 71, as part of the PG3. At time of construction, representatives from NCPP and FP2 will be on-site for additional training on equipment calibration, application rates, material testing/sampling, inspection and what to look for in good treatment construction. There will be test cells for long term monitoring of performance.

Scheduling of Test Cell Construction

- NCPP Preservation Specialists and / or industry volunteers must be on site for Test Cell construction.
- The Agency and Contractor shall provide the following notices to the NCPP Representative.
  - 14-days' notice of anticipated Test Cell construction date.
  - 5-day schedule review.

Scheduling of Test Cell Construction

- 48-hour Go / No Go
  - It is understood that this is construction and things happen. If the representative arrives on site and Test Cell construction is delayed due to weather, equipment or materials a decision will be made to hold or return at a later date

Scheduling of Test Cell Construction

- It is preferable but not required that Test Cell construction be completed during weekday day-time hours.
- Test cell details shall be approved by PG3 Data Team prior to scheduling Test Cell construction.
- Contractor shall provide unlimited access to equipment, calibration information, mix designs, supervisors and crew members for recordkeeping and training purposes.

Test Cell Construction – Responsibilities

- Agency shall designate at least one on-site individual to assist in the RECORD KEEPING process.
- Data forms will be provided by NCPP
- Meet specifications and best practices
- The Agency shall be responsible for all field data retention and storage.
- The data shall be shared with the Pool Study team (MnDOT, NCPP, NCAT) in a common protocol.

Test Cell Construction – Responsibilities

- Record keeping

- There are 2 forms that need to be completed for the Scrub Seal and Micro-Surfacing Test Section
- Preconstruction
- Construction

Test Cell Construction – Responsibilities

- NCPP
  - Equipment Review
  - Material and Stockpile Review
  - Discussion of Best Practices with crew and inspectors
  - Assist agency with completion of Data Form
  - Completion of “After Action Review” of Test Cell Construction.

Test Cell Construction – Responsibilities

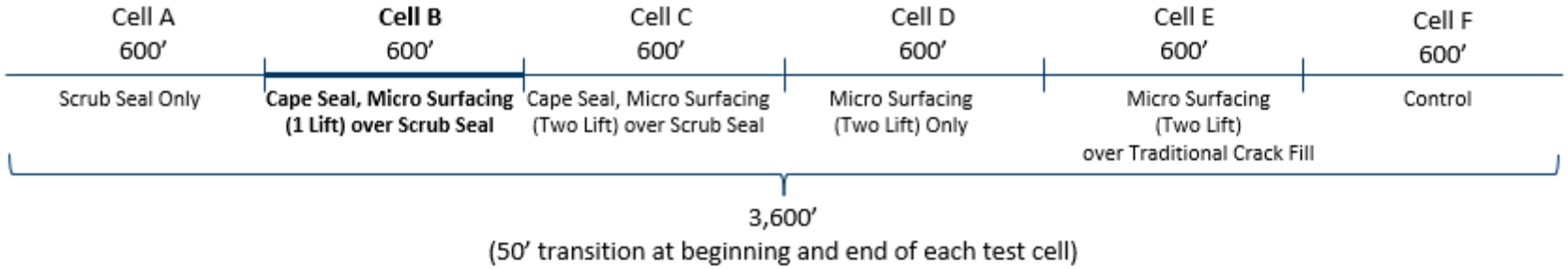
- Contractor
  - Provide access to equipment, employees and materials
  - Perform work that meets project specification and industry best practices.
  - Assist in gathering data.

Test Cell Construction – Responsibilities

- Industry Volunteers
  - Assist NCPP with gathering project data.
  - Take photos and/or videos and provide to NCPP.
  - Review project in post PG3 years

Test Cell Layout

PG3 Test Sections:	**Primary Treatment**	**Cell B - Cape Seal, Micro-Surfacing (1 lift) over Scrub Seal**
	Other Treatments	Cell A - Scrub Seal Only
		Cell C - Cape Seal, Micro Surfacing (2 lift) over Scrub Seal
		Cell D - Micro Surfacing only (2 lift)
		Cell E - Micro Surfacing over traditional crack fill
		Cell F - Control



(50' transition at beginning and end of each test cell)

Preconstruction and Construction Forms

MAU-PG3 – Project Forms – All Documents

LTPP Form

LTPP SPS-11 DATA SHEET 34 MICRO-SURFACING APPLICATION DATA	STATE CODE [_____] SHRP ID [_____]

1. LAYER NUMBER (From LTPP Data Sheet 4) [___]
2. DATE SEALING BEGAN (dd/mmm/yyyy) [_____/_____/_____]
3. DATE SEALING COMPLETE (dd/mmm/yyyy) [_____/_____/_____]

DESIGN INFORMATION

4. APPLICATION RATE FOR BITUMINOUS MATERIAL (gallons/sq. yard) [__._____]
5. APPLICATION RATE FOR AGGREGATE (pounds/sq. yard) [_____.___]
6. APPLICATION RATE FOR MINERAL FILLER (pounds/sq. yard) [_____.___]
7. APPLICATION RATE FOR MIXTURE (pounds/sq. yard) [_____.___]
8. RESIDUAL ASPHALT CONTENT (pounds /sq. yard) [__._____]
9. WEAR VALUE (WTAT loss) (g/sq. ft) (ASTM D3910) [_____]

GENERAL CONDITION INFORMATION

10. CONDITION OF EXISTING PAVEMENT SURFACE [___]

Flushed-bleeding 1
Smooth, non-porous 2
Slightly porous, slightly oxidized 3
Slightly pocked, porous, oxidized 4
Badly pocked, porous, oxidized 5

11. INITIAL PREPERATION OF EXISTING PAVEMENT SURFACE [___] None
.....1
Cold Mill 3
Sweep Clean Only 2
Shot Blast 4
Other (Specify) [_____] 5

LTPP Form

12. FINAL PREPARATION OF EXISTING PAVEMENT SURFACE [___] None
(Other Than Identified Above) 1
Primarily Air Blast 2
Primarily Water Blast 3
Primarily Sand Blast 4
Sand Blast and Air Blast 5
Other (Specify)[_____] 6

13. SURFACE CLEANLINESS PRIOR TO PLACEMENT
Clean....1 Moderately Clean....2 Dirty....3 [___]

14. SURFACE MOISTURE AT PLACEMENT—Dry.....1 Wet.....2 [___]

AMBIENT CONDITIONS AT TIME OF APPLICATION

15. AIR TEMPERATURE (F) [_____]
16. SURFACE TEMPERATURE (F) [_____]
17. RELATIVE HUMIDITY (percent) [_____]
18. CLOUD COVER (percent) [_____]
19. WIND SPEED (mph) [_____]

PREPARER EMPLOYER DATE

LTPP Form

LTPP SPS-11 DATA SHEET 35 MICRO-SURFACING APPLICATION DATA (CONTINUED)	STATE CODE [_____] SHRP ID [_____]

1. LAYER NUMBER (From LTPP Data Sheet 4) [___]

EQUIPMENT INFORMATION

MIXING MACHINE

2. MANUFACTURER/MODEL [_____]
3. SPREADER BOX WIDTH (inches) [_____]
4. TYPE OF DRAG USED [___]

None..... 1 Burlap 2

Other (Specify)[_____] 3

ROLLERS

	ROLLER CODE	ROLLER DESCRIPTION	GROSS WGT (tons)	TIRE PRES. (psi)	SPEED (mph)	COVERAGES (number of passes)
5.	E	PNEUMATIC-TIRED	_____.	_____.		_____
6.	F	PNEUMATIC-TIRED	_____.	_____.		_____
7.	G	PNEUMATIC-TIRED	_____.	_____.		_____
8.	H	PNEUMATIC-TIRED	_____.	_____.		_____
9.	Q	OTHER	_____.			_____

CONSTRUCTION INFORMATION

LTPP Form

CONSTRUCTION INFORMATION

10. TACK COAT MATERIAL (See Table 54) [_____] Other (Specify)[_____]
11. TACK COAT APPLICATION RATE (gallons/sq. yard) [__._____]
12. BITUMINOUS MATERIAL APPLICATION RATE (gallons/sq. yard) [__._____]
13. AGGREGATE APPLICATION RATE (pounds/sq. yard) [_____.___]
14. MINERAL FILLER APPLICATION RATE (pounds/sq. yard) [_____.___]
15. WATER ADDED TO MIX (gallons/sq. yard) [__._____]
16. MICRO-SURFACING APPLICATION RATE (pounds/sq. yard) [_____.___]
17. BITUMINOUS MATERIAL TEMPERATURE (ºF) [_____]
18. APPEARANCE OF NON-UNIFORM APPLICATION (ft) [_____]
19. WEAR VALUE (WTAT loss)—AS PLACED (g/sq. ft) (ASTM D3910) [_____]

AGGREGATE CONDITION PRIOR TO USE

20. CLEANLINESS - Clean...1 Moderately Clean...2 Dirty...3 [___]
21. WETNESS—Very Dry..1 Only Slightly Damp..3 Slightly Wet..5 [___]
Dry.....2 Somewhat Damp.....4 Wet.....6
22. MOISTURE CONTENT (percent by weight) [_____.___]

23. ESTIMATED TIME BETWEEN SPREADING AND FOOT TRAFFIC (hours) [__.___]
24. ESTIMATED TIME BETWEEN SPREADING AND VEHICLE TRAFFIC (hours) [_____.___]

FINISHED SURFACE INFORMATION

25. APPROXIMATE FINISHED SURFACE TREATMENT THICKNESS (inches) [__.___]
26. SURFACE TEXTURE PROVIDED [___]
Rough and Open .....1 Somewhat Smooth and Tight.3 Somewhat Rough and Open .2
Smooth and Tight.....4
27. DOES BROOMING DISLODGE SURFACE (Y/N) [___]

PREPARER_____EMPLOYER_____DATE_____

Pre-Construction Micro

Form	Slurry/Micro Surfacing Construction Data Sheet	
Project	Location Description	
Owner	Agency	
Design Information		
1	TYPE OF SURFACE	Dropdown (Micro/Slurry/Polymer Modified Slurry)
2	DESIGN COMMENTS	Text
3	% ASPHALT EMULSION	%
4	% MIX RESIDUE	%
5	% MINERAL FILLER	%
6	APPLICATION RATE FOR AGGREGATE	Pounds/SYD
7	APPLICATION RATE FOR PLACED MIXTURE	Pounds/SYD
8	MATERIAL TEST RESULTS	Attached Sheet
General Condition Information		
9	PRIMARY DISTRESS	Dropdown?
10	PRIMARY DISTRESS SEVERITY	LTPP Severity
11	PRIMARY DISTRESS EXTENT	LTPP Extent
12	SECONDARY DISTRESS	Dropdown?
13	SECONDARY DISTRESS SEVERITY	LTPP Severity
14	SECONDARY DISTRESS EXTENT	LTPP Extent
15	DISTRESS COMMENTS	Text
16	CRACK SEALED?	Dropdown (Yes/No)
17	CRACK SEAL MATERIAL	Text
18	CRACK SEAL DATE	dd/mm/yy

Construction Micro

Form	Slurry/Micro Surfacing Construction Data Sheet	
Project	Location Description	
Owner	Agency	
Item	**Description**	**Data**
1	LAYER NUMBER (From Data Sheet XX)	Numeric
2	DATE SEALING BEGAN	dd/mm/yy
3	DATE SEALING COMPLETE	dd/mm/yy
Surface Preparation		
4	PAVEMENT SURFACE PREPARATION	Dropdown (Sweep/Micro Mill/None/Other Describe in Comment)
5	PAVEMENT SURFACE PREPARATION COMMENT	Text
6	EXISTING PAVEMENT MARKING TREATMENT	Dropdown (Total Removal/Fog/None/Other Describe in Comment)
7	EXISTING PAVEMENT MARKING TREATMENT COMMENT	Text
8	TACK APPLIED	Dropdown (Yes/No)
9	TACK MATERIAL	Text
10	TACK APPLICATION RATE	Gallons/SYD
11	TACK COMMENTS	Text
Ambient Conditions at Time of Placement		
12	SURFACE MOISTURE AT PLACEMENT	Dropdown (Dry/Damp)
13	AIR TEMPERATURE (°F)	Numeric
14	SURFACE TEMPERATURE (°F)	Numeric
15	RELATIVE HUMIDITY (%)	Numeric
16	CLOUD COVER (%)	Numeric
17	WIND SPEED (MPH)	Numeric

Construction Micro

Equipment Information		
18	TYPE OF PAVER	Dropdown (Continuous/Truck Mount)
19	PAVER CONTROL	Dropdown (Electronic/Mechanical)
20	PAVER CALIBRATED?	Dropdown (Yes/No)
21	PAVER CALIBRATION DATE	dd/mm/yy
22	PAVER CALIBRATION COMMENTS/DOCUMENTATION	Text
23	PAVER MANUFACTURER/MODEL	Text
24	SURFACE ROLLED?	Dropdown (Yes/No)
25	NUMBER OF PNEUMATIC TIRE ROLLERS ON PROJECT	Numeric
26	PNEUMATIC ROLLER COMMENTS	Text
27	NUMBER OF POWER BROOMS ON PROJECT	Numeric
28	BROOM #1 MANUFACTURER/MODEL	Text
29	BROOM #2 MANUFACTURER/MODEL	Text
30	BROOM COMMENTS	Text
31	SCREENING PLANT USED	Dropdown (Yes/No)

Construction Micro

Material Information		
32	AGGREGATE SOURCE	Text
33	AGGREGATE TYPE	Text (geology)
34	GRADATION TYPE	Dropdown (Type 1, Type 2, Type 3)
35	AGGREGATE MOISTURE	%
36	AGGREGATE APPLICATION RATE (LB/SYD)	Numeric
37	MINERAL FILLER SOURCE	Text
38	MINERAL FILLER TYPE	Text
39	BREAK ADDITIVE SOURCE	Text
40	BREAK ADDITIVE TYPE	Text
41	EMULSION SOURCE	Text
42	EMULSION TYPE	Text

Micro Materials Test Results

Form	Slurry/Micro Material Test Results	
Aggregate Tests		
Gradation		
	Sieve	**% Passing**
	3/8"	
	#4	
	#8	
	#16	
	#30	
	#50	
	#100	
	#200	
	Decant	
Wet Cohesion		kg-cm
Wet Stripping		%
Compatibility Classification		pts
Wet Track Abrasion Loss		g/sq m
Mix Time@77° F		sec
Mix Time@104° F		sec
Excess Binder		g/sq m
Deformation		%

Questions?

Thank You!

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National Center for Pavement Preservation
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785-819-1403