# Roadway Inspection Recertification

Quality Control / Quality Assurance

SD DEPARTMENT OF TRANSPORTATION

****IMPORTANT****

**Recertification is only for individuals currently certified and actively participating on Asphalt Concrete Projects (must attend certification class every 8 years)**

# DOT Employee Timesheet Information

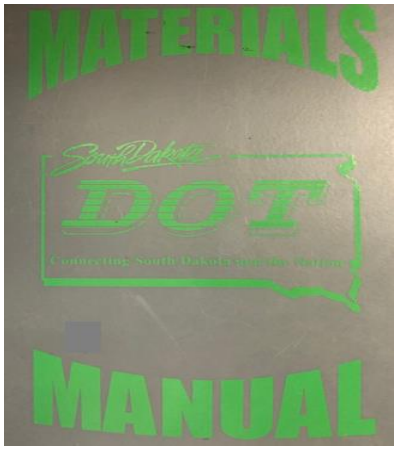
Charge to Office Overhead

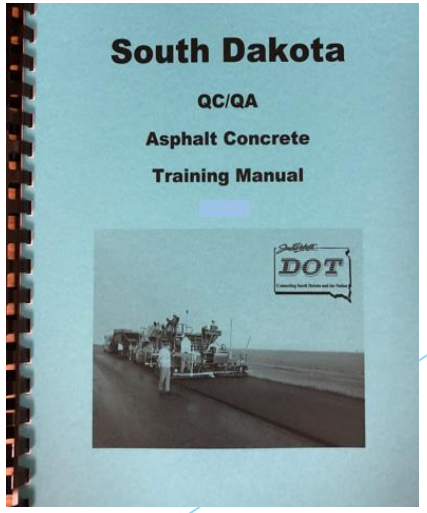
AFE – 71B6

Function - 1174

# Course Materials

- QC/QA Asphalt Concrete Training Manual
- Standard Specifications for Roads and Bridges
  - Supplemental Specifications
- South Dakota DOT Materials Manual
  - Minimum Sample & Test Requirements



# Course Agenda

- Hot Mix Laydown/Construction
- Consistent Paving Operation
- Compaction/Density, Rollers
- Emulsion Shot Rates, Tack Rates & Flush Seal Rates
- In-place Density Cores
- Pay Factor Attributes & Spreadsheet
- Construction Issues
- Recertification Exam

# Preconstruction Meeting

- List of Certified technicians to be on Project
- Organizational chart (line of authority)
- If test strip will be used
  - Approximately 500 tons
  - All tests completed
  - Roller pattern established
- If no test strip, specify how roller pattern will be established

# Inspection Requirements

- Certified technicians must be present at the plant and roadway whenever the plant is supplying asphalt concrete to the roadway.

# Diary Requirements

- The Contractor is responsible for documenting all observations, inspection records, mixture adjustments, and test results on a daily basis.

- The roadway diaries shall include:
  - Hours paved
  - Equipment in use
  - Stations paved
  - Course depth, width, crown
  - Spread checks and tonnage
  - Weather
  - Temp. of mixture delivered to the road.

# Sampling Asphalt Concrete from Roadway

- Discussed in SD 312 and 313
- Stratified random number to get sampling location
- QC/QA sampling is from the windrow in front of the paver
- Use a square bottom shovel
  - Remove and discard approximately top 1 foot of windrow
  - Remove and discard outside edge to create a vertical face
  - Sample from vertical face into alternating buckets

# Consistent Paving Operation

- Balance plant, trucks, & paver
- Unnecessary starting & stopping is not allowed
- **EXAMPLE PROBLEMS #1 and #2**

# Problem #1

## Balance Plant, Truck and Paver

1. The spread rate for hot mix calls for 1634 tons per mile, full width and the total pavement width is 24 feet with a two foot bevel on each side. How far should a 25 ton load go on one side?

# Problem #1 - Answer

- 1634 tons per mile divided by 2 = 817 tons per side
- (5280 feet in a mile) divided by 817 tons = 6.463 feet per ton
- 6.463 ft per ton x 25 tons = 161.6 feet

**<u>Answer:</u> a 25 ton load should go 161.6 feet on one side.**

# Problem #2

## Paver Speed

2. Scheduled plant production is 450 tons per hour. Spread rate is 6.463 feet per ton on one side. How fast should the pave speed be (in ft/min or mi/hr) to keep the paver moving full time and eliminate starts and stops?

# Problem #2 - Answer

- (450 ton per hour) x (6.463 ft per ton) = 2908 ft per hour
- (2908 ft per hour) divided by (60 min. in an hour) = **48.5 feet per minute**

**- OR -**

- (2908 ft per hour) divided by (5280 ft in a mile) = **0.55 miles per hour**

# Specified Density

- Number and types of rollers (establish a roller pattern using nuclear or non-nuclear density device)
- Compaction rolling will be completed before the mix temp. drops below 175°F.
- Smooth surface - free from irregularities, heat checking, damage to mat
- Polymer-modified binder: steel/pneumatic rollers

# Vibratory Rollers

- Density Factors
  - Frequency and Amplitude
  - Speed
  - Number of Passes
- Ride Quality
  - Impacts per foot (Roller speed & vibrations per minute)
  - Limit starts and stops
- EXAMPLE PROBLEM #3

# Problem #3

## Roller Speed

3. At least 10 impacts per foot are needed to keep the pavement smooth. A roller operates at 2520 vibrations per minute. How fast should the roller go in vibratory mode? In mph, what is the top speed the roller should travel?

# Problem #3 - Answer

- (2520 vibrations per minute) divided by (10 impacts per ft) = speed (252 feet per minute)
- (252 feet per minute) x (60 minutes in an hour) = (15,120 feet per hour)
- (15120 feet per hour) divided by (5280 ft in a mile) =

**Answer = 2.86 miles per hour**

# Segregation

Stop production and correct the problem. Segregation or excessive pulling of the mix shall warrant suspension of operations.

# Visual Inspection

- The Engineer may reject any quantity of material that appears to be defective based on visual inspection or test results.
- Causes for rejection may include, but are not limited to:
  - Segregation
  - Low temp. material
  - Very high or low asphalt binder content
- Sample and test to verify defective material

# Weather & Seasonal Limitations

**320.3 CONSTRUCTION REQUIREMENTS**

**A. Weather and Seasonal Limitations:** Asphalt concrete shall not be placed when the underlying surface is wet or frozen. Asphalt concrete shall not be placed when weather conditions prevent proper handling, compaction, or finishing. The temperature and seasonal limitations are as follows:

**MINIMUM AIR TEMPERATURES & SEASONAL LIMITATIONS**

| Compacted Thickness | Surface Course | | Subsurface Course & Shoulder Course | |
|---|---|---|---|---|
| | Minimum Temperature*[1] | Seasonal Limits | Minimum Temperature*[1] | Seasonal Limits |
| 1 inch or less | 45°F | May 1 to Oct. 15 (inclusive) | 45°F | none |
| over 1 inch | 40°F | May 1 to Oct. 15 (inclusive) | 40°F | none |

*[1] Minimum air and surface temperature in the shade.

# Compaction Equipment


- Rollers, self-propelled
- Smooth surface
- Fuel oil not allowed as release agent
- Contractor needs to monitor density
- Establish roller pattern
- Change as conditions warrant

# Rubber tire roller in PG 64-28

# Trucks

- No fuel oil
- Clean
- Smooth
- Release agent
- Loads shall be tarped in inclement weather conditions and when directed by the Engineer

# Longitudinal joints

- On lane lines
- Lifts offset by 6 inches
- Rolled from hot side
- Compaction:
  - For confined edges, on the first pass adjacent to the confined edge, the compaction equipment shall be entirely on the hot mat 6 inches from the longitudinal joint.
  - For unconfined edges, on the first pass adjacent to the unconfined edge, the compaction equipment shall extend 6 inches beyond the edge of the mat.


Unacceptable
Longitudinal
Joint

# Tacking

- Surface shall be tacked according to Section 330.
- The tack coat shall be allowed a cure period, as determined by the Engineer, prior to asphalt concrete placement.
- Clean surface
- One day of paving
- EXAMPLE PROBLEMS #4 and #5

# Problem #4

## Tack Rate

- Emulsion rate for tack is 0.06 to 0.09 gallons per square yard at 60° F.

$$\frac{(length \ \times \ width)}{9} = square\ yards$$

4. There are 392 gallons of emulsion (undiluted) used on a shot of 3298 feet by 12 feet. The emulsion temperature is 150°F. The temperature conversion is 0.97750 for 150°F to 60°F. What is the shot rate?

# Problem #4 - Answer

- (392 gallons at 150$^{o}$ F) x 0.97750 =
  383.2 gallons at 60$^{o}$ F
- (3298 ft) x (12 ft) divided by 9 =
  4397 sq. yd.
- (383.2 gallons) divided by (4397 sq.yd.) =

  **0.09 gallons per sq. yd.**

# Problem #5

## Flush Seal Rate

5. If 12,256 lbs. of emulsion in a distributor has 14,456 lbs. of water added to it, what shot rate should be used to give an undiluted shot rate of 0.05 gallons per sq. yd. for a flush seal? The weight per gallon of emulsion at 60°F is 8.328.

# Problem #5 - Answer

- Weight per gallon of emulsion at 60°F = 8.328 pounds for this emulsion
- $\frac{12{,}256\ lbs}{8.328} = 1471.7\ gal\ @\ 60°\text{F}$
- $\frac{14{,}456\ lbs}{8.328} = 1735.8\ gal\ of\ water$
- $(1471.7\ gal) + (1735.8\ gal) = 3207.5\ total\ gallons$
- $\left(\frac{3207.5\ gal}{1471.7\ gal}\right) \times \left(0.05\ \frac{gal}{yd^2}\right) = \mathbf{0.109\ gal/yd^2}$

# Spot Leveling

- 3 inch max lift
- Blade laid or paver laid
- Specified roller coverage

# Paving Sequence

- On the final surfacing lift, laydown operations may progress continuously toward or away from the plant.
  - *If damage to the top mat is occurring, the Engineer may require laydown operations to commence from the farthest point and progress continuously toward the plant.
- Rural 2-lane projects - one day's run past
- When turning lanes are present, the Contractor may alter the laydown operation.
  - *Must get prior approval from the Engineer.

# Paver Feeder

- Consistent paving
- Segregation; helps control, does not correct
- Pick up substantially all of the mix and feed it into the paver without segregation
- Material transfer device (MTD) can be used
- Exceptions:
  - shoulders
  - turning lanes < 500 ft.
  - roadway paving < 500 ft.
  - transitions into bridge decks < 500 ft.

# Self-Propelled Paver

- Paver extensions (used as recommended by manufacturer)
- Device to make outside bevel
- Equipped with:
  - a hopper having a bottom conveyor
  - a full-width vibrating screed with heaters
  - capable of spreading and finishing the mix to the specified widths, typical sections and thickness.

# In-Place Density Cores

- Taken next working day
- Stratified random sampling – State determines
- Cored by Contractor – witnessed by State
- Sawed by Contractor and measured by State
- Checked by Contractor and State for damage
- Tested by State - core dry-back procedure (SD 315)
- The Contractor will fill all core holes before the end of the next working day
- Pay Factor Attribute

# Core Sampling (SD 315)

- Determined by tons and offset
- 2 cores per 1000 ton
- No “buffers”
- Incomplete sublots/lots added to previous lot
- DOT-42Q Density for Bituminous Surfacing form
- EXAMPLE PROBLEM #6

# Example (SD 315)

Core Location (1 core per 500 ton) 2 cores per lot

1A $0 + (500 \times Random\ \#) = Core\ Location$

1B $500 + (500 \times Random\ \#) = Core\ Location$

2A $1000 + (500 \times Random\ \#) = Core\ Location$

2B $1500 + (500 \times Random\ \#) = Core\ Location$

**etc. for rest of lot; *round to the nearest 0.5 foot**

$$\boldsymbol{Offset\ from\ Centerline} = (\boldsymbol{Top\ Driving\ Width}) \times (\boldsymbol{Random}\ \#)$$

1A $\mathbf{12} \times (\boldsymbol{Random}\ \#) = \boldsymbol{Offset}$

**etc. for rest of lot**

*** Adjust core locations falling within one foot of the pavement edge to one foot from the pavement edge**

# Problem #6

## Core Locations

6. Given the following information for a 12 ft. wide pavement, determine the coring tonnage and the centerline offset for the following cores.

| Core # | Ton Random # | Offset Random # |
|---|---|---|
| 1A | 0.53 | 0.74 |
| 1B | 0.63 | 0.98 |
| 2A | 0.35 | 0.30 |
| 2B | 0.63 | 0.43 |

| | | | |
|---|---|---|---|
| Core 1A tonnage = | | Core 1A offset = | |
| Core 1B tonnage = | | Core 1B offset = | |
| Core 2A tonnage = | | Core 2A offset = | |
| Core 2B tonnage = | | Core 2B offset = | |

# Problem #6 - Answer

$$1A \quad 0\ ton + (500\ ton \times 0.53) = 265\ ton$$
$$1B \quad 500\ ton + (500\ ton \times 0.63) = 815\ ton$$
$$2A \quad 1000\ ton + (500\ ton \times 0.35) = 1175\ ton$$
$$2B \quad 1500\ ton + (500\ ton \times 0.63) = 1815\ ton$$

$$1A\ \text{Offset} \quad 12\ ft. \times 0.74 = 8.9 \rightarrow 9.0$$
$$1B\ \text{Offset} \quad 12\ ft. \times 0.98 = 11.8 \rightarrow 11.0^{*}$$
$$2A\ \text{Offset} \quad 12\ ft. \times 0.30 = 3.6 \rightarrow 3.5$$
$$2B\ \text{Offset} \quad 12\ ft. \times 0.43 = 5.2 \rightarrow 5.0$$

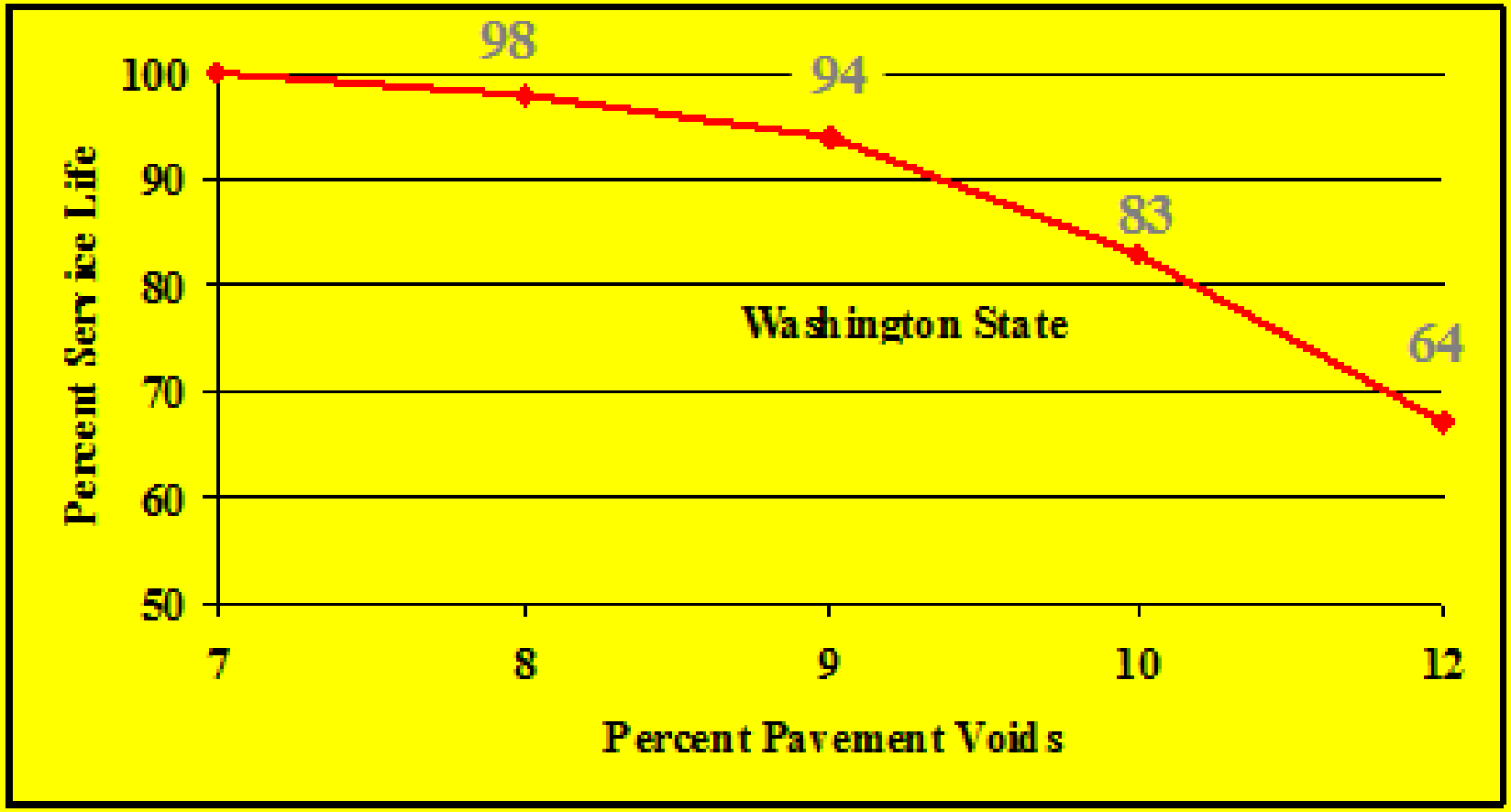
| | | | |
|---|---|---|---|
| Core 1A tonnage = | **265** | Core 1A offset = | **9.0** |
| Core 1B tonnage = | **815** | Core 1B offset = | ***11.0** |
| Core 2A tonnage = | **1175** | Core 2A offset = | **3.5** |
| Core 2B tonnage = | **1815** | Core 2B offset = | **5.0** |

# In-Place Density - Specified

- Specification (Upper & Lower Spec Limits)
- “Standard” - Rice (Gmm) or (Theoretical Maximum Density) average of lot

| | | |
|---|---|---|
| In Place Density (% Compaction) | Class Q1 | 92.0% to 97.0% |
| | Class Q2 | 92.0% to 97.0% |
| | Class Q3 | 92.0% to 97.0% |
| | Class Q4 | 92.0% to 97.0% |
| | Class Q5 | 92.0% to 97.0% |

# Effect of Voids on Life




*Very important to get 92% in-place pavement density for service life!

# Independent Assurance Cores

- One core in first 5,000 ton
- Thereafter one core every 15,000 ton
- Cored by Contractor
- Within 1’ & at same offset
- Tested by DOT Region lab

# Pay Factor Attributes

- Air Voids
- In Place Density

| TABLE L - PAY FACTOR ATTRIBUTES | | | |
|---|---|---|---|
| a. | % Air Voids | 4.0% ± 1.0% | |
| b. | In Place Density (% Compaction) | Class Q1 | 92.0% to 97.0% |
| | | Class Q2 | 92.0% to 97.0% |
| | | Class Q3 | 92.0% to 97.0% |
| | | Class Q4 | 92.0% to 97.0% |
| | | Class Q5 | 92.0% to 97.0% |

# Non-Pay Factor Material

- Entrances, intersecting roads, spot leveling
- Most shoulder mix; check project plans
- Table usually included to show quantities

# Pay Factor Spreadsheet

| | | | | | |
|---|---|---|---|---|---|
| **Project Number :** | | **Pay Factor Data for all Lots** | | % Air Voids | % Density |
| **PCEMS Number :** | | Upper Specification Limit (USL) | | 5.0 | 96.0 |
| **County :** | | Lower Specification Limit (LSL) | | 3.0 | 92.0 |
| **Target Air Voids :** | 4.0 | Price Adjustment Factor (f) | | 50.0 | 50.0 |
| **Contract Bid Price for Asphalt Concrete :** | | $30.00 | | | |

| **Lot No.:** | **1** | | **Dates:** | | | **Tons of Asphalt Concrete in Lot :** | | | | | 5000.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sublot 1 | Sublot 2 | Sublot 3 | Sublot 4 | Sublot 5 | Sublot | Sublot | Sublot | Sublot | Mean | Standard Deviation |
| % Air Voids | 3.3 | 3.3 | 3.5 | 3.3 | 3.6 | | | | | 3.40 | 0.14 |
| % Density | 95.0 | 94.8 | 94.8 | 94.1 | 95.2 | | | | | 94.78 | 0.41 |

| **% Air Voids** | |
|---|---|
| Upper Quality Index (QU) | 11.43 |
| Lower Quality Index (QL) | 2.86 |
| % in USL (PU) from Table R | 100 |
| % in LSL (PL) from Table R | 100 |
| Quality Level (QL) | 100 |
| Pay Factor (PF) | 105.00 |

| **% Density** | |
|---|---|
| Upper Quality Index (QU) | 2.98 |
| Lower Quality Index (QL) | 6.78 |
| % in USL (PU) from Table R | 100 |
| % in LSL (PL) from Table R | 100 |
| Quality Level (QL) | 100 |
| Pay Factor (PF) | 105.00 |

| | | | | | |
|---|---|---|---|---|---|
| **Composite Pay Factor:** | **1.05** | use | **1.05** | **Lot Incentive(disincentive):** | $7,500.00 |

| **Lot No.:** | **2** | | **Dates:** | | | **Tons of Asphalt Concrete in Lot :** | | | | | 5000.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sublot 6 | Sublot 7 | Sublot 8 | Sublot 9 | Sublot 10 | Sublot | Sublot | Sublot | Sublot | Mean | Standard Deviation |
| % Air Voids | 3.3 | 3.4 | 3.9 | 3.5 | 3.4 | | | | | 3.50 | 0.23 |
| % Density | 96.0 | 95.2 | 95.5 | 93.8 | 94.2 | | | | | 94.94 | 0.92 |

| **% Air Voids** | |
|---|---|
| Upper Quality Index (QU) | 6.52 |
| Lower Quality Index (QL) | 2.17 |
| % in USL (PU) from Table R | 100 |
| % in LSL (PL) from Table R | 100 |
| Quality Level (QL) | 100 |
| Pay Factor (PF) | 105.00 |

| **% Density** | |
|---|---|
| Upper Quality Index (QU) | 1.15 |
| Lower Quality Index (QL) | 3.20 |
| % in USL (PU) from Table R | 88 |
| % in LSL (PL) from Table R | 100 |
| Quality Level (QL) | 88 |
| Pay Factor (PF) | 99.00 |

| | | | | | |
|---|---|---|---|---|---|
| **Composite Pay Factor:** | **1.02** | use | **1.00** | **Lot Incentive(disincentive):** | $0.00 |

# Pay Factor Mix

- Any QL of less than 90, the composite will not exceed 1.00 pay factor
- Individual pay factor < 85 % may reject lot
- A lot with < 0.85 composite pay factor may be rejected
- Rejection by visual inspection
  - segregation
  - low temperature
  - High/low asphalt content

# Special Provision for Flexible Pavement Smoothness

- Mainline smoothness - (high-speed profiler)
- Non-mainline & exclusion areas – use 10’ straightedge
- Pay Scale based on average IRI per 528’ lot and opportunity level
- Areas of Localized Roughness (ALR) table determines corrective grinding areas
- Contractors notify DOT Central Lab 2 weeks prior to anticipated completion of final lift

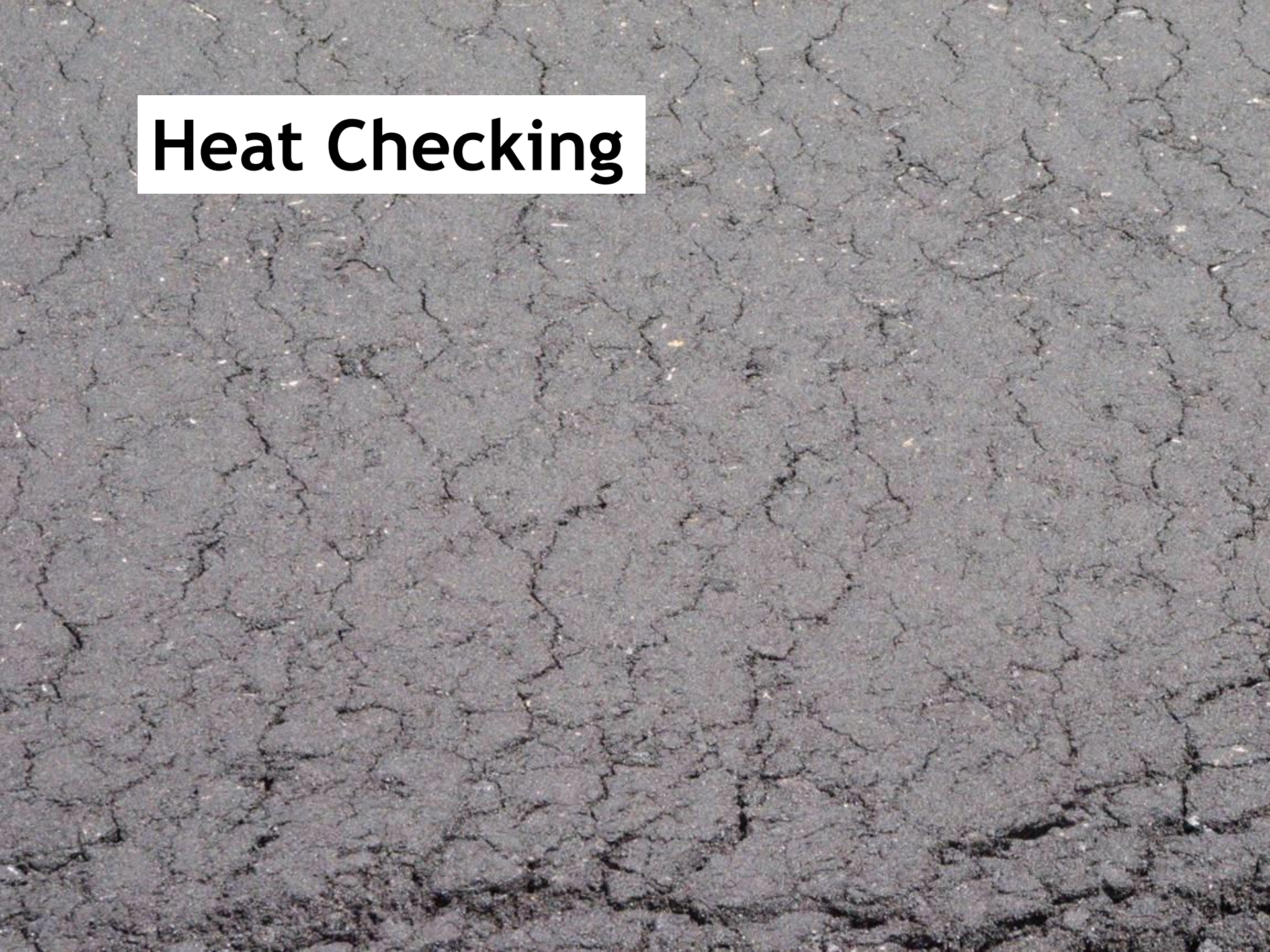
# Safety Edge


# Roadway Operations - Issues

- Improper tack application
- No nuclear gauge or geo gauge
- No established roller pattern
- Extendable paver screeds operating without auger extensions or strike off plates
- Paving without vibratory screed turned on
- Outside  edge drop-off is very steep

# Roll the Bevel

# Patties From Rubber Tired Roller On Mat


Heat Checking

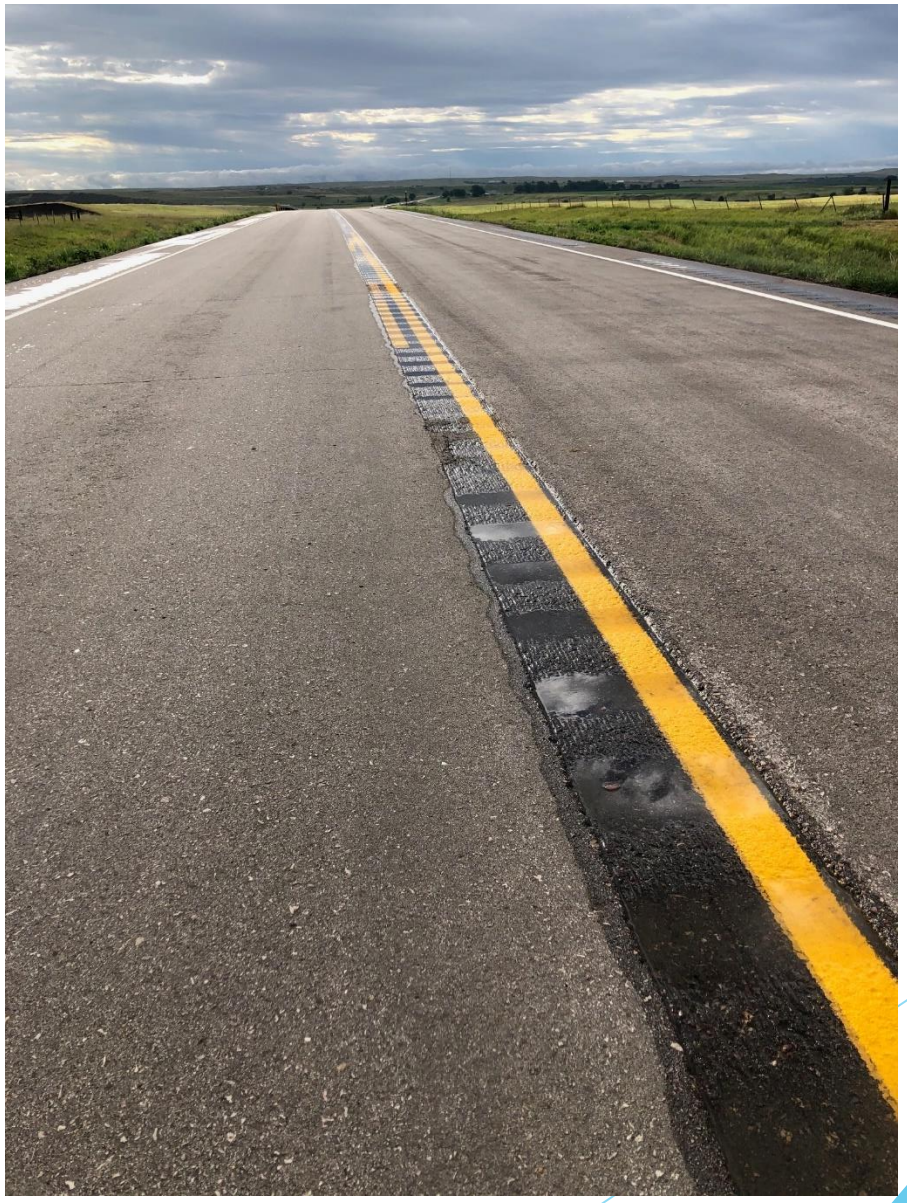
# Tack Not Cured Before Overlay


Bleeding


Rutting

# Slippage Cracks

# Centerline Rumble Strips



# Be seen! Be safe!

# Recertification Exam

- The Exam is open book/notes (Standard Specifications for Roads and Bridges – 2015, QC/QA Asphalt Concrete Training Manual and the Materials Manual)
- A score of 70% or better is required to pass the exam.