Pavement Performance is Defined by the Strength of our Quality Assurance System

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Importance of QC/QA

- **Ensures Material Quality**
  QC/QA verifies that aggregates, asphalt binder, and mix designs meet specifications before placement.
- **Improves Pavement Performance**
  Proper testing and inspection help ensure the pavement achieves the intended strength, durability, and service life.
- **Reduces Costly Failures**
  Identifying issues early prevents premature cracking, rutting, and costly repairs or replacements.
- **Promotes Consistency in Construction**
  Routine testing and monitoring ensure uniform mix production, proper placement, and adequate compaction.
- **Builds Confidence and Accountability**
  A strong QC/QA program provides transparency and assurance to owners, contractors, and the public that the pavement was built correctly.

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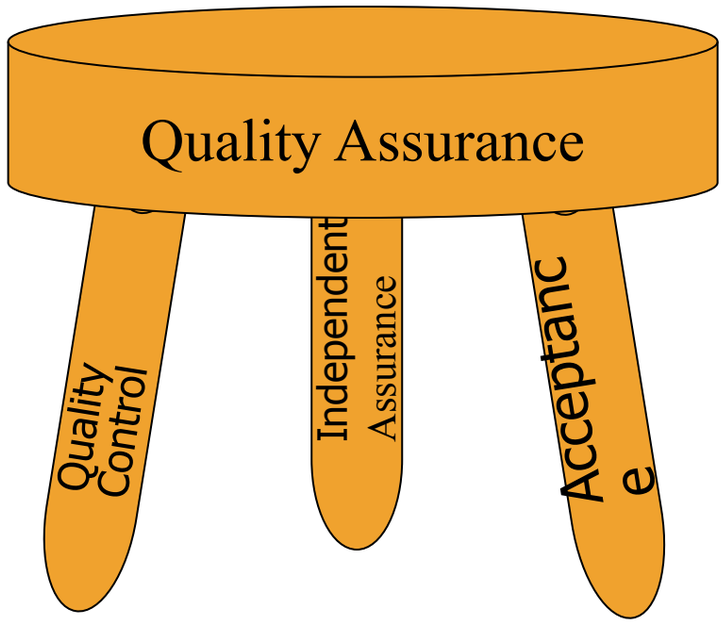
Quality Assurance System

- What is Quality
  - A characteristic with respect to excellence, fineness, or grade of excellence.
    - Product Quality
      - A certain level of performance in terms of service and life
        - Riding comfort / pavement life
- Assurance
  - A promise or certainty about something

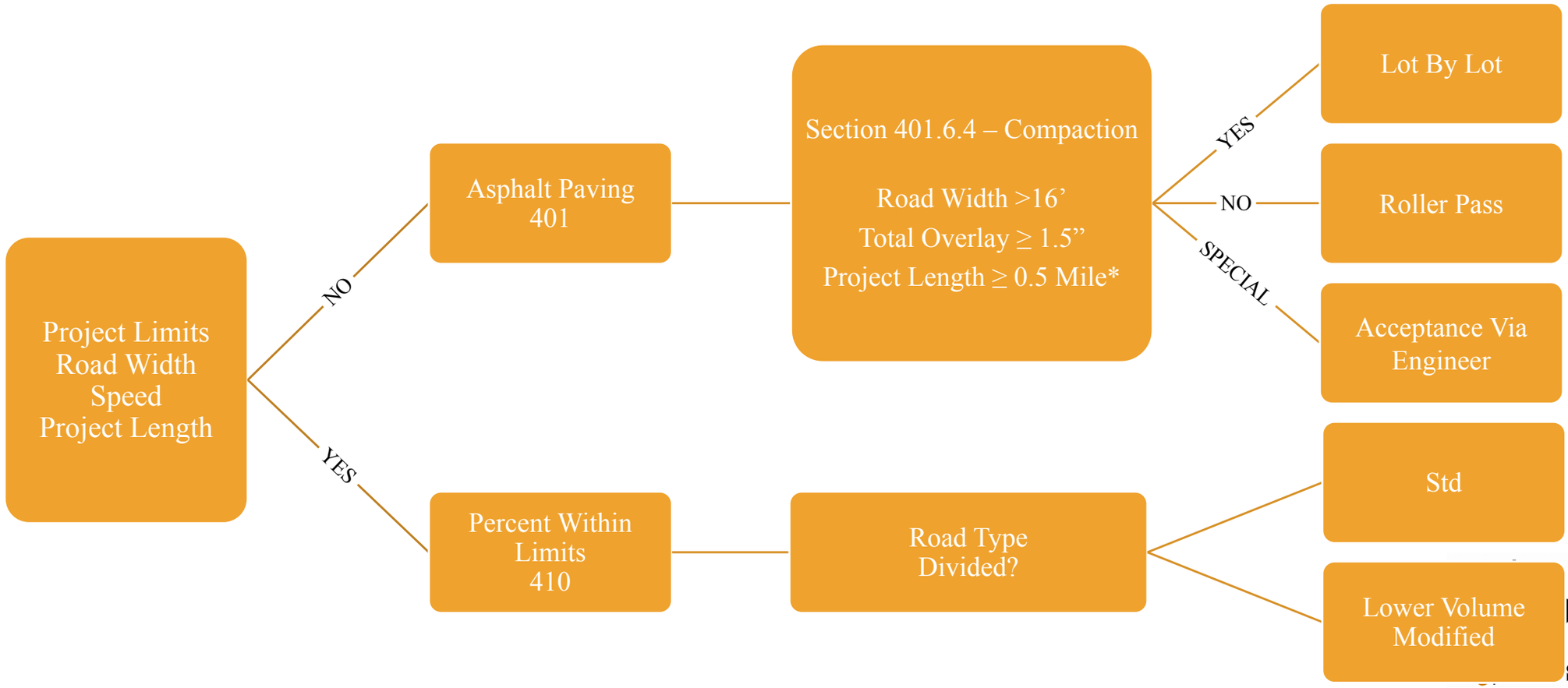
Quality Assurance System

- Quality Assurance
  - Actions necessary to provide confidence that a product will perform satisfactorily in service
  - Ensures a product is what is should be



Which QC/QA Spec?

- Boils down to size and project location on the network



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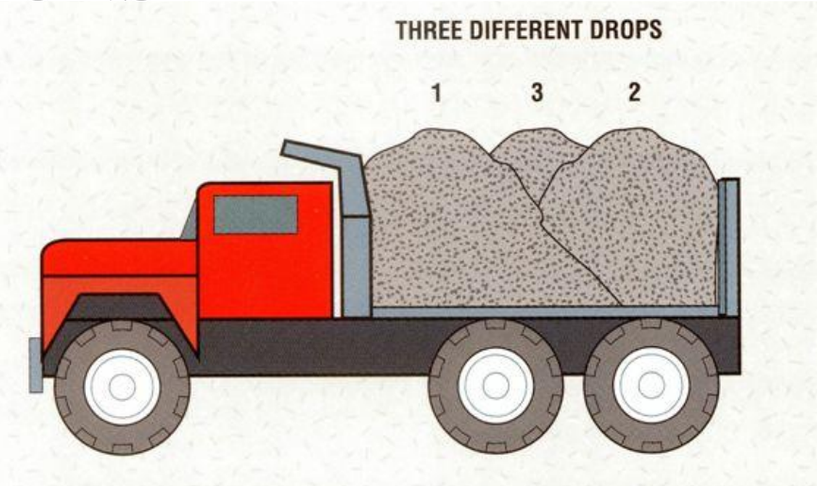
Our Specifications

Percent within Limits 401

- What's the difference?
- Why we do it?
- Why its "better"?

QC Plans – MP 401.03.50 (2024/08/01)

- Producer/Contractor details what they are to do at the plant and in the field for asphalt projects
  - EXAMPLE QC PLAN FOR PLANT OPERATIONS
    - Calibrate asphalt pump
    - Check feeder gate output at gate setting to be used
    - Ross Count (degree of coating)
    - Temperature check
    - Asphalt Content, gradation, volumetrics
    - Etc.
  - EXAMPLE QC PLAN FOR FIELD OPERATIONS
    - Temperature of Mix, Base, Mat
    - Density Checks
    - Tack/Prime Application Rate



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SECTION 401 ASPHALT BASE, WEARING, AND PATCHING AND LEVELING COURSES

Plant QC/QA

Section 401 - JMF Verification

- **SECTION 401.6.2-Job Mix Formula (JMF) Field Verification:** For each JMF, a mix design field verification shall be conducted during the first days of plant production. For Marshall designs, the verification shall be in accordance with the guidelines established in MP 401.02.27. For Superpave, designs it shall be in accordance with MP 401.02.29. The field verification is for the purpose of demonstrating that the JMF can be produced within the specified tolerances set forth in the MP. If the mix cannot be produced within these requirements, a new mix design will be required.
  - MP 401.02.27(Marshall) & MP 401.02.29(Superpave)
- **MP's Section 5.2 -** This field design verification shall consist of a randomly selected Asphalt Concrete sample taken in accordance with AASHTO T168 for each three hours of production, with no more than three samples in one day. A minimum of three samples are required for verification, however, three additional samples are required if none of the first three samples are completely within the specification limits. Samples used for gradation analysis during the verification process shall be obtained from the asphalt ignition oven samples (AASHTO T308). If there is a problem with major aggregate breakdown affecting the gradation test results when using the ignition oven, gradation samples may be obtained from hot bins, cold feeds, or extracted Asphalt Concrete samples.
  - Sample each 3 hours of Production (max 3/day)
  - Minimum of 3 samples to Verify… if first 3 fail to verify, 6 total samples are required.
- **MP's Section 5.3 -** Field design verification testing shall not be conducted if less than 200 tons of material is to be produced in a single day.

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Section 401 - JMF Verification

- Verification mix properties and Gradations shall meet the requirements are listed in corresponding MP

Property	Marshall	Superpave
Asphalt Content (%)	JMF ± 0.4 %	
Air Voids (%)	3.0 – 5.0 %	
Air Voids (%) – Base-I	3.0 – 6.0 %	N/A
Voids in Mineral Agg %	Min. of 0.5 % Below Design Criteria	
Stability (Newtons)	Design Criteria	N/A
Flow (0.25 mm)	Design Criteria	N/A

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Section 401 - JMF Verification

- After each Verification Sample
  - Evaluated to determine conformance to the requirements
    - YES? At least one of the samples is within all of the allowable tolerance limits then verification of the design is complete.
    - NO? Production adjustments shall be made to bring the mix within requirements
      - Initial 3 fail to meet criteria? 3 additional samples shall be tested.
      - All 6 samples fail to meet criteria?
        - The mix design shall be rejected, and a new mix design will be required(notify MCS&T)
        - SUPERPAVE - Price reduction in accordance with Section 7.0 for VTM and %AC.

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Section 401 – Production Mix Adjustments

- Bin Change – up to 10% for a single Aggregate. (Checks if > ± 5%)
- Asphalt Content adjustment shall be set at a value within ± 0.2% of the JMF
- VMA shall be set from the field verification test data at a value which also provided a 4% air void content.
  - VMA value may be adjusted to optimize the ± 1.0 % tolerance
- Maximum Theoretical Density set based on average value of verification samples

Section 401 – Production

- Minimum of 1 sample per 6-hours of production
  - If production exceeds 6-hours, a sample shall represent each half.
  - If production exceeds 12-hours, a sample shall represent each third.
- A four-sample average shall be used for the purpose of determining whether the material meets specification requirements.
  - Asphalt Content, Air Voids, VMA, and (Stability & Flow - Marshall)

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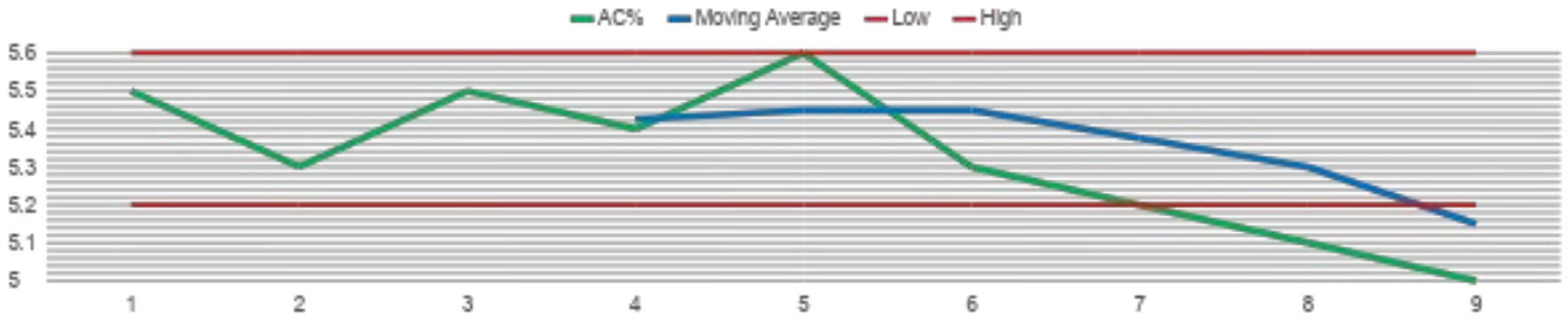
Section 401 – Production

- Moving Average Failure?
  - Production shall be halted, producer responsible to production change to return material to within requirements
  - Evaluate Air Void and Asphalt Content Moving Average values for degree of nonconformance and subsequent price reduction in accordance with MPs section 7.
  - Resume Production and begin a new moving average for evaluation



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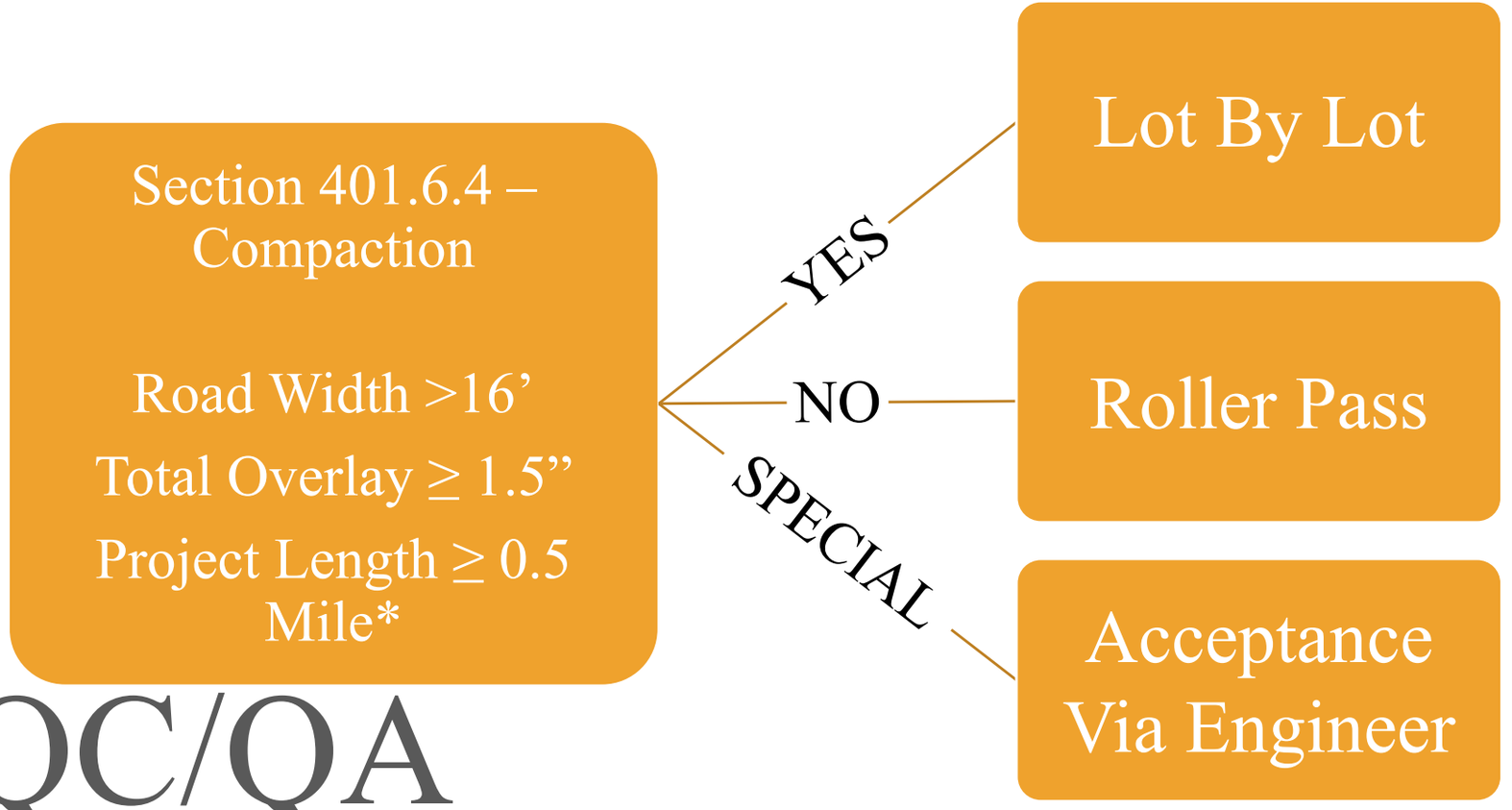
SECTION 401 ASPHALT BASE, WEARING, AND PATCHING AND LEVELING COURSES



Field QC/QA

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Section 401 – Standardizing the Gauge

- Make sure you don't standardize within 30 feet of another gauge.
- Check to make sure Gauge Standard counts are within limits of the Calibrated Manufacturer's Standard Counts.
- Density = +/- 2%
- Moisture = +/- 4%
- Standardization every 4 hours (i.e. 6 am / 10 am / 2 pm)

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Section 401 – Gauge Verification

- Randomly locate 3 test sites within the first 500 ft of paving – starting 100 ft from the take-off Joint & a minimum of 1-ft from either edge.
- Take 5 One-Minute readings in the same spot.
- For each gauge used – the Range of the 5 readings cannot exceed 25 kg/m^3.
- Once all 3 locations are done average the 15 readings for each gauge to compare differences between gauges.
- This will be used so the Contractor can determine the Density to achieve on their gauge.

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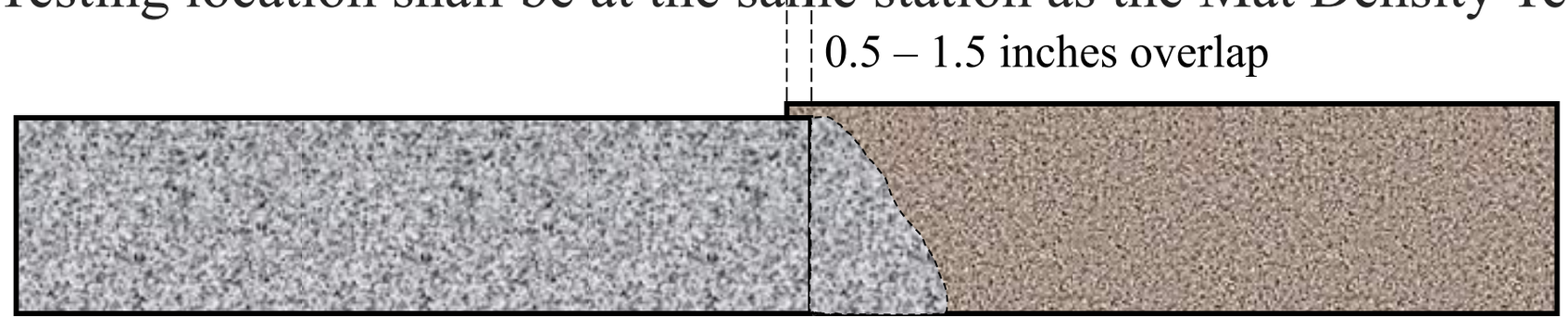
Section 401 – Density Testing – Lot By Lot

- Quality Control
  - Mat Density Acceptance Range = 93% - 97%
    - Minimum of 1’ in - away from an unconfined edge
    - Typical Lot = 1,000 Ft long
    - Requires 5 equal divided sublots each with a density readings
  - Joint Density Acceptance Range = 90% - 97%
    - Testing is completed on the HOT SIDE of the Joint
      - 4-inches off of the longitudinal Joint
    - Testing location shall be at the same station as the Mat Density Test



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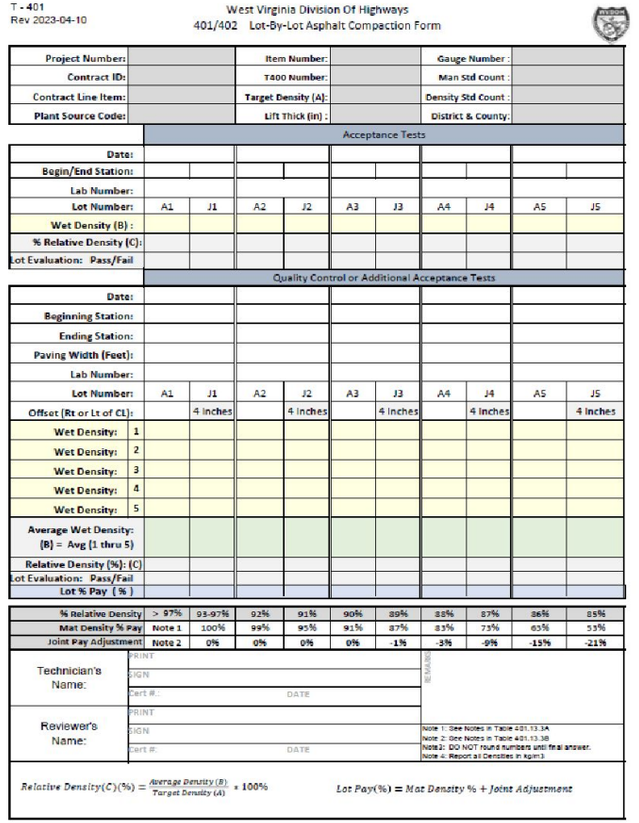
Section 401 – Density Testing – Lot By Lot

- Quality Acceptance
  - Mat Density Acceptance Range = 93% - 97%
    - Minimum of 1’ in - away from an unconfined edge
    - Typical Lot = 1,000 Ft long
    - Requires 1 density reading per lot
      - If lot reading is outside 93-97%, divide lot into 5 equal sublots.
      - Average the corresponding 5 density readings
  - Joint Density Acceptance Range = 90% - 97%
    - Testing is completed on the HOT SIDE of the Joint
      - 4-inches off of the longitudinal Joint
    - Testing location shall be at the same station as the Mat Density Test



T - 401
Rev 2023-04-10

West Virginia Division Of Highways
401/402 Lot-By-Lot Asphalt Compaction Form

Project Number:			Item Number:			Gauge Number :				
Contract ID:			T400 Number:			Man Std Count :				
Contract Line Item:			Target Density (A):			Density Std Count :				
Plant Source Code:			Lift Thick (in) :			District & County:				
	Acceptance Tests									
Date:										
Begin/End Station:										
Lab Number:										
Lot Number:	A1	J1	A2	J2	A3	J3	A4	J4	A5	J5
Wet Density (B) :										
% Relative Density (C):										
Lot Evaluation: Pass/Fail										
	Quality Control or Additional Acceptance Tests									
Date:										
Beginning Station:										
Ending Station:										
Paving Width (Feet):										
Lab Number:										
Lot Number:	A1	J1	A2	J2	A3	J3	A4	J4	A5	J5
Offset (Rt or Lt of CL):		4 Inches		4 Inches		4 Inches		4 Inches		4 Inches
Wet Density: 1										
Wet Density: 2										
Wet Density: 3										
Wet Density: 4										
Wet Density: 5										
Average Wet Density: (B) = Avg (1 thru 5)										
Relative Density (%): (C)										
Lot Evaluation: Pass/Fail										
Lot % Pay (%)										

% Relative Density	> 97%	93-97%	92%	91%	90%	89%	88%	87%	86%	85%
Mat Density % Pay	Note 1	100%	99%	95%	91%	87%	83%	75%	65%	53%
Joint Pay Adjustment	Note 2	0%	0%	0%	0%	-1%	-3%	-9%	-15%	-21%

Technician's Name:	PRINT SIGN Cert #: DATE	REMARKS
Reviewer's Name:	PRINT SIGN Cert #: DATE	Note 1: See Notes in Table 401.13.3A Note 2: See Notes in Table 401.13.3B Note3: DO NOT round numbers until final answer. Note 4: Report all Densities in kg/m3

$$Relative\ Density(C)(\%) = \frac{Average\ Density\ (B)}{Target\ Density\ (A)} \times 100\%$$

$$Lot\ Pay(\%) = Mat\ Density\ \% + Joint\ Adjustment$$

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Section 401 – Density Testing – Roller Pass

- Control Section - 100 ft to 200 ft from the take-off joint. (100 Feet Long)
  - Break into two – 50 Ft. sublots with 1 random testing location within each
  - Apply 4 passes to the section
  - Take a 1-Minute Test in each location
  - Mark Gauge Location, record results and temperature
  - Apply 2 more passes – Repeat Test in the same spots, record results & temp

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Section 401 – Density Testing – Roller Pass

- 100’ Control Section Cont.
  - Continue adding 2 passes until one of the following occur:
  - Less than 5 kg/m³ increase in Average Wet Density.
  - One or Both test Locations “Break Over”
    - Shows a reduction in Density
  - The Relative Density exceeds 97% of the Theoretical Max Gravity (Gmm)
  - The Mat Temperature Reaches 175 Degrees

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Section 401 – Density Testing – Roller Pass

- Proving Section – Roller Pass
  - 1000 Feet long beginning at the end of the Control Section.
  - 5 Random Wet Density Tests
    - Average Density must be 92% or greater
    - Average must be within 50 Kg/m³ of the Control Section Density
- Proceed with Established pattern

- If pavement/subgrade conditions do not support the compactive effort, and density can not be achieved.
  - Continue with # of passes associated with highest % density or as determined otherwise by the Engineer

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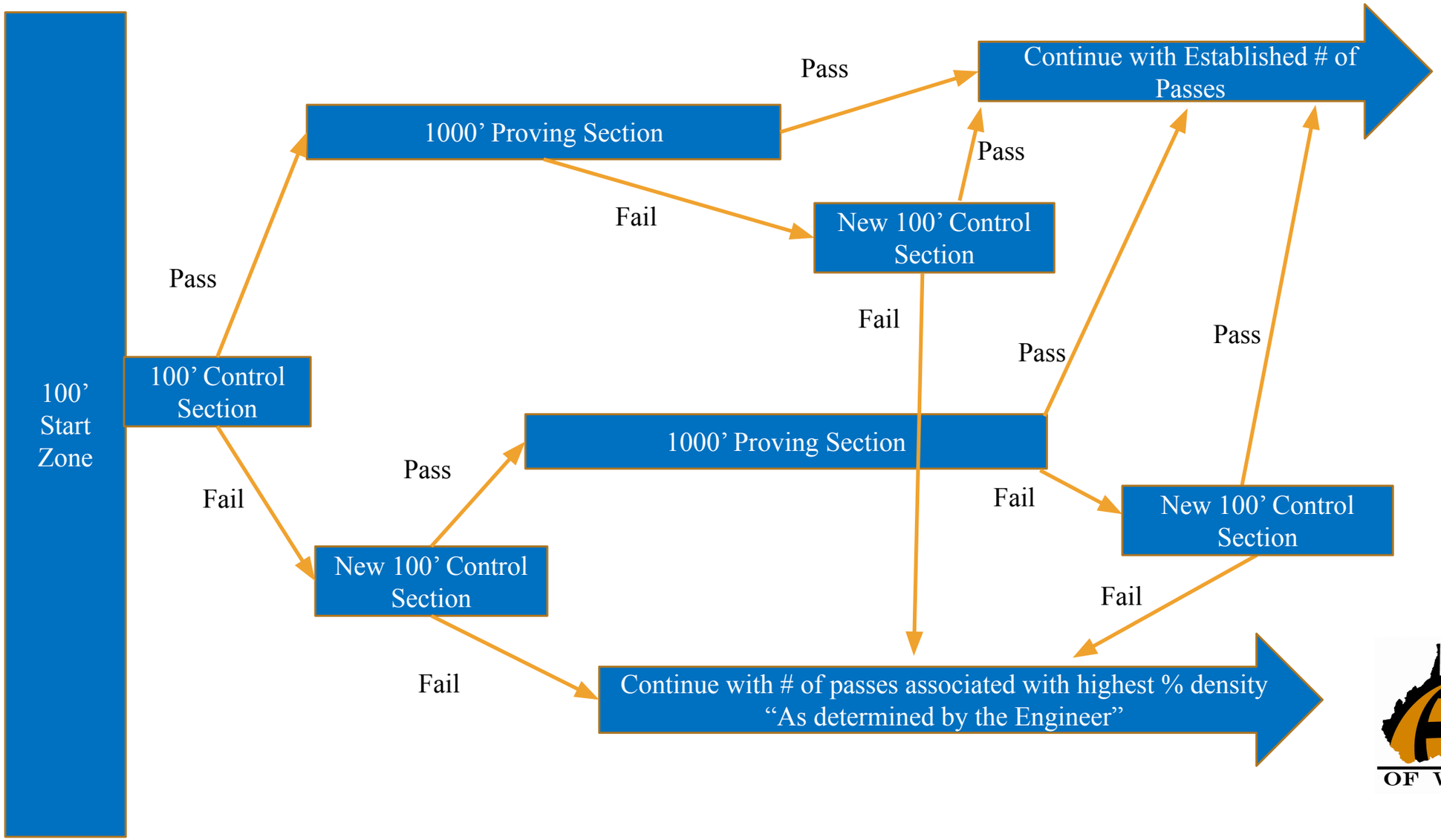
Section 401 – Density Testing – Roller Pass



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SECTION 410 ASPHALT BASE AND WEARING COURSES, PERCENT WITHIN LIMITS (PWL)

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Section 410 (PWL) - JMF Verification

- **Section 410.6.2-Job Mix Formula Field Verification:** For each JMF, a mix design field verification shall be conducted during the first days of plant production. For Marshall and Superpave designs, the verification shall be in accordance with the guidelines established in MP 401.02.31.
  - MP 401.02.31 All Mixtures
- **MP Section 5.2 -** This field design verification shall consist of a randomly selected asphalt mixture sample taken in accordance with the AASHTO T168 truck bed sampling method for each 750 tons (680 Mg) delivered to the project with a maximum of three samples in one day. A minimum of three samples are required for verification, however, up to three additional samples are required if none of the first three individual samples and the average of the three samples are completely within the tolerance limits of Table-A.
  - Sample each 750 tons of Production (max 3/day)
  - Minimum of 3 samples to Verify… up to 3 additional samples may be tested
  - Average Samples data and an induvial sample must pass to verify
- **MP's Section 5.3 –** Samples shall not be collected within the first 100 tons of production during a give day.
- **MP's Section 5.5 –** Do not conduct Field Design Verification on sublots representing less than 200 tons of production.
- **MP's Section 5.12 –** Mixtures previous verified under 401, may be considered verified for 410 given their compliance to this MP.

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Section 410 (PWL) - JMF Verification

- Verification Samples shall meet the following requirements

Property	Individual	Moving Average
Asphalt Content (%)	JMF ± 0.6 %	JMF ± 0.4 %
Air Voids (%)	3.2 – 5.8 %	3.5 – 5.5 %
Voids in Mineral Agg %	JMF ± 2.0 %	JMF ± 1.5 %
Stability (Newtons)	Design Criteria	N/A
Flow (0.25 mm)	Design Criteria	N/A
%Passing NMAS of Mix	JMF - 2.0 %	JMF
%Passing one sieve below NMAS of Mix	92% of JMF Max	90% of JMF Max
%Passing No.8 Sieve	JMF ± 2.0 %	JMF
%Passing No.200 Sieve	JMF ± 3.0 %	JMF ± 2.0 %

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Section 410 (PWL) - JMF Verification

- After each Verification Sample- Evaluated to determine conformance to the requirements
  - Both a 5 sample moving average and the Individual sample must pass
    - YES? Verification of the design is complete.
    - NO? Production adjustments shall be made to bring the mix within requirements
      - % AC in Plant Computer may be adjusted by ± 0.3% from the JMF design target in order to meet the target asphalt content determined from the field acceptance samples
      - ± 0.2% adjustment to %AC allowed during design verification
      - ± 10% adjustment to aggregate blend percentages (checks if > ± 5%)
      - Initial 3 fail to meet criteria? Up to 3 additional samples shall be tested.
      - All 6 samples fail to meet criteria?
        - The mix design shall be rejected, and a new mix design will be required(notify MCS&T)
        - No price adjustments need – as QA Field Samples control payment

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Job Mix Formula Verification

- Design = 5.5%AC
  - Allowable Target = 5.3 – 5.7
  - Plant system = 5.2 – 5.8
- Production = 5.6% AC (after Verification)
  - Plant system = 5.3 – 5.9
- NOTE: all volumetrics must still meet those in Table A

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Section 410 (PWL) – Production Adjustments

- Bin Changes – up to 10% for a single Aggregate (checks if > ± 5%)
- Asphalt Content adjustment shall be set at a value within ± 0.2% of the JMF
- VMA shall be set from the field verification test data at a value which also provided a 4% air void content.
  - VMA value may be adjusted to optimize the ± 1.0 % tolerance
- Maximum Theoretical Density set based on average value of verification samples

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Section 410 (PWL) – Production QC

- Minimum of 1 sample/1000 tons (Minimum of 1 sample/day)
- QC samples shall adhere to the same single and 5-sample moving average as in verification (AC, VTM, VMA, Grad, etc)
  - If AC target is not adjusted, continue moving average established in verification
  - If AC target is adjusted, a new moving average shall be established
- % AC in Plant Computer may be adjusted by ± 0.3% from the JMF design target in order to meet the target asphalt content determined from the field acceptance samples

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Section 410 (PWL) – Production QC

- If Individual QC sample fails
  - Make adjustments to return material to within requirements
    - If 5% bin change, take an additional sample
- If QC Moving Average Failure
  - Production shall be halted, producer responsible to production change to return material to within requirements
    - A written Explanation of the problem and proposed solution shall be provided to the Division.
    - If Division approves measures, when Production resumes, a new JMF Verification shall be conducted.

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Section 410 (PWL) – Field Quality Assurance

- Pre-paving Meeting
  - Agree on paving sequence – Layout Lots in field for sampling
- On the Job
  - Give the Contractor the Loose mix locations in advance
    - Allows the crew to be aware and ready when sample is approaching
  - Mark and Notify contractor of core locations as soon as the finish roller has moved to their next section.

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Section 410 (PWL) – Field Quality Assurance

- Acceptance testing of the mixture shall be performed independently of design verification and QC testing
- Samples are taken at the roadway behind the paver in accordance with MP 401.07.20 and 401.07.21 using a 2500 ton lot sizes
  - A random sample shall be taken in each 500 ton sublot
    - Calculate random stations and offsets for each sample
  - Sample shall be of sufficient size to determine %AC and gradation, as well as Max Gravity
  - Cores shall be to the appropriate depth to ensure capture of the entire layer

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What's required and What's not? Quality Assurance (QA)

- Field Sampled – 2500-ton Lots w/ 5 sublots
  - Thickness – Cores
  - Density Mat – Cores
  - Bond Strength – Cores
  - Asphalt Content – Loose Mix
  - (Dust Content) – Loose Mix
- Density Joint – Cores 10,000 FT Lot w/ 5 sublots

Test	Limits
Asphalt Content	JMF ± 0.4%
Dust (-%200)	JMF ± 2.0%
Density	91.5 – 97.0% G_{mm}
Joint Density	> 89.0% G_{mm}
Bond Strength*	> 50 psi
Thickness	Design – 0.04"

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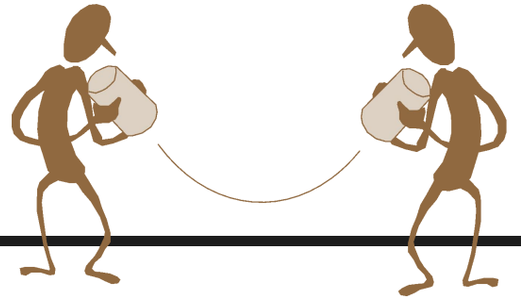
The Spec Can’t Cover All Sampling Scenarios

- Sample Data – 24hr turn around to the contractor
- Don’t set a sample location:
  - Within the first/last bit of the day
  - Within areas of varying depth – Bridge approach
  - At a shoulder break over on a super elevated turn
  - Within the inside 4’ shoulder

Communication



- For QC/QA to matter everyone needs to be involved and everyone needs to communicate with each other!
  - Plant Personnel – especially your loader operator
  - Lab Tech and field Tech
  - Truckers
  - Roller Operators
  - Paving Operators
- Sample Data needs to be communicated to the project personnel

Questions?

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