ASPHALT MIX

Section 9 – QA / QV Specifications

Description

- Applies to Bituminous Pavement
- Specification Types
- Quality Assurance
- Specification Types
  - 2021 Specification Book
- Contractor: Quality Acceptance Testing
- WYDOT: Quality Verification Testing

Personnel Requirements

- Documented experience and training for mix design testing – AASHTO Accreditation Req'd
- QC Supervisor
  - Capable of reviewing and interpreting test data and taking the appropriate actions to ensure quality
  - Certification is preferred

Personnel Requirements (continued)

- QA/QV Testing Technicians
  - Must be qualified
- Qualified Testing Technician at the production site:
  - Aggregate production
  - Bituminous pavement production
- Work reviewed and signed by Certified Testing Technician
- Check specification for each particular project

Level of Control

- Shown on plans
- Function of:
  - Traffic
  - Type of Construction
  - Type of Facility
  - Type of Funding
  - Quantity of Material

Table 401.4.23-1 Testing Requirements

Table 401.4.23-1
Testing Requirements

TEST PROCEDURE	LEVEL OF CONTROL			
	2	3	4	5
Quality Acceptance-Mix Production [1]				
Mix Volumetrics	2 locations on first day & 1 location each 5000 ton [5000 t] thereafter	2 locations on first day & 1 location each day thereafter until no further corrective actions are required	No tests required	No tests required
Virgin Aggregate Gradation	1 lot/5000 ton [1 lot/5000 t]	1 lot/5000 ton [1 lot/5000 t]	1 lot/5000 ton [1 lot/5000 t] [2]	No tests required
Asphalt Binder Content	1/day	1/day	1/day	No tests required
Virgin Aggregate-LL; PI; Coarse Aggregate Angularity (Fractured Faces); Fine Aggregate Angularity; Flat & Elongated [3]	1/1000 ton [1/1000 t] min.	1/1000 ton [1/1000 t] min.	No tests required	No tests required
Moisture Content of Virgin Aggregate/ Hydrated Lime; Moisture Content of Mix	1/day min.	1/day min.	No tests required	No tests required
Verification—Mix Production				
Mix Volumetrics	Split sample required but no test frequency specifically required	Split sample required but no test frequency specifically required	No tests required	No tests required
Virgin Aggregate Gradation	1/lot	1/lot	No tests required	No tests required
Asphalt Binder Content	No tests required	No tests required	No tests required	No tests required
Virgin Aggregate-LL, PI, Coarse and Fine Aggregate Angularity; Moisture Content of Virgin Aggregate/ Hydrated Lime; Moisture Content of Mix; Flat and Elongated	1/mix design [3]	1/mix design [3]	No tests required	No tests required

[1] Testing frequencies shown are minimum quantities. Example:

Table 401.4.23-2
In Place Density Test Requirements

Table 401.4.23-2
In-Place Density Test Requirements

Requirement	In-Place Density Designation				
	I	II	III	IV	V
In-Place Density [1]	1 lot/1500 ton [1 lot /1500 t] of produced material.	All in place mix compacted to ≥ 92.0% of voidless unit weight.	All in place mix compacted until a nuclear density gauge indicates the mix no longer increases in compaction.	5 passes [2] of a pneumatic tire and 5 passes [2] of a steel wheel roller in accordance with Subsection 210.3.6, Roller.	≥ 5 passes [2] of a steel wheel roller in vibratory mode in accordance with Subsection 210.3.6, Roller.
Test Strip	Required	Not required	Not required	Not required	Not required
Quality Acceptance Testing	1 lot/1500 ton [1 lot/1500 t]	1 test/200 ton [1 test/200 t]	No tests required	No tests required	No test required
Verification Testing	1/lot	No tests required	No tests required	No tests required	No test required

[1] Compact temporary surfaces in accordance with In-Place Density Designation II, unless otherwise noted in the contract.
[2] The department defines one pass with a roller as a forward or backward movement over the full length of the area to be compacted.

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Job Mix Formula

- WYDOT 401.4.1.2
- Contractor – JMF and Mix Design
- WYDOT – Approval
- Will include:
  - Single % passing each sieve
  - Single asphalt content
  - Single mixing and compaction temperature (MTM 414.0)

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Job Mix Formula (Continued)

- Table 401.4.1-1
  - Virgin Aggregate Tolerances
    - Passing #4 (4.75 mm) and larger ±5%
    - Passing #8 ±4%
    - Passing #30 ±3%
    - Passing #200 (0.075 mm) ±2%
- JMF + tolerance shall be within band specified
- Liquid anti stripping agents might be used instead of lime.

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Mix Design

- Performed by:
  - Contractor
  - Private Lab
- Fourteen days prior to paving
- Sampling (proper sampling & splitting)
  - Split samples
    - Contractor Mix design
    - WYDOT verification
- No paving without Materials Program approval
- Marshall - WYDOT MTM 414.0
- Superpave - WYDOT MTM 414.0

Department Furnished Sources

- Maybe Provided for Information Only
  - LAR of coarse aggregate
  - Gradation of each fraction
  - Combined gradation
  - % of each fraction in combined

Department Furnished Sources (continued)

- Mix Design Data
  - Number of Marshall blows or Gyrations
  - Binder content
  - Marshall stability
  - Marshall flow
  - % VMA
  - % Air Voids
  - TSR from AASHTO T-283

Table 401.4.1-2 Marshall and Superpave Plant Mix Properties

Table 401.4.1-2
Marshall and Superpave Plant Mix Properties[1]

Property	Class					
	I-M	II-M	III-M	I-S	II-S	III-S
Number of Marshall Blows	75	75	50			
Marshall Stability (lbs [N]) minimum	2500 [11 000]	2500 [11 000]	2000 [9000]			
Marshall Flow (0.01 in [0.25 mm])	8–16 [8–16]	8–16 [8–16]	8–16 [8–16]			
Number of Superpave Gyrations				100	75	50
% Voids in Laboratory Mix	5.0–6.0	4.0–5.0	4.0–5.0	4.0–5.0	4.0–5.0	4.0–5.0
% Voids in Production Mix	4.0–6.0	3.0–5.0	2.5–5.0	3.0–5.0	3.0–5.0	2.5–5.0
Dust/Effective Asphalt Binder	0.8–1.4	0.8–1.4	0.8–1.4	0.8–1.4	0.8–1.4	0.8–1.4
Minimum % Asphalt Binder	4.5	4.5	4.5	4.5	4.5	4.5
Minimum Tensile Strength Retained %	75	75	75	75	75	75
Film Thickness µm[2]	6–12	6–12	6–12	6–12	6–12	6–12
Voids Filled with Asphalt Binder (VFA)				65–75	65–78	65–78
Aggregate/Lime Moisture Content, % Minimum	4.0	4.0	4.0	4.0	4.0	4.0
Mixture Moisture Content, % Maximum	0.5	0.5	0.5	0.5	0.5	0.5

[1] The requirements are for properties obtained from laboratory-batched and mixed samples of the plant mix, except for air voids and VMA which are for laboratory batched and production mix requirements.

[2] This test is not required when the plant mix contains RAP.

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Percent Voids in Mineral Aggregate (VMA) Table 401.4.1-3

Table 401.4.1-3
Percent Voids in Mineral Aggregate

Class	Voids in Mineral Aggregate (%) Maximum Nominal Size			
	1 in [25 mm]	¾ in [19 mm]	½ in [12.5 mm]	⅜ in [9.50 mm]
Laboratory Mix				
I-M, II-M, I-S, II-S	12.0–15.0	13.0–16.0	14.0–17.0	14.0–17.0
III-M, III-S	11.0–14.0	12.0–15.0	13.0–16.0	13.0–16.0
Production Mix				
I-M, II-M, I-S, II-S	11.0–15.0	12.0–16.0	13.0–17.0	13.0–17.0
III-M, III-S	10.0–14.0	11.0–15.0	12.0–16.0	12.0–16.0

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Gradation Requirements

Table 803.5.5-1
Gradation Requirements: Marshall and Superpave Mixes

Sieve	1 in	¾ in	½ in	3/8 in
1 ¼ inch	100	---	---	---
1 inch	90-100	100	---	---
¾ inch	65-90	90-100	100	---
½ inch	50-85	55-90	90-100	100
3/8 inch	40-75	45-85	55-90	90-100
No. 4	30-60	30-65	35-70	45-85
No. 8	20-45	20-50	20-55	30-65
No. 30	5-25	5-30	5-35	10-40
No. 200	2-7	2-7	2-7	2-7

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Testing Technicians Correlations

- WYDOT 114.3.3.1
- Prior to any testing, a meeting will be held between responsible parties and testing technicians
- Aggregate Tests (WYDOT 14.3.3.2)
  - During first Lot
  - May be done during crushing if combined samples available
  - Procedure
    - Based on five tests
    - Split samples – independent testing
      - Contractor
      - WYDOT
      - Referee – if necessary

Testing Technicians Correlations (continued)

- Results evaluated with WYDOT MTM 126.0
- If results correlate
  - QC/QA verification testing begins
  - Referee samples discarded
- If no agreement
  - Resolution procedure
- Recorrelate if any change in equipment or personnel occurs.

Testing Technicians Correlations

- Density Tests (WYDOT 114.3.3.3)
  - During test strip
  - Procedure for cores
  - 7 Locations
  - Cores must be taken in the presence of the engineer

Testing Technicians Correlations (continued)

- Seven locations – 2 cores/each
  - Independent testing for S.G. and density
    - WYDOT
    - Contractor
  - Evaluated with WYDOT MTM 423.0
  - If samples correlate
    - QC/QA verification begins
  - If no agreement
    - Resolution procedure

Dispute Resolution

- WYDOT 114.3.4
- Procedure
  - Meet to review testing, equipment and calibration
    - Materials Program may assist
  - If bias is found:
    - Correct bias
    - Repeat correlation
  - If bias not found:
    - Reference testing by Materials Program

Dispute Resolution (continued)

- Referee Testing
  - Aggregate – Retained samples
  - Density – WYDOT cores
  - Results – 1 week
- For Quality Acceptance
  - Group correlating with materials Program

Mix Design Correlation

- Laboratory Requirements
  - AASHTO accreditation required
  - Approval by Materials Program
- Procedures
  - Results compared with multi-lab precision statements

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Mix Design Correlations (continued)

- If within limits:
  - Use Contractor's design for:
    - JMF
    - AC content
    - Voidless unit weight
- If not within limits:
  - Dispute resolution
    - WYDOT values may be used in interim

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Mix Design Dispute Resolution

- Procedures (WYDOT 114.2)
  - Meet to review testing, equipment, etc
  - If resolved:
    - Written agreement
    - In project file

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Mix Design Dispute Resolution (continued)

- If unresolved:
  - Third party selected
    - Mutual agreement
  - Lab correlating with third party lab to be used
- Cost of third party testing
  - WYDOT if Contractor confirmed
  - Contractor if WYDOT confirmed

Quality Acceptance

- Testing performed by Contractor / Acceptability by Dept.
- Department generate random numbers
- Samples not valid if not taken in presence of dept. inspector
- Applies to;
  - Gradation
  - Density
  - AC Content
- Frequency – Table 401.4.23-1
- Based on quality analysis of lots

Verification Testing

- Engineer or representative
  - Different from QC & QA testing
- Frequency as PER Table 401.4.23-2
- One verification sample randomly selected from each lot
- Difference between QA & Verification OK
- (MTM416.0, MTM417.0)
- Contractor results are used

Verification Testing (continued)

- **Difference is not OK**
  - **Engineer test rest of verification samples for lot**
- **Determine if both samples use for acceptance and new correlation performed**
- **Contractors results not used until new correlation accepted**
- **If verification sample indicated bonus, only paid 1st lot**

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Table (MTM417.0)

Grading (Nominal Max. Size)					
	1"	3/4"	1/2"	3/8"	PMWC
Sieve	Allowable Difference (% Passing)				
1 ¼"	1.5				
1"	2	1.5			
¾"	3	2	1.5		
½"	3.4	3	2	1.5	1.5
3/8"	3.4	3.4	3.4	2	2
No. 4	3.4	3.4	3.4	3.4	3.4
No. 8	3.3	3.3	3.3	3.3	3.3
No. 30	2.9	2.9	2.9	2.9	
No. 200	1.2	1.2	1.2	1.2	1.2

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Table 2 (MTM529)

Allowable Density Difference
Density 1.50

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Definition of Lot

- Gradation
  - Quantity represented by 5 tests
  - Maximum tonnage: 5000t, Table 401.4.12-1
  - Unusual conditions
    - Quantity represented by 3 to 7 tests
  - Single lot may span several days

Definition of Lot (continued)

- In – place Density
  - Quantity represented by 7 tests
  - Maximum tonnage:1500 t, Table 401.4.12-2
  - Single lot may span several days
- Asphalt Content
  - One day's production

Sampling

- Gradation
  - One sample/sublot
  - QA one extra sample for verification
  - Random location
  - Contractor samples – Engineer directs
  - Conveyor sample
  - 30 lbs
  - Samples must be taken in the presence of an engineer

Sampling (continued)

- Density
  - Seven samples – 2 per sublot (one for acceptance, one for verification)
  - Core samples
  - Random locations contractor samples – engineer directs
  - No test less than 1 ft from any edge
  - Cores must be taken in the presence of the engineer

Sampling (continued)

- Asphalt Content
  - Contractor to determine asphalt on hand
  - WYDOT personnel to do calculations
  - Sample must be taken in the presence of the engineer

Asphalt Sampling

WYDOT (401.4.19.5)

- Contractor samples; Engineer observes
- Immediate custody by engineer
- From line between storage tank and drum during placement of mix
- A minimum of 1 gal shall be drawn from sampling value and discarded
- Line materials shall be circulating

Asphalt Sampling (continued)

- Two, 1 quart containers representing 100 ton or one sublot
- Sampling shall be random; locations determined by engineer
- Engineer will retain all samples for a lot until receipt of the last sample.
- The Resident Engineer will retain referee containers as a referee sample from each sample.
- Projects less than 100 ton, no sampling is required

Pay Factor

- Determined by the Engineer
- Aggregate Gradation
  - Based on Gradation Quality Level Analysis
  - Calculated according to WYDOT 113.1

Pay Factor

- Asphalt Content
  - Basis – Asphalt Used vs. Production
  - Lot size = 1 day's production of mix

$$\% \ AC = \frac{\text{AC USED}}{\text{Total PMP}} \ x \ 100$$

AC Used = AC on hand + AC delivered – AC remaining at day's end

  - Pay Factor out of Table 401.5.3-3

Daily Asphalt Content Pay Factors Table 401.5.3-3

Variance of Actual Asphalt Content from design Asphalt Content	Pay Factor
0.00 – 0.25	1.00
0.26 – 0.30	0.95
0.31 – 0.35	0.90
0.36 - 0.40	0.85
0.41 – 0.45	0.80
0.46 – 0.50	0.75
≥ 0.51	Reject

Pay Factor Determination (continued)

- **Density**
  - **Determine core densities**
    - **WYDOT MTM 415.0**
    - **Round to 0.01%**
  - **Determine % density**

$$\%\ \text{Density} = \frac{\text{density}}{\text{max. theor.}} = x$$

  - **Determine average ($\bar{x}$)**

$$\bar{x} = \frac{\Sigma x}{n}$$

Pay Factor Determination (continued)

- **Determine standard deviation (s)**

$$s = \sqrt{\left(\frac{1}{n-1}\right)\Sigma\left(x - \bar{x}\right)^2}$$

  - **Calculate the Quality Index (QI)**

$$QI = \frac{x - 92.00}{s}$$

  - **If QI < 0.01 Reject**
  - **If QI ≥ 0.01 and $\bar{x}$ ≤ 96.00%**
  - **See Table IV**
  - **IF $\bar{x}$ > 96.00, PF = lesser of 1.00 or Table 401.5.3-2**

Table 401.5.3-2

Quality From	Index To	Pay Factor	Quality From	Index To	Pay Factor	Quality From	Index To	Pay Factor
	≤ 0.00	Reject	0.50	0.53	0.67	1.08	1.11	0.85
0.01	0.01	0.50	0.54	0.56	0.68	1.12	1.14	0.86
0.02	0.04	0.51	0.57	0.59	0.69	1.15	1.18	0.87
0.05	0.07	0.52	0.60	0.62	0.70	1.19	1.21	0.88
0.08	0.10	0.53	0.63	0.65	0.71	1.22	1.25	0.89
0.11	0.13	0.54	0.66	0.69	0.72	1.26	1.28	0.90
0.14	0.16	0.55	0.70	0.72	0.73	1.29	1.31	0.91
0.17	0.19	0.56	0.73	0.75	0.74	1.32	1.34	0.92
0.20	0.22	0.57	0.76	0.78	0.75	1.35	1.37	0.93
0.23	0.25	0.58	0.79	0.82	0.76	1.38	1.40	0.94
0.26	0.28	0.59	0.83	0.85	0.77	1.41	1.43	0.95
0.29	0.31	0.60	0.86	0.88	0.78	1.44	1.46	0.96
0.32	0.34	0.61	0.89	0.91	0.79	1.47	1.49	0.97
0.35	0.37	0.62	0.92	0.95	0.80	1.50	1.52	0.98
0.38	0.40	0.63	0.96	0.98	0.81	1.53	1.55	0.99
0.41	0.43	0.64	0.99	1.01	0.82	1.56	3.57	1.00
0.44	0.46	0.65	1.02	1.04	0.83		≥ 3.58	1.10
0.47	0.49	0.66	1.05	1.07	0.84			

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Basis of Payment

- **Contractor Quality Control**
  - **Paid by Lump Sum**
  - **Schedule**
    - **25% - 1st Monthly Estimate**
    - **25% - 1st Estimate after testing begins**
    - **50% - At Completion of Testing**

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Pay Factor for PGAB (Table 401.5.3-1)

Dynamic Shear ($G^*/\sin\delta$), original PGAB, High Grade temp., kPa	Dynamic Shear ($G^*/\sin\delta$), RTFO residue, High grade temp., kPa	Creep Stiffness (S), PAV residue, Low grade temp. +10°C, MPa	Creep Slope (m-value), PAV residue, Low grade temp. +10°C unit less	Elastic Recovery, RTFO residue, 77°F, %	Pay Factor
≥ 0.90	≥1.98	≤311	≥0.094	≥55	1.00
0.89	1.97 -1.95	312 - 315	0.293 - 0.291	54	0.95
0.88 - 0.87	1.94 - 1.91	316 - 320	0.290 - 0.288	53	0.90
0.86	1.90 - 1.88	321 - 324	0.287 - 0.285	52	0.85
0.85 - 0.84	1.87 - 1.85	325 - 329	0.284 - 0.282	51	0.80
0.83	1.84 - 1.82	330 - 333	0.281 - 0.280	50	0.75
0.82 - 0.81	1.81 - 1.78	334 - 337	0.279 - 0.277	49	0.70
0.8	1.77 - 1.75	338 - 342	0.276 - 0.274	48	0.65
0.79 - 0.78	1.74 - 1.72	343 - 346	0.273 - 0.271	47	0.60
0.77	1.71 - 1.68	347 - 351	0.270 - 0.268	46	0.55
0.76 - 0.75	1.67 - 1.65	352 - 355	0.267 - 0.265	45	0.50
<0.75	<1.65	≥355	<0.265	<45	REJECT

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Pay Adjustments

Aggregate Gradation:

$PA_A = 0.67 \times PMP \times (PF_A - 1) \times (LS_A - AP_Q)$

$PA_A = 0.67 \times PMP_{AP} \times (PF_A - 1) \times (LS_A - ML_Q)$

Aggregate Gradation For Recycle:

$PA_A = 0.67 \times RPMP \times (RPF - 1) \times (LS_A - AP_Q)$

$PA_A = 0.67 \times PMP_{AP} \times (RPF - 1) \times (LS_A - ML_Q)$

In-Place Density:

$PA_D = 1.33 \times PMP \times (PF_D - 1) \times LS_D$

Asphalt Content:

$PA_{AC} = 0.67 \times PMP \times (PF_{AC} - 1) \times (LS_{AC} - AP_Q)$

$PA_{AC} = 0.67 \times PMP_{AC} \times (PF_{AC} - 1) \times (LS_{AC} - MP_Q)$