# ASPHALT MIX

## Section 9 – QA / QA 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/QA 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 | LVEL OF CONTROL | | | |
|---|---|---|---|---|
| | 2 | 3 | 4 | 5 |
| **Quality Acceptance-Mix Production [5]** | | | | |
| 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] [6] | 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 [7] | 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 [8] | 1/mix design [8] | No tests required | No tests required |

[1] Testing frequencies shown are minimum quantities. Example:
1 min/1000 ton [1 min/1000 t]

# 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.

# 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)

# 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.

# 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.

# 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 |

# 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 |

# 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

# 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

# Mix Design Dispute Resolution

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

# 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

# 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 |

# Table 2 (MTM529)

| Allowable Density Difference |
| --- |
| Density 1.50 |

# 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 ( $\overline{x}$ )**

$$\overline{x} = \frac{\Sigma\, x}{n}$$

# Pay Factor Determination (continued)

- **Determine standard deviation (s)**

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

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

$$\text{Upper Quality Index} = Q_u = \frac{SL_u - \bar{x}}{s}$$

$$\text{Lower Quality Index} = Q_l = \frac{\bar{x} - SL_l}{s}$$

  - **Where:**

$SL_U$ = 100

$SL_L$ = 92

n = 7

# Table 113.1-1

**Table 113.1-1**
**Quality Level Analysis by the Standard Deviation Method**

| PU or PL percent Within Limits for Positive Values of QU or QL | Upper Quality Index QU or Lower Quality Inex QL | | | | |
|---|---|---|---|---|---|
| | n = 3 | n = 4 | n = 5 | n = 6 | n = 7 |
| 100 | 1.16 | 1.50 | 1.79 | 2.03 | 2.23 |
| 99 | | 1.47 | 1.67 | 1.80 | 1.89 |
| 98 | 1.15 | 1.44 | 1.60 | 1.70 | 1.76 |
| 97 | | 1.41 | 1.54 | 1.62 | 1.67 |
| 96 | 1.14 | 1.38 | 1.49 | 1.55 | 1.59 |
| 95 | | 1.35 | 1.44 | 1.49 | 1.52 |
| 94 | 1.13 | 1.32 | 1.39 | 1.43 | 1.46 |
| 93 | | 1.29 | 1.35 | 1.38 | 1.40 |
| 92 | 1.12 | 1.26 | 1.31 | 1.33 | 1.35 |
| 91 | 1.11 | 1.23 | 1.27 | 1.29 | 1.30 |
| 90 | 1.10 | 1.20 | 1.23 | 1.24 | 1.25 |
| 89 | 1.09 | 1.17 | 1.19 | 1.20 | 1.20 |
| 88 | 1.07 | 1.14 | 1.15 | 1.16 | 1.16 |
| 87 | 1.06 | 1.11 | 1.12 | 1.12 | 1.12 |
| 86 | 1.04 | 1.08 | 1.08 | 1.08 | 1.08 |
| 85 | 1.03 | 1.05 | 1.05 | 1.04 | 1.04 |
| 84 | 1.01 | 1.02 | 1.01 | 1.01 | 1.00 |
| 83 | 1.00 | 0.99 | 0.98 | 0.97 | 0.97 |
| 82 | 0.97 | 0.96 | 0.95 | 0.94 | 0.93 |
| 81 | 0.96 | 0.93 | 0.91 | 0.90 | 0.90 |
| 80 | 0.93 | 0.90 | 0.88 | 0.87 | 0.86 |
| 79 | 0.91 | 0.87 | 0.85 | 0.84 | 0.83 |
| 78 | 0.89 | 0.84 | 0.82 | 0.80 | 0.80 |
| 77 | 0.87 | 0.81 | 0.78 | 0.77 | 0.76 |
| 76 | 0.84 | 0.78 | 0.75 | 0.74 | 0.73 |
| 75 | 0.82 | 0.75 | 0.72 | 0.71 | 0.70 |
| 74 | 0.79 | 0.72 | 0.69 | 0.68 | 0.67 |
| 73 | 0.76 | 0.69 | 0.66 | 0.65 | 0.64 |

# Table 113.1-1

**Table 113.1-1**
**Quality Level Analysis by the Standard Deviation Method**

| PU or PL percent Within Limits for Positive Values of QU or QL | Upper Quality Index QU or Lower Quality Inex QL | | | | |
|---|---|---|---|---|---|
| | n = 3 | n = 4 | n = 5 | n = 6 | n = 7 |
| 100 | 1.16 | 1.50 | 1.79 | 2.03 | 2.23 |
| 99 | | 1.47 | 1.67 | 1.80 | 1.89 |
| 98 | 1.15 | 1.44 | 1.60 | 1.70 | 1.76 |
| 97 | | 1.41 | 1.54 | 1.62 | 1.67 |
| 96 | 1.14 | 1.38 | 1.49 | 1.55 | 1.59 |
| 95 | | 1.35 | 1.44 | 1.49 | 1.52 |
| 94 | 1.13 | 1.32 | 1.39 | 1.43 | 1.46 |
| 93 | | 1.29 | 1.35 | 1.38 | 1.40 |
| 92 | 1.12 | 1.26 | 1.31 | 1.33 | 1.35 |
| 91 | 1.11 | 1.23 | 1.27 | 1.29 | 1.30 |
| 90 | 1.10 | 1.20 | 1.23 | 1.24 | 1.25 |
| 89 | 1.09 | 1.17 | 1.19 | 1.20 | 1.20 |
| 88 | 1.07 | 1.14 | 1.15 | 1.16 | 1.16 |
| 87 | 1.06 | 1.11 | 1.12 | 1.12 | 1.12 |
| 86 | 1.04 | 1.08 | 1.08 | 1.08 | 1.08 |
| 85 | 1.03 | 1.05 | 1.05 | 1.04 | 1.04 |
| 84 | 1.01 | 1.02 | 1.01 | 1.01 | 1.00 |
| 83 | 1.00 | 0.99 | 0.98 | 0.97 | 0.97 |
| 82 | 0.97 | 0.96 | 0.95 | 0.94 | 0.93 |
| 81 | 0.96 | 0.93 | 0.91 | 0.90 | 0.90 |
| 80 | 0.93 | 0.90 | 0.88 | 0.87 | 0.86 |
| 79 | 0.91 | 0.87 | 0.85 | 0.84 | 0.83 |
| 78 | 0.89 | 0.84 | 0.82 | 0.80 | 0.80 |
| 77 | 0.87 | 0.81 | 0.78 | 0.77 | 0.76 |
| 76 | 0.84 | 0.78 | 0.75 | 0.74 | 0.73 |
| 75 | 0.82 | 0.75 | 0.72 | 0.71 | 0.70 |
| 74 | 0.79 | 0.72 | 0.69 | 0.68 | 0.67 |
| 73 | 0.76 | 0.69 | 0.66 | 0.65 | 0.64 |

# Table 113.1-1 Contd.

**Table 113.1-1**
**Quality Level Analysis by the Standard Deviation Method**

| PU or PL percent Within Limits for Positive Values of QU or QL | Upper Quality Index QU or Lower Quality Inex QL | | | | |
|---|---|---|---|---|---|
| | n = 3 | n = 4 | n = 5 | n = 6 | n = 7 |
| 72 | 0.74 | 0.66 | 0.63 | 0.62 | 0.61 |
| 71 | 0.71 | 0.63 | 0.60 | 0.59 | 0.58 |
| 70 | 0.68 | 0.60 | 0.57 | 0.56 | 0.55 |
| 69 | 0.65 | 0.57 | 0.54 | 0.53 | 0.52 |
| 68 | 0.62 | 0.54 | 0.51 | 0.50 | 0.49 |
| 67 | 0.59 | 0.51 | 0.47 | 0.47 | 0.46 |
| 66 | 0.56 | 0.48 | 0.45 | 0.44 | 0.44 |
| 65 | 0.52 | 0.45 | 0.43 | 0.41 | 0.41 |
| 64 | 0.49 | 0.42 | 0.40 | 0.39 | 0.38 |
| 63 | 0.46 | 0.39 | 0.37 | 0.36 | 0.35 |
| 62 | 0.43 | 0.36 | 0.34 | 0.33 | 0.32 |
| 61 | 0.39 | 0.33 | 0.31 | 0.30 | 0.30 |
| 60 | 0.36 | 0.30 | 0.28 | 0.27 | 0.27 |
| 59 | 0.32 | 0.27 | 0.25 | 0.25 | 0.24 |
| 58 | 0.29 | 0.24 | 0.23 | 0.22 | 0.21 |
| 57 | 0.25 | 0.21 | 0.20 | 0.19 | 0.19 |
| 56 | 0.22 | 0.18 | 0.17 | 0.16 | 0.16 |
| 55 | 0.18 | 0.15 | 0.14 | 0.13 | 0.13 |
| 54 | 0.14 | 0.12 | 0.11 | 0.11 | 0.11 |
| 53 | 0.11 | 0.09 | 0.08 | 0.08 | 0.08 |
| 52 | 0.07 | 0.06 | 0.06 | 0.05 | 0.05 |
| 51 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 |
| 50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: If the value of $Q_U$ or $Q_L$ does not correspond exactly to a figure in the table, use the next highest figure. For values of $Q_U$ or $Q_L$ less than zero, use the absolute value of the calculated $Q_U$ or $Q_L$ to determine the corresponding value for $P_U$ or $P_L$. The actual value of $P_U$ or $P_L$ equals 100 minus the table value for $P_U$ or $P_L$.

# Table 113.1-1 Contd.

**Table 113.1-1**
**Quality Level Analysis by the Standard Deviation Method**

| PU or PL percent Within Limits for Positive Values of QU or QL | Upper Quality Index QU or Lower Quality Inex QL | | | | |
|---|---|---|---|---|---|
| | n = 3 | n = 4 | n = 5 | n = 6 | n = 7 |
| 72 | 0.74 | 0.66 | 0.63 | 0.62 | 0.61 |
| 71 | 0.71 | 0.63 | 0.60 | 0.59 | 0.58 |
| 70 | 0.68 | 0.60 | 0.57 | 0.56 | 0.55 |
| 69 | 0.65 | 0.57 | 0.54 | 0.53 | 0.52 |
| 68 | 0.62 | 0.54 | 0.51 | 0.50 | 0.49 |
| 67 | 0.59 | 0.51 | 0.47 | 0.47 | 0.46 |
| 66 | 0.56 | 0.48 | 0.45 | 0.44 | 0.44 |
| 65 | 0.52 | 0.45 | 0.43 | 0.41 | 0.41 |
| 64 | 0.49 | 0.42 | 0.40 | 0.39 | 0.38 |
| 63 | 0.46 | 0.39 | 0.37 | 0.36 | 0.35 |
| 62 | 0.43 | 0.36 | 0.34 | 0.33 | 0.32 |
| 61 | 0.39 | 0.33 | 0.31 | 0.30 | 0.30 |
| 60 | 0.36 | 0.30 | 0.28 | 0.27 | 0.27 |
| 59 | 0.32 | 0.27 | 0.25 | 0.25 | 0.24 |
| 58 | 0.29 | 0.24 | 0.23 | 0.22 | 0.21 |
| 57 | 0.25 | 0.21 | 0.20 | 0.19 | 0.19 |
| 56 | 0.22 | 0.18 | 0.17 | 0.16 | 0.16 |
| 55 | 0.18 | 0.15 | 0.14 | 0.13 | 0.13 |
| 54 | 0.14 | 0.12 | 0.11 | 0.11 | 0.11 |
| 53 | 0.11 | 0.09 | 0.08 | 0.08 | 0.08 |
| 52 | 0.07 | 0.06 | 0.06 | 0.05 | 0.05 |
| 51 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 |
| 50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: If the value of $Q_U$ or $Q_L$ does not correspond exactly to a figure in the table, use the next highest figure. For values of $Q_U$ or $Q_L$ less than zero, use the absolute value of the calculated $Q_U$ or $Q_L$ to determine the corresponding value for $P_U$ or $P_L$. The actual value of $P_U$ or $P_L$ equals 100 minus the table value for $P_U$ or $P_L$.

# Pay Factor Determination (continued)

- **Determine PWL(Density) (Quality Level)**

$$\text{quality level} = (P_U + P_L) - 100$$

- **Calculate the Pay Factor(Density)**

$$PF_D = 0.55 + 0.50 \times \frac{PWL_D}{100}$$

- **Where:**

| | | |
|---|---|---|
| $PF_D$ | = | pay factor for in-place density, rounded to the nearest 0.0001 |
| $PWL_D$ | = | percent within limits for in-place density |

# 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

# Pay Factor for PGAB (Table 401.5.3-1)

| Dynamic Shear (G*/Sinδ), original PGAB, High Grade temp., kPa | Dynamic Shear (G*/Sinδ), 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 |

# 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:**

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

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