



**SUPPLEMENTAL SPECIFICATIONS  
FOR  
FLEXIBLE PAVEMENT**

**Effective Date  
April 19, 2016**

**THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

**Replace all of Section 2303 of the Standard Specifications with the following:**

**2303.01 DESCRIPTION.**

- A.** Design, produce, place, and compact flexible paving mixtures using proper quality control. Construct to the dimensions specified in the contract documents.
- B.** A surface course is the top lift. An intermediate course is the next lower lift or lifts. Use intermediate course mixtures for leveling, strengthening, and wedge courses. A base course is the lift or lifts placed on a prepared subgrade or subbase.

**2303.02 MATERIALS.**

- A. Asphalt Binder.**

Use the specified Performance Graded (PG) asphalt binder meeting the requirements of Section 4137. For shoulder mixtures refer to Section 2122. For base widening mixtures refer to Section 2213. Adjustments to the contract binder grade may be required according to Article 2303.02, C, 6.
- B. Aggregates.**
  - 1. Individual Aggregates.**
    - a.** Use virgin mineral aggregate as specified in Section 4127.
    - b.** When specified, furnish friction aggregate from sources identified in Materials I.M. T203.
      - 1) Friction Classification L-2.**

Use a combined aggregate such that:

        - a)** At least 80% of the combined aggregate retained on the No. 4 sieve is Type 4 or better friction aggregate, and
        - b)** At least 25% of the combined aggregate retained on the No. 4 sieve is Type 2 or better friction aggregate, and
        - c)** For Interstates and all mixtures designed for 30,000,000 ESALS and higher, the fineness modulus of the combined Type 2 aggregate is at least 1.0. Calculations for fineness modulus are shown in Materials I.M. 501.
        - d)** On Interstates and all mixtures designed for 30,000,000 ESALS and higher, if

40% or more of the total aggregate is a limestone as defined in Materials I.M. T203, at least 30% of the combined aggregate retained on the No. 4 sieve is Type 2 or better friction aggregate

**2) Friction Classification L-3.**

Use a combined aggregate such that:

- a) At least 80% of the combined aggregate retained on the No. 4 sieve is Type 4 or better friction aggregate, and
- b) At least 45% of the combined aggregate retained on the No. 4 sieve is Type 3 or better friction aggregate, or if Type 2 is used in place of Type 3, at least 25% of the combined aggregate retained on the No. 4 sieve is Type 2.

**3) Friction Classification L-4.**

Use a combined aggregate such that at least 50% of the combined aggregate retained on the No. 4 sieve is Type 4 or better friction aggregate.

**2. Combined Aggregates.**

- a. Use a combined aggregate meeting the requirements in Materials I.M. 510.
- b. When mixtures include RAM, use a combined aggregate gradation consisting of a mixture of RAM aggregate and virgin aggregate.

**C. Recycled Asphalt Materials.**

1. RAM includes RAP and RAS. The designations Classified and Unclassified are exclusively for the use of RAP in HMA.
2. Identify each RAP stockpile and document Classified and Unclassified RAP stockpiles as directed in Materials I.M. 505. Do not add material to a Classified RAP stockpile without the approval of the District Materials Engineer.
3. The Engineer may reject a RAP stockpile for non-uniformity based on visual inspection. Work the stockpiles in such a manner that the materials removed are representative of a cross section of the pile.
4. Place stockpiles of RAP as directed in Materials I.M. 505. Do not use RAP stockpiles containing concrete chunks, grass, dirt, wood, metal, coal tar, or other foreign or environmentally restricted materials. RAP stockpiles may include PCC (not to exceed 10% of the stockpile) from patches or composite pavement that was milled as part of the asphalt pavement.
5. When RAP is taken from a project, or is furnished by the Contracting Authority, the contract documents will indicate quantity of RAP expected to be available and test information, if known. RAP not used in HMA becomes the property of the Contractor.
6. For mix design purposes, the Contracting Authority will test samples of the RAM. The aggregate gradation and amount of asphalt binder in the RAM will be based on the Contracting Authority's extraction tests. For mixtures containing RAM, adjust the contract binder grade as directed in Materials I.M. 510. No adjustments will be made to the contract unit price for required changes to the asphalt binder grade. RAP may be used in accordance with Materials I.M. 510 Appendix C. For surface mixtures, 70% of the total asphalt binder shall be virgin.
  - a. **Classified RAP.**
    - 1) Classified RAP is one of the following
      - RAP from a documented source.
      - RAP from an undocumented source meeting quality control sampling, testing, and reporting requirements in Materials I.M. 505. Material shall be tested at a lab designated by the Engineer according to Iowa Test Method 222 at no additional cost to the Contracting Authority.

- 2) Classified RAP may be used in mixtures for which the RAP aggregate meets the quality requirements for the mixture design per Materials I.M. 510 Appendix A.
- 3) When from a documented source, credit will be given for frictional aggregate and crushed particles used in the original pavement to be reclaimed as determined in the paving history (or mix design when paving history is unavailable).
- 4) For all other Classified RAP, credit for crushed particles shall be the percent of aggregate retained on the No. 8 sieve from Engineer's extraction test. No friction credit will be given.

**b. Unclassified RAP.**

- 1) Any stockpiled RAP not meeting the requirements of Classified RAP shall be designated as Unclassified RAP. No frictional aggregate credit or aggregate crushed particles credit will be given for Unclassified RAP.
  - 2) When an Unclassified RAP stockpile is characterized by sampling and testing for mix design, no material can be added to the stockpile until the project is completed.
7. Pre-consumer or post-consumer shingles that have been processed, sized, and ready for incorporation into an asphalt mixture constitute RAS material.
  8. Up to 5% RAS by weight of total aggregate may be used in the design and production of an asphalt mixture. The percentage of RAS used is considered part of the maximum allowable RAP percentage. Unless explicitly stated otherwise in this specification or Materials I.M. 505, use RAS according to the same requirements as prescribed for RAP material.
  9. RAS shall be certified from an approved supplier designated in Materials I.M. 506. Material processed prior to Iowa DOT source approval will not be certified.

**D. Flexible Paving Mixture.**

1. The JMF is the percentage of each material, including the asphalt binder, to be used in the asphalt mixture. Ensure the JMF gradation is within the control points specified for the particular mixture designated.
2. The basic asphalt binder content is the historical, nominal mixture asphalt binder content, expressed as percent by weight (mass) of the asphalt binder in the total mixture. Apply the values in Table 2303.03-1, based on mixture size and type.
3. If the asphalt binder demand for the combination of aggregates submitted for an acceptable mix design exceeds the basic asphalt binder content (see Table 2303.02-1) by more than 0.75%, include an economic evaluation with the mix design. For economic evaluation, provide an alternate mix design utilizing aggregates which results in an optimum binder content not exceeding basic asphalt binder content by more than 0.75% and documentation of costs associated with hauling both proposed aggregates and alternate aggregates to plant site. Alternate JMF shall meet requirements of Section 2303.

**Table 2303.02-1: Basic Asphalt Binder Content (%)**

Size	Aggregate Type	1 inch	3/4 inch	1/2 inch	3/8 inch
Intermediate and Surface	Type A	4.75	5.50	6.00	6.00
Intermediate and Surface	Type B	5.25	5.75	6.00	6.25
Base	Type B	5.25	6.00	6.00	6.25

4. Use a mixture design meeting gyratory design and mixture criteria corresponding to the design level specified in the contract documents. The Engineer may approve mixtures

substitutions meeting guidelines in Materials I.M. 511. When a commercial mix is specified, use a 1/2 inch 300K surface mixture or higher for JMF approval.

5. For shoulders placed as a separate operation refer to Section 2122. When paving the shoulder with the mainline the Contractor has the option to substitute the mainline intermediate or surface mixture for a specified shoulder mixture at the Contractor's expense.
6. For base widening refer to Section 2213. When an adjoining surface is designed for 300,000 ESALs or less and is paved during the same project, use a base mixture at same ESAL level used in surface mixture.
7. WMA refers to asphalt concrete mixtures produced at temperatures approximately 50°F or more below those typically used in production of HMA but no higher than that shown in Article 2303.03, C, 3, d, a. Temperature reductions may be achieved through additives or water injection systems.
8. Submit a mixture design complying with Materials I.M. 510. Propose both a production and a compaction temperature between 215°F and 280°F for WMA mixture designs.
9. Produce and place WMA mixtures meeting the same requirements established for HMA mixtures. Equivalent WMA mixtures may be substituted for HMA mixtures unless it is prohibited by the specifications.

**E. Other Materials.**

**1. Tack Coat.**

Tack coat may be SS-1, SS-1H, CSS-1, or CSS-1H. Do not mix CSS and SS grades. RC-70 and MC-70 may also be used after October 1, at the Contractor's option. An equivalent trackless product approved on AASHTO's Product Evaluation Listing (APEL) may be used when ambient temperatures are at least 55°F.

**2. Anti-strip Agent.**

- a. Perform a moisture sensitivity evaluation of the proposed asphalt mixture design in accordance with Materials I.M. 319 for the following mixtures when placed in travelled lanes:
  - 1) Mixtures for Interstate and Primary highways designed for 30,000,000 ESALS and higher
  - 2) Mixtures for Interstate and Primary highways containing quartzite, granite, or other siliceous (not a limestone or dolomite) aggregate obtained by crushing from ledge rock in at least 40% of the total aggregate (virgin and recycled) or at least 25% of the plus No. 4.For the purpose of evaluating moisture sensitivity of a proposed mix design, Contractor may test proposed JMF from plant produced material placed off-site at no additional cost to the Contracting Authority.
- b. Sample and test plant produced mixture for moisture susceptibility in accordance with Materials I.M. 204 Appendix F and Materials I.M. 319 for bid item plan quantities of more than 1000 tons as follows:
  - 1) For mixtures satisfying Article 2303.02, E, 2, a.
  - 2) For conditions satisfied in Article 2303.02, E, 2, f.
- c. Moisture susceptibility testing will not be required for base repair, patching, temporary pavement, or paved shoulders. Moisture susceptibility testing for mixture bid items of 1000 tons or less is only required on the mix design for mixtures satisfying Article 2303.02, E, 2, a.
- d. Use the following minimum stripping inflection point (SIP) requirements for plant produced material:

PG High Temperature, °C	SIP, Number of Passes <sup>1,2</sup>	
	< 3,000,000 ESALS	≥ 3,000,000 ESALS
58	10,000	14,000
64	10,000	14,000
70	10,000	14,000

Note 1: If ratio between creep slope and stripping slope as defined in Materials I.M 319 is less than 2.00, the SIP is invalid.

Note 2: Minimum SIP for mixtures placed as base widening is 5000 passes.

When notified of non-compliant results, the Engineer may suspend paving operations until an approved "significant mix change" is implemented.

- e. When the Contractor's mix design SIP results are below the minimum specified in Article 2303.02, E, 2, d, an anti-strip agent will be required. Plant produced material with anti-strip shall be tested to verify the minimum SIP is achieved.
  - f. The Engineer may require an evaluation of the test method in Materials I.M. 319 for plant produced mixture at any time.
  - g. The following anti-strip agents may be used:
    - 1) **Hydrated Lime.**  
Meet the requirements of AASHTO M 303, Type I or ASTM C 1097, Type S. Hydrated lime will not be considered part of the aggregate when determining the job mix formula.
    - 2) **Liquid Anti-strip Additives.**  
For each JMF, obtain approval for liquid anti-strip additives blended into the binder. Approval will be based on the following conditions:
      - a) The asphalt binder supplier provides test results that the additive does not negatively impact the asphalt binder properties, including short term and long term aged properties.
      - b) The design is to establish the additive rate that produces the maximum SIP value.
    - 3) **Polymer-based Liquid Aggregate Treatments.**  
For each JMF, obtain approval for polymer-based liquid aggregate treatments. Approval will be based on the design establishing the optimum additive rate that produces the maximum SIP value. See Materials I.M. 319 for additional information.
3. **Sand for Tack Coats.**  
Use sand meeting the requirements of Gradation No. 1 of the Aggregate Gradation Table in Article 4109.02.
4. **WMA Technologies.**  
Chemical additives, organic additives, zeolites, or water injection systems may be used at the rate established by the mixture design in the production of WMA. Once production of a bid item has begun with a WMA technology, continue its use throughout the remainder of the bid item's production unless otherwise approved by the District Materials Engineer.

### 2303.03 CONSTRUCTION.

#### A. General.

- 1. The Contractor is responsible for all aspects of the project.
- 2. Provide quality control management and testing, and maintain the quality characteristics specified.
  - a. Apply Article 2303.03, D to asphalt mixture bid items when the plan quantity is greater than 1000 tons.

- b. Apply Article 2303.03, E, for asphalt mixture bid items that have a plan quantity of 1000 tons or less as well as patching, detours, and temporary pavement bid items. For items bid in square yards, apply Article 2303.03, E when the plan quantity by weight (estimated with a unit weight of 145 pounds per cubic foot unless otherwise stated on the plans) does not exceed 1000 tons.

**B. Equipment.**

Use equipment meeting the requirements of Section 2001 with the following modifications:

**1. Plant Calibration.**

- a. Calibrate each plant scale and metering system before work on a contract begins. Use calibration equipment meeting the manufacturer's guidelines and Materials I.M. 514.
- b. The Engineer may waive calibration of permanent plant scales when a satisfactory operational history is available. The Engineer may require any scale or metering system to be recalibrated if operations indicate it is necessary.
- c. Make calibration data available at the plant.
- d. Calibrate each aggregate feed throughout an operating range wide enough to cover the proportion of that material required in the JMF. Make a new calibration each time there is a change in size or source of any aggregate being used.
- e. For continuous and drum mixing plants, calibrate the asphalt metering pump at the operating temperature and with the outlet under pressure equal to that occurring in normal operations.

**2. Paver.**

Apply Article 2001.19. Spreaders described in Article 2001.13, D, may be used to place paved shoulders. Spreaders used to place the final lift of paved shoulders shall meet additional requirements of Article 2001.19.

**3. Rollers.**

- a. For initial and intermediate rolling, use self-propelled, steel tired, pneumatic tired or vibratory rollers meeting the requirements of Article 2001.05, B, C, or F. Their weight or tire pressure may be adjusted when justified by conditions.
- b. For finish rolling, use self-propelled, steel tired rollers or vibratory rollers in the static mode that meet the requirements of Article 2001.05, B, or F.

**4. Scales.**

Apply Article 2001.07, B, to paving operations regardless of the method of measurement.

**C. Construction.**

**1. Maintenance of the Subgrade and Subbase.**

- a. Maintain completed subgrade and subbase to the required density, true cross section, and smooth condition, prior to and during subsequent construction activities.
- b. If rutting or any other damage occurs to the subgrade or subbase as a result of hauling operations, immediately repair the subgrade and subbase. Such repair will include, if necessary, removal and replacement, at no additional cost to the Contracting Authority.
- c. Should traffic by others authorized to do work on the project be specifically permitted by the Engineer to use loads which exceed the Contractor's established limit, the Contracting Authority will pay repair costs for repairs directed by the Engineer.

**2. Preparation of Existing Surfaces.**

**a. Cleaning.**

Clean and prepare existing surface according to Article 2212.03, B, 1.

**b. Tack Coats.**

- 1) Apply tack coats when the entire surface area on which the coat is to be applied is free of moisture. Do not apply them when the temperature on the surface being covered is less than 25°F.
- 2) Place a tack coat to form a continuous, uniform film on the area to be covered. Tack coat may be diluted with water at a 1:1 ratio to improve application. Unless directed otherwise, spread tack coat at the following undiluted rates:
  - New HMA Surface: 0.03 to 0.05 gallon per square yard
  - Milled HMA Surface: 0.05 to 0.07 gallon per square yard
  - PCC/Existing HMA Surface: 0.04 to 0.06 gallon per square yard
- 3) Tack the vertical face of exposed, longitudinal joints as a separate operation at a rate from 0.10 to 0.15 gallon per square yard. Tack before the adjoining lift is placed. Lightly paint or spray vertical surfaces of all fixtures, curbs, bridges, or cold mixture with which the hot mixture will come in contact to facilitate a tight joint with the fresh mixture.
- 4) Limit tack coat application lengths to minimize inconvenience to the public. Keep applications within the hot mixture placing work area that is controlled by flaggers at each end. Plan applications so they will be covered with hot mixture when the work area is opened to traffic at the end of the days' work.
- 5) Allow tack coat to adequately cure prior to placement of HMA. If tack coat surface becomes dirty from weather or traffic, thoroughly clean and, if necessary, retack. A light application of sand cover may also be required for excessive application rates, breakdowns, and short sections remaining at the end of a day's run.

**3. Handling, Production, and Delivery.**

Ensure plant operation complies with the following requirements:

**a. Handling Mineral Aggregate and RAM.**

Apply Materials I.M. 505 and Materials I.M. 508.

**b. Handling Asphalt Binder.**

Maintain asphalt binder temperature between 260°F and 330°F. Heat modified asphalt binder according to the supplier's recommendations.

**c. Handling Anti-strip Agents.****1) Hydrated Lime.****a) Added to a Drum Mixer.**

(1) Add hydrated lime at the rate of 0.75% by weight of the total aggregate (virgin and RAM) for Interstate and Primary projects. Add hydrated lime to a drum mixer using one of the following methods:

- (a) Add to virgin aggregate on the primary feed belt, as a lime water slurry.
- (b) Add to the outer drum of a double drum system away from heated gas flow and prior to the addition of the virgin asphalt binder.

(2) Alternative methods for mixing will be allowed only with the Engineer's approval. Do not introduce hydrated lime directly into a single drum mixer by blowing or by auger.

**b) Added to a Batch Plant.**

Add hydrated lime at the rate of 0.5% by weight of the total aggregate (virgin and RAM) for Interstate and Primary projects. Introduce it to a batch plant using one of the methods below. In any case, introduce the lime prior to the start of the dry mix cycle.

- (1) Place on the recycle belt which leads directly into the weigh hopper.
- (2) Add directly into the pugmill.
- (3) Add directly into the hot aggregate elevator into the hot aggregate stream.

**c) Added to the Aggregate Stockpile.**

Add hydrated lime at a rate established by the optimization of the SIP as determined by Materials I.M. 319. Add it to the source aggregates defined in Article 2303.02, E, 2, thoroughly mixed with sufficient moisture to achieve aggregate coating, and then place in the stockpile.

**2) Liquid.**

- a) When liquid anti-strip additives are used, employ equipment complying with the anti-strip manufacturer's recommended practice to store, measure, and blend the additive with the binder.
- b) The additive may be injected into the asphalt binder by the asphalt supplier or the Contractor. If the Contractor elects to add the liquid anti-strip agent, they assume the material certification responsibilities of the asphalt binder supplier. Ensure the shipping ticket reports the type and amount of additive and time of injection.
- c) Ensure the asphalt supplier provides the Contractor and Engineer with the shelf life criteria defining when the anti-strip additive maintains its effectiveness. Do not use binder that has exceeded the shelf life criteria.
- d) When using polymer-based aggregate treatment, comply with the manufacturer's recommended specifications and guidelines.

**d. Production of Hot Mix Asphalt Mixtures.**

- 1) Regulate the exact proportions of the various materials to be within the limits specified to produce a satisfactory asphalt coating and mixture.
- 2) Do not allow the temperature of the mixtures to fall outside the following parameters:
  - a) Keep the production temperature of WMA mixtures between 215°F and 280°F until placed on the grade. Maximum production temperature for WMA is 330°F after October 1st.
  - b) Do not produce WMA mixtures more than 10°F below the target temperature designated in the JMF without the approval of the Engineer.
  - c) Keep the production temperature of HMA mixtures between 225°F and 330°F until placed on the grade. Do not discharge HMA into the hopper when its temperature is less than:
    - (1) 245°F for a nominal layer thickness of 1 1/2 inches or less, or
    - (2) 225°F for a nominal layer thickness of more than 1 1/2 inches.
  - d) Flexible paving mixtures not meeting these requirements will be rejected.
  - e) Production temperature limits apply starting at point of discharge from mixer.
- 3) Minimize segregation to the extent that it cannot be visibly observed in the compacted surface.
- 4) Apply only approved release agents to trucks and equipment, as specified in Article 2001.01.
- 5) Except for an unavoidable delay or breakdown, provide continuous and uniform delivery of hot HMA to any individual spreading unit.

**4. Placement.**

- a. Clean each lift according to Article 2212.03, B, 1. If necessary, re-tack.
- b. Prior to placing the final lift, correct bumps or other significant irregularities that appear or are evident in the intermediate course or other lower course.
- c. Do not place HMA mixtures under the following circumstances:
  - 1) On a wet or damp surface.
  - 2) When road surface temperature is less than that shown in Tables 2303.03-1 and 2303.03-2.

**Table 2303.03-1: Base and Intermediate Course Lifts of Asphalt Mixtures**

Nominal Thickness - inches	Road Surface Temperature, °F
1 1/2	40
2 – 3	35
Over 3	35

**Table 2303.03-2: Surface Course Lifts of Asphalt Mixtures**

Nominal Thickness - inches	Road Surface Temperature, °F
1	HMA: 50 / WMA: 40



1 1/2	HMA: 45 / WMA: 40
2 and greater	40

- d. The Engineer may further limit placement if, in the Engineer's judgment, other conditions are detrimental to quality work.
- e. Maintain a straight paving edge alignment. Correct edge alignment irregularities immediately.
- f. Base the minimum layer thickness on Table 2303.03-3. Minimum layer thickness does not apply to leveling/scratch courses.

**Table 2303.03-3: Minimum Lift Thickness**

Design Mix Size - inches	Minimum Lift Thickness - inches
3/8	1
1/2	1 1/2
3/4	2
1	3

- g. Complete each layer to full width before placing succeeding layers.
  - h. While operating on the road surface, do not use kerosene, distillate, other petroleum fractions, or other solvents, for cleaning hand tools or for spraying the paver hopper. Do not carry containers of cleaning solution on or near the paver. When a solvent is used, do not use the paver for at least 5 hours after cleaning.
  - i. After spreading, carefully smooth to remove all segregated aggregate and marks.
  - j. When placing two adjacent lanes, pave no more than 1 day of rated plant production before paving the adjacent lane(s). Place the adjacent lane to match the first lane during the next day of plant production.
  - k. At the close of each working day, clear all construction equipment from the roadbed.
  - l. Prior to opening a lane to traffic, place fillets, safety edge, or full width granular shoulders according to Article 2121.03, C, 4. Place the material adjacent to and equal in thickness to the resurfacing. Fillet removal is incidental to the HMA mixture.
- 5. Compaction.**
- a. **General.**
    - 1) Promptly and thoroughly compact each layer. Use mechanical tampers for areas inaccessible to the rollers.
    - 2) Use a rolling procedure and compactive effort that will produce a surface free of ridges, marks, or bumps.
    - 3) The quality characteristic is in-place air void content and will be based on the theoretical maximum specific gravity ( $G_{mm}$ ) for that day's mixture.
  - b. **Class I Compaction.**
    - 1) **Applications.**  
Use Class I compaction for all courses for the traffic lanes, ramps, and loops on all roadways.
    - 2) **Test Strip Construction for Class I Compaction.**
      - a) For the purpose of evaluating properties of the asphalt mixtures and for evaluating an effective rolling pattern:
        - (1) Construct a test strip of the surface mixture prior to its placement on the surface course for Interstate highways, Primary highways, and ramps connecting Interstate and Primary highways.
        - (2) Construct a test strip of the intermediate mixture at the start of its placement on the intermediate course for Interstate highways, interstate-to-interstate ramps.
        - (3) Test strips for other mixtures may be constructed, but are not required.
      - b) Test strips are not required when the entire production of the mixture bid item is placed in a single day.

- c) The quantity of mixture subject to the test strip production, will be pre-established with the Engineer and limited to a half day's production
- d) When the contract documents specify both intermediate and surface courses and a test strip is required, place a surface course test strip in lieu of intermediate mixture in a section of the intermediate course prior to actual surface course placement. If surface course and intermediate course are not placed the same calendar year, then place test strip at beginning of surface mix production.
- e) Only one test strip will be allowed for each mixture and shall be declared to the Engineer prior to placement. The Engineer may require additional test strips if a complying HMA mixture or rolling pattern was not established.
- f) Use test strip production control that meets the requirements of Article 2303.03, D, 3, b. The test strip will be an independent lot. Determine sublots in accordance with Table 2303.03-5.

**c. Class II Compaction.**

Intended for paved shoulders, temporary crossovers, onsite detours, base widening in a non-travel lane and other situations where Class I is not specified.

- 1) Establish a rolling pattern to verify adequate density.
- 2) At the Engineer's option, cores or gauge readings at the frequency designated in Materials I.M. 204 Appendix F for the first day of placement will be used. The Engineer may modify the sample size and frequency provided compaction is thorough and effective.
- 3) The Engineer will accept the rolling pattern based on the average test results. When the average field voids is less than or equal to 8.0%, the pattern is considered thorough and effective.
- 4) When the average field voids exceeds 8.0%, modify the rolling pattern. The Engineer may require additional testing until thorough and effective compaction is achieved.
- 5) For areas inaccessible to rollers, use mechanical tampers or other approved compaction methods.

**6. Joints and Runouts.**

- a. Construct longitudinal joints for courses on resurfacing projects within 3 inches of the existing longitudinal joint. Construct longitudinal joints to secure complete joint closure and avoid bridging of the roller. When the joint is completed, the hot side shall be no more than 1/4 inch higher than the cold side.
- b. Saw transverse construction joint to a straight line at right angles to the center line to provide a full thickness vertical edge before continuing paving.
- c. Place temporary runouts according to road standards. Remove temporary runouts before commencing paving. Runout removal is incidental to the HMA mixture.

**7. Miscellaneous Operations.**

**a. Leveling and Strengthening Courses.**

- 1) Use the same mixture specified for the base or intermediate course.
- 2) Compact leveling courses and intermediate mixtures placed as leveling/scratch courses (less than or equal to 1 inch plan thickness) using pneumatic and vibratory rollers.

**b. Wedge Courses.**

- 1) Use the base or intermediate mixture to construct wedge courses used to secure desired curve super-elevation. When possible, spread using a finishing machine.
- 2) Place wedge courses in compacted layers no thicker than 3 inches.
- 3) On super-elevated curves which require wedge course placement, stage the shoulder construction. After completing each day's wedge placement operations and prior to suspending that day's construction activities, construct a full width shoulder on the high side up to the completed wedge course elevation. Shoulder construction staging will be considered incidental to shoulder construction.
- 4) Use Class II compaction.

**c. Fixtures in the Pavement Surface.**

- 1) Adjust manholes, intakes, valve boxes, or other fixtures encountered within the area to be covered by HMA to conform to the final adjacent finished surface. Payment for adjustment of manholes or intakes will be per Section 2435. Payment for adjustment of valve boxes and other fixtures will be per Section 2554. Unless specified otherwise in the plans, adjust fixtures:
  - Between placing the surface course and the layer preceding the surface course, or
  - After placing the surface course using a composite patch or PCC patch.
- 2) Use PCC and HMA patch material complying with the requirements of Section 2529. Make patches large enough to accommodate the structure being adjusted.
- 3) Unless otherwise approved, construct patches to be square. Orient them diagonally to the direction of traffic flow. Ensure the elevation of the adjusted fixture and patch does not differ from the elevation of the surrounding pavement surface by more than 1/4 inch.
- 4) When shaping and compacting resurfacing near inlets to storm sewer intakes, shape to ensure maximum drainage into intakes.

**d. Fillets for Intersecting Roads and Driveways.**

- 1) Shape, remove loose material, and tack the surface adjacent to the pavement. On the tack coated surface, place and compact the hot mixture in layers equal to the adjacent layer. Extend from the edge of the pavement as shown on the plans.
- 2) Place and compact fillets at intersecting roads at the same time as the adjacent layer.
- 3) Entrance fillets that are 8 feet or wider may be placed as a separate operation. Pave fillets which are 8 feet or wider with a self-propelled finishing machine described in Article 2001.19.
- 4) The Engineer may approve other equipment for placement of fillets, based on a demonstration of satisfactory results.

**e. Stop Sign Rumble Strips.**

If the plans include the bid item Rumble Strip Panel (In Full Depth Patch), apply Section 2529. To meet the requirements of placing Stop Sign Rumble Strips before opening roadway sections to traffic, the Contractor may construct temporary rumble strip panels meeting the final pattern and location of the Stop Sign Rumble Strip indicated in the plans

**f. Paved HMA Shoulders.**

- 1) Compact paved HMA shoulders using one of the following methods:
  - a) Class II compaction (Article 2303.03, C, 5, c),
  - b) Same rolling pattern established for adjoining mainline or ramp driving lane, as determined by density coring.
- 2) Shoulder area will not be included in PWL calculations for field voids on adjoining mainline or ramp driving lane. A price adjustment may be applied to shoulder areas that do not adhere to the established roller pattern.

**D. Quality Assurance Program.****1. General.**

Except for small quantities as defined in Article 2303.03, A, 2, follow the procedures and meet the criteria established in Articles 2303.02 and 2303.03, B, Section 2521, Materials I.M. 510 and Materials I.M. 511.

**2. Mix Design - Job Mix Formula.**

- a. The Contractor is responsible for the JMF for each mixture.
- b. Submit a completed JMF, using the computer format of Form 956, for approval to the materials lab designated by the Contracting Authority. Submit supporting documentation demonstrating the design process was followed and how the recommended JMF was determined. Include an economic evaluation when required. Include trial and final proposed aggregate proportions (Form 955) and corresponding gyratory data. In addition, submit sufficient loose mixture and individual material samples for approval of the design.

- c. Personnel preparing the JMF shall be Iowa DOT certified in HMA Level II.
- d. An approved JMF will be required prior to beginning plant production.

**3. Plant Production.**

**a. General.**

- 1) All of the following qualify as a “significant mix change”:
  - A single occurrence of an aggregate interchange of greater than 5%.
  - An aggregate interchange of greater than 5% from last approved JMF.
  - A single occurrence of an asphalt content change greater than 0.2%.
  - An asphalt content change greater than 0.2% from last approved JMF.
  - A deletion or introduction of a new material into the mix.
  - A change of additive dosage rate.
  - A change of binder, aggregate, or additive source.

**b. Production Control.**

- 1) After the JMF is established, the combined aggregate gradation furnished for the project, asphalt binder content, asphalt film thickness, and laboratory air voids should consistently comply with the JMF target values and design criteria in Materials I.M. 510 Appendix A. Control them within the production tolerances given in Table 2303.03-4.

**Table 2303.03-4: Production Tolerances**

Measured Characteristic	Target Value (%)	Specification Tolerance (%) <sup>(a)</sup>
Cold feed gradation No. 4 and larger sieves	by JMF	± 7.0
Cold feed gradation No. 8	by JMF	± 5.0
Cold feed gradation No. 30	by JMF	± 4.0
Cold feed gradation No. 200	by JMF	± 2.0
Field laboratory air voids absolute deviation from target <sup>(b)</sup>	0.0	≤ 1.0
Daily asphalt binder content	by JMF	± 0.3
(a) Based on single test unless noted otherwise.		
(b) When lab voids acceptance is not based on PWL.		

- 2) The gyratory mix design gradation control points for the size mixture designated in the project plans will not apply to plant production control.
- 3) Adjustments to the JMF target gradation and asphalt binder content values may be made.
  - a) The Contractor determines from quality control testing that adjustments are necessary to achieve the specified properties.
  - b) Consult with the Engineer regarding adjustments to the JMF.
  - c) Notify the Engineer if the average daily gradation for a mixture bid item is outside the production tolerances. If other production tolerances and mixture requirements of Materials I.M. 510 Appendix A are acceptable, a change in gradation target can be requested.
  - d) The Contractor’s adjustment recommendations prevail provided all specifications and established mix criteria are being met for plant production.
- 4) Calculate estimated film thickness every day of production according to Materials I.M. 501. Compliance is based on limits in Materials I.M. 510 Appendix A.
- 5) Calculate absolute deviation from target lab voids according to Materials I.M. 501. To determine the moving average absolute deviation from target laboratory voids, use the average of the last four individual sample absolute deviations from target laboratory voids.

- 6) Notify the Engineer whenever the process approaches a specification tolerance limit. When acceptance for lab voids is not based on PWL, cease operations when the moving average point for absolute deviation from target lab voids is outside the specification tolerance limit. Assume responsibility to cease operations, including not incorporating material which has not been placed. Do not start the production process again until notifying the Engineer of the corrective action proposed. The moving AAD may restart only in the event of a mandatory plant shutdown for failure to maintain the average within the production tolerance.
- 7) After the second occurrence of the moving AAD falling outside the specification tolerance limit, the Engineer may declare the lot or portions of the lot defective.

#### 4. Sampling and Testing.

##### a. General.

- 1) Perform sampling and testing to provide the quality control of the mixture during plant production. Certified Plant Inspection according to Section 2521 is required.
- 2) Personnel involved in sampling and testing on both verification and quality control shall be Iowa DOT certified for the duties performed per Materials I.M. 213.
- 3) Provide easy and safe access for Iowa DOT staff to the location in the plant where samples are taken.
- 4) Maintain and calibrate the quality control testing equipment using prescribed procedures. Sample and test according to the specified procedures as listed in the applicable Materials I.M. and Specifications. When the results from a Contractor's quality control lab are used as part of product acceptance, the Contractor's quality control lab is required to be qualified.
- 5) Identify, store, and retain all quality control samples and field lab gyratory specimens used for acceptance until the lot is accepted.
- 6) Obtain verification samples at random times as directed and witnessed by the Engineer according to Materials I.M. 204 Appendix F. Secure all verification samples according to Materials I.M. 205 Appendix A. Store verification samples for the Contracting Authority until delivery to the Contracting Authority's lab.
- 7) Deliver the Plant Report to the Engineer and the designated district materials laboratory daily. At project completion, provide the Engineer a copy of the reports, charts, and other electronic file(s) containing project information generated during the progress of the work.

##### b. Asphalt Binder.

Sample and test asphalt binder to verify the quality of the binder grade. Do not sample when daily production is less than 100 tons of mixture.

##### c. Tack Material.

Sample and test asphalt emulsions to verify residual asphalt content.

##### d. Aggregate Gradation.

- 1) Use cold feed or ignition oven gradation for aggregate gradation control to assure materials are being proportioned according to the specifications.
- 2) Take a minimum of one aggregate gradation for each day's production that exceeds 100 tons of mixture. When more than one sample in a day's production is tested, use the average gradation to determine compliance of the daily lot.
- 3) Engineer will verify Contractor gradation with an ignition oven or a split cold feed sample. For ignition oven validation, split a cold feed sample with the Engineer to determine the need for a correction factor according to Materials I.M. 511. The Engineer may require additional cold feed split samples.

##### e. Uncompacted Asphalt Mixture.

- 1) Sample the loose mixture according to Materials I.M. 322.
- 2) Modify sampling location to include placement with mix stored from a previous day's production.
- 3) The number of daily samples is defined in Table 2303.03-5 based on the day's estimated production. See Materials I.M. 511 for determining sample locations.

**Table 2303.03-5: Uncompacted Mixture Sampling**

Estimated Daily Production, Tons	Number of Samples
101-500	1
501-1250	2
1251-2000	3
2001-4500	4
Over 4500	5

- 4) Do not take samples from the first 100 tons of mix produced each day or the first 100 tons of mix following a significant mix change. When paving operations are staged so each day of placement is less than 100 tons for the entire production of the bid item, establish a sampling plan with the Engineer that includes a minimum of one sample per 2500 tons.
  - 5) Split samples for specimen preparation according to Materials I.M. 357.
  - 6) Paired sampling may also be accomplished by taking a bulk sample and immediately splitting the sample according to Materials I.M. 322 on the grade.
  - 7) Test the quality control sample of each production paired sample as follows:
    - a) Prepare and compact two gyratory specimens according to Materials I.M. 325G.
    - b) Determine the bulk specific gravity of compacted mixture ( $G_{mb}$ ) at  $N_{design}$  for each specimen according to Materials I.M. 321. Average the results.
    - c) Determine the Theoretical Maximum Specific Gravity ( $G_{mm}$ ) of the uncompacted mixture according to Materials I.M. 350.
    - d) Determine laboratory air voids for each sample according to Materials I.M. 501. Use the target laboratory voids listed in Materials I.M. 510 Appendix A unless otherwise specified in the contract documents.
- f. Compacted Pavement Cores.**
- 1) The Engineer will determine the core locations. The length laid in each lot will be divided into approximately equal sublots. Obtain one sample at a random location in each subplot. Determine a new random location for the subplot when the designated core location falls on a runout taper at an existing pavement, bridge, or bridge approach section where the thickness is less than the design thickness.
  - 2) Take samples from the compacted mixture and test no later than the next working day following placement and compaction.
  - 3) Restore the surfaces the same day. Dry, fill with the same material, and properly compact core holes.
  - 4) Pavement core samples will be identified, taken possession of by the Engineer, and delivered to the Contractor's quality control field laboratory.
  - 5) The Engineer may either:
    - Transport the cores directly to the lab, or
    - Secure the cores and allow the Contractor to transport the cores to the lab.
  - 6) Prepare and test the cores according to Materials I.M. 320, 321, and 337.
  - 7) Cut and trim samples under the direction of and witnessed by the Engineer for tests of  $G_{mb}$ , thickness, or composition by using a power driven masonry saw.
  - 8) The compacted HMA pavement will be tested in a timely manner by the Engineer's personnel. The Engineer will test each lot of cores at the Contractor's field quality control laboratory. Cores may also be tested by the Contractor; however, the Contractor's test results will not be used for material acceptance.
- 5. Verification and Independent Assurance Testing.**
- a. The Contractor's quality control test results will be validated by the Engineer's verification test results on a regular basis using guidelines and tolerances set forth in Materials I.M. 216 and Materials I.M. 511.
  - b. If the Engineer's verification test results validate the Contractor's test results, the Contractor's results will be used for material acceptance. Disputes between the Contractor's and Engineer's test results will be resolved according to Materials I.M. 511.

- c. The Engineer will randomly select one or more of the daily production verification samples. Some or all of the samples selected will be tested in the materials laboratory designated by the Engineer. The Engineer will use the verification test results to determine if the Contractor's test results can be used for acceptance.
- d. Personnel and laboratory equipment performing tests used in the acceptance of material are required to have participated in the statewide Independent Assurance Program according to Materials I.M. 207.

**6. Acceptance of Asphalt Mixtures.**

**a. Lab Voids.**

- 1) Use the following methods of acceptance for laboratory voids:
  - a) For base widening, ramps and loops, shoulders, recreational trails, and other mixture bid items not placed in travel lanes of a permanent pavement, acceptance for laboratory voids will be based on a moving average absolute deviation (AAD) from target as defined in Materials I.M. 501. Use the production tolerance in Table 2303.03-4. During a day's production, if more than 100 tons of the bid item is placed in an area not listed above, apply Article 2303.03, D, 6, b, for entire production of bid item.
  - b) Determine PWL for each lot as defined in Materials I.M. 501. The PWL limits shall be +/- 1.0% from the target air voids. Each mixture bid item will constitute a lot. Lot size is defined as follows:
    - (1) No less than eight and no more than 15 sequential tests will constitute a lot (exceptions stated below).
    - (2) After the eighth test, all subsequent samples collected will also be included in the lot up to a maximum of 15.
    - (3) Once a lot has been established with at least eight tests, a new lot will begin the day following the fifteenth sample. Lots shall not contain partial days. When the fifteenth sample is reached, include all samples taken that day in the lot.
    - (4) If the bid item's production has ended and fewer than eight tests are available, those tests may be combined with the previous lot provided the maximum lot size has not already been reached. When combining results, if the day to be combined contains the fifteenth sample, include all samples for that day. Do not combine partial day's results.
    - (5) If samples cannot be combined with the previous lot due to maximum lot size restrictions or if fewer than eight tests are available for the entire production of a bid item, combine those tests into a single lot and use the AAD analysis in Materials I.M. 501.
    - (6) Test strips will be considered a separate lot.
    - (7) When the same mix type is produced for multiple bid items in one day from a single plant and the production going to each item exceeds 500 tons, assign all box samples to each bid item's existing lot for lab voids. In addition, assign the quantity of each bid item produced to its respective lot.
    - (8) When the same mix type is placed in both PWL and AAD areas in a single day on a single project, include all samples for that day in the PWL lot as well as the quantity of the mixture bid item produced and placed in the PWL area.
- 2) Determine the pay factor using the AAD procedure described in Materials I.M. 501 for mix in a PWL lot which is produced at irregular intervals and placed in irregular areas. The following items qualify as such and shall be combined into a single lot:
  - Asphalt mixture produced and placed on gores, detours, cross-overs, temporary pavements, turning lanes, and fillets,
  - Asphalt mixture produced and placed on ramps
  - Asphalt mixture produced and placed on shoulders.

To be considered irregular, the production rate for mixture bid items described above is not to exceed 1000 tons in a single day.

**b. Field Voids.**

**1) Class I.**

- a) A lot is considered to be one layer of one mixture bid item placed during a day's operation. The Engineer may approve classifying multiple layers of construction placed during a single day as a lot provided only one mixture was used.
- b) For the following situations sampling for field voids may be waived by the Engineer provided compaction has been thorough and effective, or sampling may be modified by mutual agreement to include more than one day's production provided samples are taken prior to trafficking:
  - When the day's operation is not more than 2500 square yards excluding areas deducted from the field voids lot,
  - When the day's operation is not more than 500 tons excluding quantities deducted from the field voids lot,
  - When the mixture is being placed in irregular areas, or
  - When placing strengthening courses.

- c) If a sample is damaged or measures less than 70% or more than 150% of the intended thickness, an alternate sampling location will be determined and used. Take samples from no less than 1 foot from the unconfined edge of a given pass of the placing equipment, from run-outs, or from day's work joints or structures.

- d) Use the following methods of acceptance for field voids:

**(1) For mixture bid items placed in the following areas:**

- Base widening placed in a travel lane,
- Ramps,
- Bridge approaches placed as a separate operation,
- Non-interstate travel lanes intended to be in service for fewer than 12 months,
- State Park and Institutional roadways,
- Recreational trails, and
- Irregular areas identified by the Engineer that may include areas not suitable for continuous paving,

The Engineer will accept the field voids lot based on the average test results or an established effective rolling pattern when approved by the Engineer. Do not exceed 8.0% average field voids. The Engineer may modify the sample size and frequency provided compaction is thorough and effective. The Engineer may apply the pay schedule in Article 2303.05, A, 3, b, 3, to areas where thorough and effective compaction is not achieved.

**(2) For all other areas of Class I compaction, determine PWL as defined in Materials I.M. 501. The PWL limits shall be between 91.5% of  $G_{mm}$  (8.5% voids) and 98.5% of  $G_{mm}$  (3.5% voids). Use maximum specific gravity ( $G_{mm}$ ) results in field voids calculations as follows:**

- (a)** When cores represent one day's production and more than one  $G_{mm}$  test result is available, use the average  $G_{mm}$  in the field voids calculation for all cores.
- (b)** When cores represent one day's production and only one  $G_{mm}$  test result is available, use the single  $G_{mm}$  test result in the field voids calculation for all cores.
- (c)** When the cores represent more than one day's production, use the average of all  $G_{mm}$  test results from all days corresponding with the cores.
- e)** When the PWL falls below 80.0, use the procedure outlined in Materials I.M. 501 to identify outliers with 1.80 as the quality index criterion. Only one core may be considered an outlier in a single lot. If an outlier is identified, recalculate the PWL with the results of the remaining cores and determine whether the PWL is improved. Use the larger of the original and recalculated PWL to determine the pay factor.



- 2) For Class II apply Article 2303.03, C, 5, c.
- c. Asphalt Film Thickness.**  
A lot is considered one day's production of one mixture. When film thickness falls outside the limits in Materials I.M. 510 Appendix A, see Article 2303.05, A, 3, c, for payment adjustment.
- d. Thickness.**
- 1) The Engineer will measure cores, exclusive of thin surface treatments, according to Materials I.M. 337. Sampling frequency and lot definitions are as follows:
    - a) Class I Compaction.**  
The Engineer will obtain and test samples for each lot according to Materials I.M. 204 Appendix F. Density cores sampled as part of a field voids lot will be combined into daily lots based on cores' intended thickness. Samples for thickness not tested for  $G_{mb}$ , because they are less than 70% of the intended thickness, are included for thickness. In these particular instances, do not measure the thickness of additional sufficiently thick samples used to determine field voids. When measuring density of top lift from a full depth core, measure thickness before trimming core for density testing.
    - b) Class II Compaction.**  
The Engineer will obtain and test samples full depth once the final lift is placed. The lot shall be defined as the length of a day's production of the final lift. Take a minimum eight cores from each lot. The Engineer may approve classifying multiple days of construction as a lot.
  - 2) Provided there is reasonable assurance that the pavement complies with the required thickness, the Engineer may waive sampling for thickness for the following situations:
    - a)** When an alternate method is deployed by the Engineer
    - b)** When the day's operation is 2500 square yards or less.
    - c)** When the mixture is being placed in irregular areas.
    - d)** When the mixture is being placed next to structures.
  - 3) When the quality index falls below 0.00, the Engineer may declare the lot or parts of the lot defective. If the final lift has not been placed, the Engineer may approve additional thickness to be placed on succeeding lifts to ensure a final grade as intended. The unit price of the defective lot will be used for payment of the additional material.
- e. Smoothness.**  
Construct pavement to have a smooth riding surface according to the following:
- 1) Apply Section 2317 to HMA surface mixture bid items of a Primary project if any individual HMA mixture bid item is 1000 tons or greater or 5000 square yards or greater. Apply Section 2316 to all other Primary projects with a surface course and when specifically required for other projects.
  - 2) When neither Section 2316 nor Section 2317 is applied to a project, the Engineer may check the riding surface for defects using one of the following criteria:
    - The surface shall not deviate from a straight line by more than 1/8 inch in 10 feet when measured longitudinally with a 10 foot straightedge.
    - The surface shall not contain any bump or dip exceeding 1/2 inch over a 25 foot length when measured with a method in Materials I.M. 341.
 The Engineer may either require the defects be corrected according to Article 2316.03, B, 2, or apply a price adjustment.

## **E. Quality Control for Small HMA Paving Quantities.**

### **1. General.**

For small quantities, a lot will be the entire quantity of each HMA mixture bid item.

### **2. Mix Design.**

Prepare the JMF. Prior to production, obtain the Engineer's approval for the JMF. Comply with Article 2303.02 and Materials I.M. 510.

For mixtures meeting the criteria in Article 2303.02, E, 2, a:

- a. An anti-stripping agent is required when the optimum dosage is greater than 0%.
- b. Use Materials I.M. 319 to optimize the design dosage rate.
- c. When prior-approved designs have demonstrated acceptable field SIP values, the anti-stripping agent and dosage from the JMF may be used in lieu of optimization testing.

**3. Plant Production.**

- a. Ensure production plant calibration for the JMF is current and no more than 12 months old.
- b. Use certified asphalt binder and approved aggregate sources meeting the JMF. Ensure the plant maintains an asphalt binder log to track the date and time of binder delivery. Ensure delivery tickets identify the JMF.
- c. Monitor the quality control test results and make adjustments to keep the mixture near the target JMF values.

**4. Sampling and Testing.**

**a. Field Voids.**

- 1) Take compacted mixture  $G_{mb}$  measurements, except when Class II compaction is specified, no later than the next working day following placement and compaction.
- 2) The Engineer may accept the void content of the compacted layer based on cores or calculations from density gauge measurements. The Engineer may waive field void sampling provided the compaction has been thorough and effective.
- 3) PWL for field voids will not apply to small quantities.

**b. Lab Voids.**

Material sampling and testing is for production quality control. Acceptance of mixture is based on Contractor certification. Sampling and testing of uncompacted mixture is only required for mechanically placed mixture. Sample and test a minimum of one uncompacted mixture sample according to the Standard Specifications and Materials I.M.s using certified technicians and qualified testing equipment. The Engineer may approve alternative sampling procedures or may waive sampling of uncompacted mix and gradation if Contractor can provide plant reports from other recent project(s) demonstrating the JMF has been produced within specification. Take the sample between the first 100 to 200 tons of production. No split samples for agency verification testing are required.

**c. Binder.**

No binder sampling or testing is required.

**d. Moisture Sensitivity.**

Moisture susceptibility testing on plant produced mixture is not required.

**e. Gradation.**

Perform a minimum of one aggregate gradation.

**5. Certification.**

- a. When the production tolerances in Table 2303.03-4 are not met, payment may be adjusted according to Article 1105.04.
- b. When the production tolerances are met, provide a certification for the production of any mixture in which the requirements in this article are applied. Place the test results and the following certification statement on the Daily Plant Report.  
"The mixture contains certified asphalt binder and approved aggregate as specified in the approved mix design and was produced in compliance with the provisions of Article 2303.03, E."
- c. The Daily Plant Report may be submitted at the end of the project for all certified quantities, or submitted at intervals for portions of the certified quantity.

**2303.04 METHOD OF MEASUREMENT.****A. Hot Mix Asphalt Mixture.****1. General.**

- a. Removal of fillets is incidental to the contract unit price for the mixture.
- b. If the Contractor chooses to place intermediate or surface mixture in lieu of base for the outside shoulders, the quantity will be calculated from the pavement and shoulder template. If placed as a separate operation, the quantity will be calculated from scale tickets. If the substitute mixture placed on the shoulder is for an intermediate course fillet only, include the quantity in the fillet for payment in the quantity placed in the adjacent intermediate course.
- c. Payment for the quality control requirements for small quantities will not be measured separately.

**2. Measurement by Weight.**

- a. The quantity of the type specified, expressed in tons, will be determined from the weight of individual loads, including fillets, measured to the nearest 0.01 tons.
- b. Loads may be weighed in trucks, weigh hoppers, or from the weight from batch plants computed by count of batches in each truck and batch weight. Article 2001.07 applies. Segregate the weights of various loads into the quantities for each pay item.

**3. Measurement by Area.**

- a. The quantity of the type specified, expressed in square yards, will be shown in the contract documents to the nearest 0.1 square yard. The area of manholes, intakes, or other fixtures will not be deducted from the measured pavement area.
- b. When constructing shoulders on a basis of payment of square yards, inspection of the profile and elevation will be based on the completed work relative to the pavement edge. The Contractor is responsible for the profile and elevation of the subgrade and for thickness.

**B. Asphalt Binder.**

1. Measure the amount of asphalt binder by in-line flow meter reading, according to Article 2001.07, B.
2. Compute the asphalt binder quantity added to the storage tank using a supplier certified transport ticket accompanying each load.
3. The quantity of asphalt binder not used in the work will be deducted.
4. When the quantity of asphalt binder in a batch is measured by weight and is separately identified by automatic or semi-automatic printout, the Engineer may compute the quantity of asphalt binder used from this printout. By mutual agreement, this method may be modified when small quantities or intermittent operations are involved.
5. The Engineer will calculate and exclude the quantity of asphalt binder used in mixtures in excess of the tolerance specified in Article 2303.03, D, 3, b.
6. When payment for-HMA is based on area, the quantity of asphalt binder used will not be measured separately for payment.

**C. Recycled Asphalt Pavement.**

1. A completed Daily HMA Plant Report with the certification statement is required for measurement and payment for Contractor Certified HMA. The quantity of asphalt binder will

be based on the approved JMF and any plant production quality control adjustments.

2. The quantity of asphalt binder in RAP incorporated into the mixture will be calculated in tons. This quantity shall be based on the actual asphalt binder content determined for the mix design from the results of the Engineer's extraction tests.
3. The quantity of asphalt binder in RAP, which is incorporated into the mix, will be included in the quantity of asphalt binder used.

**D. Anti-strip Agent.**

Will not be measured separately. The quantity will be based on tons of HMA mixture with anti-strip agent added.

**E. Tack Coat.**

Will not be measured separately.

**F. Hot Mix Asphalt Pavement Samples.**

Will not be individually counted for payment if furnished according to Article 2303.03, D, 4, or required elsewhere in the contract documents,

**G. Recycled Asphalt Shingles.**

67% of the asphalt binder from RAS which is incorporated into the mixture will be included in the quantity of asphalt binder used.

**2303.05 BASIS OF PAYMENT.**

The costs of designing, producing, placing, and testing bituminous mixtures and the cost of furnishing and equipping the QM-A field laboratory will not be paid for separately, but are included in the contract unit price for the HMA mixes used. The application of tack coat and sand cover aggregate are incidental and will not be paid for separately. Pollution testing is at the Contractor's expense. The installation of temporary Stop Sign Rumble Strips will not be paid for separately, but is incidental to the price bid for the HMA course for which it is applied.

The quality control requirements for small quantities are incidental to the items of HMA mixtures in the contract.

**A. Flexible Paving Mixture.**

1. Payment will be the contract unit price for Asphalt Mixture of the type specified per ton or square yard.
2. Payment for test strips will be the contract unit price for the test strip mixture bid item per ton regardless of lift placement.
3. Payment will be adjusted by the following Pay Factor for field voids, laboratory voids, and film thickness determined for the lot.

Multiply the unit price for the HMA bid item by the Pay Factor rounded to three decimal places.

**a. Laboratory Voids.**

- 1) Payment when PWL is used for acceptance:

PWL	Pay Factor
95.1 – 100.0	PF = 0.006000*PWL + 0.430
80.0 – 95.0	1.000
50.0 – 79.9	PF = 0.008333*PWL + 0.3333
Less than 50.0	0.750 maximum

When PWL is less than 50.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 2) Payment when PWL lots are incomplete:

AAD from Target Air Void	Pay Factor
0.0 to 1.0	1.000
1.1 to 1.5	0.900
1.6 to 2.0	0.750
Over 2.0	0.500 maximum

When the AAD is more than 2.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 3) Use the following payment schedule when a test strip is constructed:

AAD from Target Air Void	Pay Factor
0.0 to 1.5	1.000
1.6 to 2.0	PF = 2.5 - AAD
Over 2.0	0.500 maximum

When the AAD is more than 2.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

**b. Field Voids.**

- 1) Payment when PWL is used for acceptance:

PWL	Pay Factor
95.1 – 100.0	PF = 0.008000*PWL + 0.240
80.0 – 95.0	1.000
50.0 – 79.9	PF = 0.008333*PWL + 0.3333
Less than 50.0	0.750 maximum

When PWL is less than 50.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 2) Payment when a test strip is constructed:

Average Field Voids (Pa), %	Pay Factor
0.0 to 9.0	1.000
9.1 to 9.5	PF = 10 - Pa
Over 9.5	0.500 maximum

When the average air void content from a test strip exceeds 9.5%, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 3) Payment when PWL is not used for acceptance:

Average Field Voids (Pa), %	Pay Factor
0.0 to 8.0	1.000
8.1 to 9.5	PF=(11-Pa)/3
Over 9.5	0.500 maximum

When the average air void content exceeds 9.5%, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

**c. Film Thickness.**

When film thickness is outside the limits in Materials I.M. 510 Appendix A, apply the following pay factor

Placement	Pay Factor	
	(Low Film)	(High Film)
Base/Shoulders	0.85*(LL - FT)	0.85*(FT-UL)
Intermediate	0.80*(LL - FT)	0.80*(FT- UL)
Surface	0.75*(LL - FT)	0.75*(FT- UL)

Where

LL = Lower Limit (Materials I.M. 510 Appendix A)

UL = Upper Limit (Materials I.M. 510 Appendix A)

1. When basis of payment is by area, multiply the pay factor by 0.5.
2. For FT < 7.0 or FT > 16.0, the Engineer may consider the lot defective. This applies to all lots (days) of production.
3. No film thickness price adjustment for the test strip (first day of production, if no test strip performed) for each job mix formula.
4. No film thickness price adjustment on temporary pavement.

**d. Pavement Thickness**

Payment will be further adjusted by the appropriate percentage in Table 2303.05-1 below according to the quality index for thickness determined for that lot:

$$QI_{\text{Thickness}} = \frac{\text{Average Thickness}_{\text{Measured}} - (\text{Thickness}_{\text{Intended}} - 0.5)}{\text{Maximum Thickness}_{\text{Measured}} - \text{Minimum Thickness}_{\text{Measured}}}$$

**Table 2303.05-1: Payment Adjustment for Thickness**

Quality Index (Thickness) 8 Samples	Percent of Payment
Greater than 0.34	100
0.14 to 0.34	95
0.00 to 0.13	85
Less than 0.00	75 maximum

4. Payment for courses for which quality index (thickness) is not determined because of size or shape, and courses which are found to be deficient in average width, will be according to Article 1105.04.

**B. Asphalt Binder.**

1. Payment will be the contract unit price per ton for the number of tons of asphalt binder used in the work.
2. Payment for asphalt binder will be for new asphalt binder, the asphalt binder in the RAP which is incorporated in the mixture, and 67% of the asphalt binder from RAS which is incorporated into the mixture. The quantity of asphalt binder in RAM, which is incorporated into the mix, will be calculated in tons of asphalt binder in the RAM. This will be based on the actual asphalt binder content determined for the mix design from the results of the Engineer's extraction test.
3. When the basis of payment for HMA is in square yards, compensation for asphalt binder will be included in the contract unit price per square yard.

**C. Recycled Asphalt Pavement.**

RAP owned by the Contracting Authority will be made available to the Contractor for the recycled mixture at no cost to the Contractor other than loading, hauling, and processing as required for incorporation into the mix.

**D. Anti-strip Agent.**

1. When anti-strip agent is required, the incorporation of the anti-strip agent into the asphalt mixture will be considered as extra work ordered by the Engineer if the Contracting Authority's test results from the field produced mixture meet or exceed the minimum requirement established in Article 2303.02, E, 2, d . Payment will be made at the rate of \$2.00 per ton of asphalt mixture in which the anti-strip agent is incorporated.
2. Payment will be full compensation for designing, adding, and testing for anti-strip agent.

**E. Tack Coat.**

Incidental to HMA.

**G. Hot Mix Asphalt Pavement Samples.**

1. Payment will be the lump sum contract price.
2. Payment is full compensation for furnishing all samples for all courses or items of work, and for delivery of samples as specified in Article 2303.03, D, 4.