Below, you will find five (5) new proposed special specifications that TxDOT is requesting Industry to review. In addition, you will find two additional documents, “HMA Specification Review Guide” and a “Summary of Changes”.

These proposed special specifications are complete updates of the items they are replacing. They include many of the changes that were initially made in SS 3224 as well as additional changes that pertain to each specific item.

These special specifications are intended to replace Item 340, Special Specification 3224, Item 342, Item 344 and Item 346.

The Texas Asphalt Pavement Association’s Specification Committee will be meeting at the TXAPA office in Buda Texas on Tuesday February 28, 2012 at 9:00 am to discuss these special specifications. At the meeting, TXAPA will receive comments to assemble and turn into to TxDOT concerning these special specifications.

All members are welcome and encouraged to attend the very important meeting. We expect the meeting to last the majority of the day. TXAPA will be providing lunch for the meeting.

In the meantime, please review these special specifications and have your comments and suggestions ready for discussion at the meeting. Also, you may email Kyle Swaner with your comments at any time. Kyle’s email address is kswaner@texasasphalt.org.

SPECIFICATION REVIEW GUIDE

This document was developed as a guide to assist in the specification review process.

There are five Special Specifications for review that will replace Items 340, 341, 342, 344 and 346. For clarity we have named them relative to the item they will be replacing.

“Draft to replace Item 340” (Dense Graded – Method)
“Draft to replace Item 341” (Dense Graded – QC/QA)
“Draft to replace Item 342” (PFC)
“Draft to replace Item 344” (Superpave)
“Draft to replace Item 346” (SMA)

All changes in these draft special specifications are color coded to denote what changes have been made as well as the type of change as explained below.

- Red text denotes changes that are unique to that particular item.
- Blue text denotes changes that were already approved in SS 3224 and are now reflected in the additional specification items.
- Green text denotes new changes proposed to SS 3224 that are common to and reflected in the additional specification items.
- Gray denotes text that was not changed, but has been moved to a different location within the specification.
- Black text has not been changed nor moved within the specification.

It is recommended to review “Draft to replace Item 341” first. This specification has already gone through significant changes in the form SP 341-024 and SS 3224 and it was used as the template the other specification items. Changes in “Draft to replace Item 341” will only be marked in red and gray because it is the reference specification for all others. “Draft to replace Item 342,” “Draft to replace Item 344,” and “Draft to replace Item 346” changes will be marked in red, blue, green and gray. “Draft to replace Item 340” was written by taking “Draft to replace Item 341” and removing all wording that refers to QC/QA and its requirements. Its changes are marked in red, green and gray.

Please refer to the summary of significant changes for each specification to assist in the review process. They are also color coded for clarity and ease of review. Note that grammatical corrections are not listed in the summaries.

If you have any questions, please contact Dale Rand at (512) 506-5836, Gisel Carrasco at (512) 506-5847, or Robert Lee at (512) 506-5938.

SUMMARY OF SIGNIFICANT CHANGES

Draft to Replace Item 341

Dense-Graded Hot-Mix Asphalt (QC/QA)

1. (Pg. 5) Changes some allowable substitute PG binders listed in Table 4.
2. (Pg. 5) Requires providing documentation showing the quantity of additives used in the project unless otherwise directed.
3. (Pg. 7) Changes the RAS grinding/granulating requirement to 100% of the particles passing the 3/8 in. sieve (was 95% passing the 3/8 in. sieve).
4. (Pg. 7) When RAS is pre-blended, no longer requires showing the RAS and sand or fine RAP as two separates bins on the mixture design.
5. (Pg. 7) Defines a RAS stockpile as any stockpile that contains RAS.
6. (Pg. 7) Reduces the allowable deleterious material in RAS from 1.5 to 0.5%.
7. (Pg. 8) Reduces the maximum ratio of recycled binder by 5% for all mixes shown in Table 5. Reduces the maximum allowable unfractionated RAP percentage to 10% for the non-surface mixes.
8. (Pg. 9) Requires the profiler and operator to be certified at TTI in order to perform ride quality measurements (Table 6, Note 2).
9. (Pg. 10) Requires the Contractor to report placement quality control test results within 1 working day of completion of the lot (Table 7).
10. (Pg. 13) Identifies the maximum sieve size for each mix type (Table 8, Note 2).
11. (Pg. 14) Allows the Engineer to require a minimum rut depth for the Hamburg Wheel test (Table 10, Note 2).
12. (Pg. 15) Allows waiving correction factors based on past experience when approved by the Engineer.
13. (Pg. 15-19) Requires the trial batch and any adjusted JMF to meet the requirements in Table 5.
14. (Pg. 15) Allows the Engineer to accept test results from a recent production of the same mixture in lieu of a new trial batch.
15. (Pg. 21) When not using a Pave-IR system for specification compliance, allows the Engineer to restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
16. (Pg. 24) When in-place air void requirements are waived, requires the Contractor to monitor the paving operation and ensure that the compacted mat has between 2.7% and 9.9% in-place air voids.
17. (Pg. 25-26) Replaces “Small Quantity Production” with “Exempt Production.” Allows “exempting” a production when shown on the plans. Similar to regular production, “exempt” production requires segregation and thermal profiles when not using the Pave-IR system.
18. (Pg. 26) Allows the Contractor to test either the “blind” or the random sample; however, referee testing will be based on the “blind” samples.
19. (Pg. 28) Requires the Contractor to suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8.
20. (Pg. 32) When in-place air void requirements are waived, allows the Engineer to measure the in-place air voids to verify conformance with the specification.
21. (Pg. 35) Removes the Contractor’s option to request a production pay adjustment factor of 1.000 when WMA is specified on the plans.

Draft to Replace Item 342

Permeable Friction Course (PFC)

1. (Pg. 1) Allows adding, modifying, or eliminating aggregate requirements.
2. (Pg. 1) Disallows using intermediate aggregate in PFC mixtures.
3. (Pg. 1) Clarifies that rated values for surface treatment do not apply to coarse aggregate sources used in hot mix.
4. (Pg. 2) Permits disallowing Class B virgin (non-recycled) aggregate when shown on the plans.
5. (Pg. 2) Allows the Engineer to test during production to ensure 50% of No. 4 aggregate comes from a Class A source.
6. (Pg. 2) Stipulates the Engineer will perform a minimum of one Micro-Deval abrasion test during production.
7. (Pg. 3) Requires providing the A-R binder blend design with the JMF1 submittal.
8. (Pg. 3) Requires providing documentation showing the quantity of CRM used in the project unless otherwise directed.
9. (Pg. 3) Allows using specialized or preferred tack coat when allowed by the Engineer or when shown on the plans.
10. (Pg. 4) Requires providing documentation showing the quantity of additives used in the project unless otherwise directed.
11. (Pg. 4) Allows pre-blending the fibers into the binder at the asphalt supply terminal unless otherwise shown on the plans.
12. (Pg. 4 & 11) Allows reducing the amount of fibers to no less than 0.10% when at least 3% RAS is used in the mixture.
13. (Pg. 4) Defines warm mix asphalt (WMA).
14. (Pg. 5) Allows using RAP and RAS unless shown on the plans.
15. (Pg. 5) Specifies requirements when using Contractor-owned and Department-owned RAP.
16. (Pg. 5) Disallows using unfractionated RAP in PFC mixtures.
17. (Pg. 5-6) Defines post-manufactured and post-consumer RAS.
18. (Pg. 6) Requires grinding or granulating RAS such that 100% of the particles pass the 3/8 in. sieve.
19. (Pg. 6) Defines a RAS stockpile as any stockpile that contains RAS.
20. (Pg. 6) Allows no more than 0.5% deleterious material in RAS.
21. (Pg. 6) Adds Table 2. The maximum ratio of recycled binder is 15%, the maximum allowable fractionated RAP is 10%, and the maximum allowable RAS is 5%.
22. (Pg. 6) Requires providing a means to calibrate the mass flow meter.
23. (Pg. 6) On or before the first day of paving, mandates scheduling and participating in a pre-paving meeting with the Engineer unless otherwise shown on the plans.
24. (Pg. 8) Requires the profiler and operator to be certified at TTI in order to perform ride quality measurements (Table 5, Note 2).
25. (Pg. 9) Adds wording to address unauthorized work.
26. (Pg. 10) Requires using a SGC and 75 gyrations as Ndesign.
27. (Pg. 11) Includes the master gradation limits and laboratory mixture design properties for the new fine PFC (PFC-F) mixture in Table 4. Includes Hamburg Wheel and Overlay testing requirements for the PFC-F mixture.
28. (Pg. 11) Requires molding the Hamburg and Overlay test samples to Ndesign at the optimum asphalt content.
29. (Pg. 11) Identifies the maximum sieve size for every mix type (Table 4, Note 1).

30. (Pg. 11) Allows designing and submitting JMF1 without including the WMA additive. Requires documenting the WMA additive or process used and recommending a rate on the JMF1 submittal.
31. (Pg. 12 & 15) Requires providing Hamburg Wheel test results with the PFC-F mixture design or requesting the Department to perform the test. Requires providing mixture and requesting the Department to perform the Overlay test for the PFC-F mixture design.
32. (Pg. 12) Allows using previously approved correction factors if the mixture design and ignition oven are the same as previously used unless otherwise directed.
33. (Pg. 12) Allows waiving correction factors based on past experience when approved by the Engineer.
34. (Pg. 13-16) Requires the trial batch and any adjusted JMF to meet the requirements in Table 2.
35. (Pg. 13) Allows the Engineer to accept test results from a recent production of the same mixture in lieu of a new trial batch.
36. (Pg. 15) Stipulates when the Engineer will perform Micro-Deval testing.
37. (Pg. 16) Allows the Engineer to require adjustments to the target binder by no more than 0.3% from the current JMF (for JMF2 and above).
38. (Pg 17) Requires that the A-R binder maintains a viscosity between 2,500 and 4,000 centipoise. Requires recording the viscosity at least once an hour and providing the Engineer with a daily summary unless otherwise directed.
39. (Pg. 17) Defines the target temperature discharge range for WMA mixtures.
40. (Pg. 18) Requires using only equipment for hauling defined in the specification unless the Engineer allows other equipment.
41. (Pg. 18) Stipulates collecting haul tickets, measuring temperature, station numbers, etc., depending on whether or not a Pave-IR system is used.
42. (Pg. 18) Allows paving if the roadway is dry and its surface temperature is at least 50°F by using a Pave-IR system for specification compliance. However, allows the Engineer to restrict paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
43. (Pg. 19) When not using a Pave-IR system for specification compliance, allows the Engineer to restrict paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
44. (Pg. 19) Requires avoiding streaks and other irregular patterns when applying tack coat. Requires allowing adequate time for emulsion to break completely.
45. (Pg. 19) Allows the usage of a thermal camera to obtain thermal profiles. No longer waives the thermal profiles.
46. (Pg. 19-20) Defines moderate and severe thermal segregation.
47. (Pg. 20) Adds a section entitled 'Use of the Pave-IR System.' Allows using the system to obtain a continuous thermal profile. Specifies reporting requirements and course of action when the system identifies thermal segregation.
48. (Pg. 20) Adds a section entitled 'Hauling Equipment.' Allows dump trucks only when used in conjunction with a MTD or when a Pave IR system is used.
49. (Pg. 20) Adds a section entitled 'Screed Heaters.' Addresses potential damage caused by screed heaters being left on during long paver stops.
50. (Pg. 21) Requires completing all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed.
51. (Pg. 21) Increases the production requirement for lot 1 to 2,000 tons (was 1,000 tons). Subsequent lot sizes should be between 2,000 and 4,000 tons.
52. (Pg. 21) Requires informational Hamburg Wheel and Overlay testing during production for all PFC mixtures.

53. (Pg. 22) Reduces binder sampling to 1 sample per lot (was 1 per sublot).
54. (Pg. 22) Defines miscellaneous areas. Requires to determine the thickness based on the rate of 90 lb./sy for each inch of pavement.
55. (Pg. 23) Requires providing a daily summary of the asphalt mass flow meter readings for A-R mixtures unless otherwise directed.

Draft to Replace Item 344

Superpave Mixtures

1. (Pg. 1) Changes the specification's name from "Performance-Designed Mixtures" to "Superpave Mixtures." The specification includes only Superpave mixtures; CMHB and RBL mixtures were removed from the specification.
2. (Pg. 1) Allows adding, modifying, or eliminating aggregate requirements.
3. (Pg. 1 & 3) Allows and defines intermediate aggregate.
4. (Pg. 1) Clarifies that rated values for surface treatment do not apply to coarse aggregate sources used in hot mix.
5. (Pg. 2) Allows the Engineer to test during production to ensure 50% of No. 4 aggregate comes from a Class A source.
6. (Pg. 2) Stipulates the Engineer will perform a minimum of one Micro-Deval abrasion test during production.
7. (Pg. 4) Allows a maximum of 1% hydrated lime when a substitute binder is used unless otherwise shown on the plans or allowed by the Engineer.
8. (Pg. 4 & 5) Adds Table 4 and allows the Contractor to use a substitute PG binder in lieu of the PG binder originally specified unless otherwise shown on the plans.
9. (Pg. 5) Changes some allowable substitute PG binders listed in Table 4.
10. (Pg. 5) Allows using specialized or preferred tack coat when allowed by the Engineer or when shown on the plans.
11. (Pg. 5) Requires providing documentation showing the quantity of additives used in the project unless otherwise directed.
12. (Pg. 5) Defines warm mix asphalt (WMA).
13. (Pg. 5) Allows using RAP and RAS unless shown on the plans.
14. (Pg. 6) If Department-owned RAP is available for the Contractor's use, allows the Contractor to use the Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP.
15. (Pg. 6) Defines post-manufactured and post-consumer RAS.
16. (Pg. 7) Requires grinding or granulating RAS such that 100% of the particles pass the 3/8 in. sieve.
17. (Pg. 7) Defines a RAS stockpile as any stockpile that contains RAS.
18. (Pg. 7) Allows no more than 0.5% deleterious material in RAS.
19. (Pg. 7) Adds Table 5. The maximum ratio of recycled binder is 5% lower than the ratios proposed for Item 341 for all mixes. The maximum allowable unfractionated RAP percentage is 5% lower than the percentages proposed for Item 341 for the non-surface mixes. The maximum allowable unfractionated RAP percentage is 10% for all mixes.
20. (Pg. 7) On or before the first day of paving, mandates scheduling and participating in a pre-paving meeting with the Engineer unless otherwise shown on the plans.
21. (Pg. 9) Requires the profiler and operator to be certified at TTI in order to perform ride quality measurements (Table 6, Note 2).
22. (Pg. 10) Adds wording to address unauthorized work.
23. (Pg. 11) Requires reporting placement quality control test results within 1 working day of completion of the lot (Table 7).
22. (Pg. 12) Requires the mixture to be design at 50 gyrations. Allows adjusting Ndesign when shown on the plans or specification or allowed by the Engineer. When reducing Ndesign, requires documenting the target value on the JMF1 submittal and performing Hamburg and IDT.

23. (Pg. 13-14) Removes RBL and CMHB mixtures' design requirements.
24. (Pg. 14) Adds the #4-sieve's mater gradation limits in Table 8.
25. (Pg. 14) Identifies the maximum sieve size for every mix type (Table 8, Note 2).
26. (Pg. 14) Removes the VFA design requirement from Table 8.
27. (Pg. 15) Allows exceeding the 200 psi IDT requirement only when the Hamburg result is greater than 4.0 mm and less than 12.5 mm (Table 10, Note 2).
28. (Pg. 15) Allows the Engineer to require a minimum rut depth for the Hamburg Wheel test (Table 11, Note 2).
29. (Pg. 15) Allows designing and submitting JMF1 without including the WMA additive. Requires documenting the WMA additive or process used and recommending a rate on the JMF1 submittal.
30. (Pg. 15) Allows the Department to require reimbursement for verification tests if more than 2 trial batches per design are required.
31. (Pg. 16) Allows using previously approved correction factors if the mixture design and ignition oven are the same as previously used unless otherwise directed.
32. (Pg. 16) Allows waiving correction factors based on past experience when approved by the Engineer.
33. (Pg. 16-20) Requires the trial batch and any adjusted JMF to meet the requirements in Table 5.
34. (Pg. 16) Allows the Engineer to accept test results from a recent production of the same mixture in lieu of a new trial batch.
35. (Pg. 17, 20, & 26) Allows the Engineer to perform or require the Contractor to perform an IDT test if the optimum asphalt content between JMF1 and JMF2 differs more than 0.5%.
36. (Pg. 18) Includes allowable differences between trial batch and JMF1 target in Table 12.
37. (Pg. 19) Stipulates when the Engineer will perform Micro-Deval testing.
38. (Pg. 21) Defines the target temperature discharge range of WMA mixtures.
39. (Pg. 21) Requires using only equipment for hauling defined in the specification unless the Engineer allows other equipment.
40. (Pg. 21) Stipulates collecting haul tickets, measuring temperature, station numbers, etc., depending on whether or not a Pave-IR system is used.
41. (Pg. 22) Removes CMHB's compacted lift thickness and core height requirements from Table 13.
42. (Pg. 22) Allows paving if the roadway is dry and its surface temperature is at least 32°F by using a Pave-IR system for specification compliance. However, allows the Engineer to restrict paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
43. (Pg. 22) When not using a Pave-IR system for specification compliance, allows the Engineer to restrict paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
44. (Pg. 23) Requires avoiding streaks and other irregular patterns when applying tack coat. Requires allowing adequate time for emulsion to break completely.
45. (Pg. 23) Allows the usage of a thermal camera to obtain thermal profiles. No longer waives the thermal profiles.
46. (Pg. 23) Defines moderate thermal segregation. Requires evaluating these areas by performing density profiles.
47. (Pg. 23) Defines severe thermal segregation. When the Pave-IR system is not used for specification compliance, no production or placement bonus will be paid for any sublot that contains severe thermal segregation. Requires evaluating these areas by performing density profiles.
48. (Pg. 24)Adds a section entitled 'Use of the Pave-IR System.' Allows using the system to obtain a continuous thermal profile. Specifies reporting requirements and course of action when the system identifies thermal segregation.

49. (Pg. 24) Removes the 'Suggested Minimum Mixture Placement Temperature' table.
50. (Pg. 24) Adds a section entitled 'Hauling Equipment.'
51. (Pg. 24) Adds a section entitled 'Screed Heaters.' Addresses potential damage caused by screed heaters being left on during long paver stops.
52. (Pg. 25) When in-place air void requirements are waived, requires monitoring the paving operation and ensure that the compacted mat has between 2.7% and 9.0% in-place air voids.
53. (Pg. 25, 26, & 31) Removes compaction and production/placement acceptance requirements for RBL mixtures.
54. (Pg. 25) Requires completing all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed.
55. (Pg. 25) Changes the requirement of suspending operations if the pay factor for 2 consecutive lots (was 3 consecutive lots) is below 1.000.
56. (Pg. 26) Allows declining referee testing and accepting the Engineer's test results.
57. (Pg. 26-27) Replaces "Small Quantity Production" with "Exempt Production." Allows "exempting" a production when shown on the plans. Similar to regular production, "exempt" production requires segregation and thermal profiles when not using the Pave-IR system.
58. (Pg. 27) Requires closing all lots within 5 working days unless otherwise allowed by the Engineer.
59. (Pg. 27) Requires the Engineer to obtain or witness all production sampling and retain custody.
60. (Pg. 27) Allows testing either the "blind" or the random sample; however, referee testing will be based on the "blind" samples.
61. (Pg. 28) Requires obtaining and providing production mixture to the Engineer for informational Cantabro and Overlay testing.
62. (Pg. 28) Reduces binder sampling to 1 sample per lot (was 1 per sublot).
63. (Pg. 28) Requires taking corrective action if the Engineer's lab-molded density is less than 95% or greater than 97%.
64. (Pg. 28) Requires providing evidence that the ignition oven results are not reliable before requesting permission to use an alternate method unless otherwise directed.
65. (Pg. 29) Table 15 makes the Contractor responsible for obtaining the Cantabro and Overlay samples and requires the Engineer to test the RAS for deleterious materials during production.
66. (Pg. 29) Requires suspending production operations and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8.
67. (Pg. 29-30) Waives the production and placement bonus on a sublot, rather than a lot, based on asphalt content and VMA. Addresses VMA calculations and required actions when VMA does not comply with the specification.
68. (Pg. 31) Adds wording to the miscellaneous areas definition.
69. (Pg. 32-33) Requires on-site trimming of cores or in close proximity to where the cores are taken. Requires the Engineer to witness coring operations. Stipulates the Engineer will maintain custody of the cores or use CST protocol to provide a secure means and process that protects the integrity of the cores during transport.
70. (Pg. 33) When in-place air void requirements are waived, allows the Engineer to measure the in-place air voids to verify conformance with the specification.
71. (Pg. 34) Density profiles are no longer waived. Requires density profiles every sublot and its documentation.
72. (Pg. 35) Removes CMHB from Table 16, "Segregation (Density Profile) Acceptance Criteria."
73. (Pg. 35) Similar to thermal and density profiles, requires joint density evaluations on every sublot.
74. (Pg. 36) To receive bonuses, requires reporting results for all required tests.

75. (Pg. 38) Added a reference to Item 5 that gives the Engineer more latitude on accepting production sublots subject to removal and replacement.
76. (Pg. 39) Permits the Engineer may allow failing placement sublots to be left in place without payment in lieu of removal and replacement.

Draft to Replace Item 346

Stone-Matrix Asphalt

1. (Pg. 1) Allows adding, modifying, or eliminating aggregate requirements.
2. (Pg. 1 & 3) Allows and defines intermediate aggregate.
3. (Pg. 1) Clarifies that rated values for surface treatment do not apply to coarse aggregate sources used in hot mix.
4. (Pg. 2) Permits disallowing Class B virgin (non-recycled) aggregate when shown on the plans.
5. (Pg. 2) Allows the Engineer to test during production to ensure 50% of No. 4 aggregate comes from a Class A source.
6. (Pg. 2) Stipulates the Engineer will perform a minimum of one Micro-Deval abrasion test during production.
7. (Pg. 4) Disallows using more than 5% fly ash unless otherwise shown on the plans.
8. (Pg. 5) Requires providing the A-R binder blend design with the JMF1 submittal.
9. (Pg. 5) Requires providing documentation showing the quantity of CRM used in the project unless otherwise directed.
10. (Pg. 5) Allows using specialized or preferred tack coat when allowed by the Engineer or when shown on the plans.
11. (Pg. 5) Requires providing documentation showing the quantity of additives used in the project unless otherwise directed.
12. (Pg. 5) Allows pre-blending the fibers into the binder at the asphalt supply terminal unless otherwise shown on the plans.
13. (Pg. 5 &14) Allows reducing the amount of fibers to no less than 0.10% when at least 3% RAS is used in the mixture.
14. (Pg. 6) Defines warm mix asphalt (WMA).
15. (Pg. 6) Allows using RAP and RAS unless shown on the plans.
16. (Pg. 6) Specifies requirements when using Contractor-owned and Department-owned RAP.
17. (Pg. 6) Disallows using unfractionated RAP in SMA and SMAR mixtures.
18. (Pg. 6) Defines post-manufactured and post-consumer RAS.
19. (Pg. 7) Requires grinding or granulating RAS such that 100% of the particles pass the 3/8 in. sieve.
20. (Pg. 7) Defines a RAS stockpile as any stockpile that contains RAS.
21. (Pg. 7) Allows no more than 0.5% deleterious material in RAS.
22. (Pg. 8) Adds Table 4. For surface mixes, the maximum ratio of recycled binder and the maximum allowable fractionated RAP percentages are 15%. For non-surface mixes, the maximum ratio of recycled binder and the maximum allowable fractionated RAP percentages are 20%.
23. (Pg. 8) Requires providing a means to calibrate the mass flow meter.
24. (Pg. 8) On or before the first day of paving, mandates scheduling and participating in a pre-paving meeting with the Engineer unless otherwise shown on the plans.
25. (Pg. 9) Requires the profiler and operator to be certified at TTI in order to perform ride quality measurements (Table 5, Note 2).
26. (Pg. 10) Adds wording to address unauthorized work.
27. (Pg. 10) Requires reporting placement quality control test results within 1 working day of completion of the lot (Table 6).
28. (Pg. 12) Requires the mixture to be design at 75 gyrations. Allows reducing Ndesign to no less than 35 gyrations at the Contractor's discretion.

29. (Pg. 12) When reducing Ndesign, requires documenting the target value on the JMF1 submittal and performing Hamburg and IDT.
30. (Pg. 12) Requires providinh the laboratory mixture and requesting that the Department perform the Overlay test.
31. (Pg. 13) Modifies the master gradation limits of the SMA-F mixture (Table 7).
32. (Pg. 13) Identifies the maximum sieve size for every mix type (Table 7, Note 2).
33. (Pg. 14) Changes the target lab-molded density for SMAR mixtures from 97.0% to 96.0% (Table 8).
34. (Pg. 14) Adds an asphalt content lower limit for the SMAR mixtures (Table 8).
35. (Pg. 14) Adds an Overlay test requirement of 300 cycles for SMA and SMAR mixtures (Table 8).
36. (Pg. 14) Allows exceeding the 200 psi IDT requirement only when the Hamburg result is greater than 4.0 mm and less than 12.5 mm (Table 8, Note 5).
37. (Pg. 14) Deletes Table 9, "Guide to Adjust Minimum Asphalt Content Based on Bulk Specific Gravity of Aggregates."
38. (Pg. 14) Allows designing and submitting JMF1 without including the WMA additive. Requires documenting the WMA additive or process used and recommending a rate on the JMF1 submittal.
39. (Pg. 14) Allows the Department to require reimbursement for verification test if more than 2 trial batches per design are required.
40. (Pg. 15) Requires providing 25,000 g of laboratory mixture and requesting the Department to perform the Overlay test when submitting JMF1.
41. (Pg. 15) Allows using previously approved correction factors if the mixture design and ignition oven are the same as previously used unless otherwise directed.
42. (Pg. 15) Allows waiving correction factors based on past experience when approved by the Engineer.
43. (Pg. 16-20) Requires the trial batch and any adjusted JMF to meet the requirements in Table 4.
44. (Pg. 16) Allows the Engineer to accept test results from a recent production of the same mixture in lieu of a new trial batch.
45. (Pg. 16) Requires providing documentation to verify the accuracy of the asphalt mass flow meter to measure the binder content. Allows the Engineer to verify the accuracy of the meter based on quantities used.
46. (Pg. 16, 20, & 26) Allows the Engineer to perform or require the Contractor to perform an IDT test if the optimum asphalt content between JMF1 and JMF2 differs more than 0.5%.
77. (Pg. 18) Adds allowable differences between trial batch and JMF1 target in Table 9.
78. (Pg. 18) Requires determining the binder asphalt content from asphalt mass flow meter readouts for SMAR mixtures (Table 9, Note 6).
79. (Pg. 19) Stipulates when the Engineer will perform Micro-Deval testing.
80. (Pg. 19) Requires the Engineer to mold samples and perform the Overlay test for JMF1.
81. (Pg. 21) Defines the target temperature discharge range of WMA mixtures.
82. (Pg. 21) Requires using only equipment for hauling defined in the specification unless the Engineer allows other equipment.
83. (Pg. 21) Stipulates Contractor to collect haul tickets, measure temperature, station numbers, etc., depending on whether or not a Pave-IR system is used.
84. (Pg. 22) Changes the minimum and maximum compacted lift thickness for SMA-F mixtures (Table 10).

85. (Pg. 22) Allows paving if the roadway is dry and its surface temperature is at least 50°F by using a Pave-IR system for specification compliance. However, allows the Engineer to restrict paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
86. (Pg. 22) When not using a Pave-IR system for specification compliance, allows the Engineer to restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
87. (Pg. 22) Requires avoiding streaks and other irregular patterns when applying tack coat. Requires allowing adequate time for emulsion to break completely.
88. (Pg. 23) Allows the usage of a thermal camera to obtain thermal profiles. No longer waives the thermal profiles.
89. (Pg. 23) Defines 'Moderate Thermal Segregation.' Requires evaluating these areas by performing density profiles.
90. (Pg. 23) Defines 'Severe Thermal Segregation.' When the Pave-IR system is not used for specification compliance, no production or placement bonus will be paid for any sublot that contains severe thermal segregation. Requires evaluating these areas by performing density profiles.
91. (Pg. 24)Adds a section entitled 'Use of the Pave-IR System.' Allows using the system to obtain a continuous thermal profile. Stipulates reporting requirements and course of action when the system identifies thermal segregation.
92. (Pg. 24) Adds a section entitled 'Hauling Equipment.'
93. (Pg. 24) Adds a section entitled 'Screed Heaters.' Addresses potential damage caused by screed heaters being left on during long paver stops.
94. (Pg. 24) Deletes the 'Suggested Minimum Mixture Placement Temperature' table.
95. (Pg. 25) When in-place air void requirements are waived, requires monitoring the paving operation and ensuring that the compacted mat has between 2.7% and 8.0% in-place air voids.
96. (Pg. 25) Requires completing all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed.
97. (Pg. 25) Changes the requirement of suspending operations if the pay factor for 2 consecutive lots (was 3 consecutive lots) is below 1.000.
98. (Pg. 26) Allows declining referee testing and accepting the Engineer's test results.
99. (Pg. 26-27) Replaces "Small Quantity Production" with "Exempt Production." Allows "exempting" a production when shown on the plans. Similar to regular production, "exempt" production requires segregation and thermal profiles when not using the Pave-IR system.
100. (Pg. 27) Requires closing all lots within 5 working days unless otherwise allowed by the Engineer.
101. (Pg. 27) Requires Engineer to obtain or witness all production sampling and retain custody.
102. (Pg. 27) Allows testing either the "blind" or the random sample; however, referee testing will be based on the "blind" samples.
103. (Pg. 28) Requires obtainig and providing production mixture to the Engineer for informational Cantabro and Overlay testing. Requires that the Overlay test meets the requirements in Table 8.
104. (Pg. 28) Reduces binder sampling to 1 sample per lot (was 1 per sublot).
105. (Pg. 28) Requires taking corrective action if the Engineer's lab-molded density is less than 95% or greater than 97%.
106. (Pg. 28) Requires that the A-R binder maintains a viscosity between 2,500 and 4,000. Requires recording the viscosity at least once an hour and providing the Engineer with a daily summary unless otherwise directed.
107. (Pg. 29) Table 11 makes the Contractor responsible for obtaining the Cantabro and Overlay samples and requires the Engineer to test the RAS for deleterious materials during production.

108. (Pg. 30) Requires suspending operation and taking corrective action if any aggregate is retained on the maximum sieve size shown in Table 7.
109. (Pg. 30) Waives the production and placement bonus on a sublot, rather than a lot, based on asphalt content and VMA. Addresses VMA calculations and required actions when VMA does not comply with the specification.
110. (Pg. 31) Adds wording to the miscellaneous areas definition.
111. (Pg. 32-33) Requires on-site trimming of cores or in close proximity to where the cores are taken. Requires the Engineer to witness coring operations. Stipulates the Engineer will maintain custody of the cores or use CST protocol to provide a secure means and process that protects the integrity of the cores during transport.
112. (Pg. 34) Requires waiving specific in-place air void requirements when the specified compacted lift thickness is less than the minimum untrimmed core height shown in Table 10.
113. (Pg. 34) When specific in-place air void requirements are waived for any reason, assigns a 1.0 placement pay factor. However, allows the Engineer to require removal and replacement if specified compaction requirements are not met.
114. (Pg. 34) Density profiles are no longer waived. Segregation (Density Profile) tests are required every sublot and documentation is required.
115. (Pg. 36) Similar to thermal and density profiles, joint density evaluations are required on every sublot and documentation is required.
116. (Pg. 37) Requires providing the Engineer with a daily summary of the asphalt mass flow meter readings for SMAR mixtures unless otherwise directed.
117. (Pg. 37) To receive bonuses, requires reporting results for all required tests.
118. (Pg. 38 & 40) Added a reference to Item 5 that gives the Engineer more latitude on accepting production sublots subject to removal and replacement.
119. (Pg. 40) Modifies the placement pay adjustment factors for in-place air voids.
120. (Pg. 38) Allows the Engineer to allow failing placement sublots to be left in place without payment in lieu of removal and replacement.

Draft to Replace Item 340

Dense-Graded Hot Mix Asphalt (Method)

1. (Pg. 5) Changes some allowable substitute PG binders listed in Table 4.
2. (Pg. 5) Requires providing documentation showing the quantity of additives used in the project unless otherwise directed.
3. (Pg. 7) Changes the RAS grinding/granulating requirement to 100% of the particles passing the 3/8 in. sieve (was 95% passing the 3/8 in. sieve).
4. (Pg. 7) When RAS is pre-blended, no longer requires showing the RAS and sand or fine RAP as two separates bins on the mixture design.
5. (Pg. 7) Defines a RAS stockpile as any stockpile that contains RAS.
6. (Pg. 7) Reduces the allowable deleterious material in RAS from 1.5 to 0.5%.
7. (Pg. 8) Reduces the maximum ratio of recycled binder by 5% for all mixes shown in Table 5. Reduces the maximum allowable unfractionated RAP percentage to 10% for the non-surface mixes.
8. (Pg. 8) Specifies that the Department's Level 1A and 1B certified specialists will conduct production and placement tests.
9. (Pg. 9) Requires the profiler and operator to be certified at TTI in order to perform ride quality measurements (Table 6, Note 2).
10. (Pg. 10) Allows the Engineer to perform any production and placement tests listed in Table 7 at any time during the project to verify compliance. Allows, but not requires, the Contractor to perform any test listed in Table 7.
11. (Pg. 10) Requires reporting production and placement test results within 1 working day of completion of the test (Table 7). Adds the VMA calculation and moisture content to the production-testing list shown in Table 7.
12. (Pg. 13) Identifies the maximum sieve size for each mix type (Table 8, Note 2).
13. (Pg. 13) Allows the Engineer to require a minimum rut depth for the Hamburg Wheel test (Table 10, Note 2).
14. (Pg. 14) Requires determining the aggregate and asphalt content correction factors from the ignition oven if the Contractor elects to perform optional production test. Allows waiving correction factors based on past experience when approved by the Engineer.
15. (Pg. 15) Allows the Engineer to accept test results from a recent production of the same mixture in lieu of a new trial batch.
16. (Pg. 15-19) Requires the trial batch and any adjusted JMF to meet the requirements in Table 5.
17. (Pg. 15) Allows the Engineer to require up to the entire lot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.
18. (Pg. 16) Requires the Engineer to make the Department TGC or Contractor-provided SGC and the Department field laboratory available if the Contractor elects to mold production samples.
19. (Pg. 19) Allows the Engineer to determine the moisture content of the mixture and obtain the mixture samples immediately after discharging into the truck.
20. (Pg. 20) When not using a Pave-IR system for specification compliance, allows the Engineer to restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
21. (Pg. 21) Allows the Engineer to perform thermal profiles as deemed necessary. Allows the Engineer to evaluate areas with moderate and severe thermal segregation by performing density profiles.

22. (Pg. 21) Allows the Engineer to use the Pave-IR system for information only or for specification compliance to meet the requirements noted in the 'Weather Conditions' and 'Hauling Equipment' sections.
23. (Pg. 22) Requires compacting the pavement to contain from 5% to 9% in-place air voids.
24. (Pg. 22) Requires providing the Engineer with control strip results that indicate the selected rolling pattern will produce the desired in-place air voids unless otherwise directed.
25. (Pg. 23) Defines 'Production Lot' as a day of production. Lots are not subdivided into sublots; however, the Engineer is allowed to perform multiple tests on any given lot.
26. (Pg. 23) Allows the Engineer to obtain mixture and binder samples, or to require the Contractor to obtain binder samples, at any time during production.
27. (Pg. 23 & 26) Allows the Engineer to perform any production and placement tests listed in Table 14 at any time during the project to verify compliance. Allows the Engineer to suspend production if production or placement tests do not meet specifications. Allows (but not requires) the Contractor to perform any test listed in Table 14 for quality control purposes.
28. (Pg. 24) Allows the Engineer to determine VMA for any production lot.
29. (Pg. 25) Defines 'Placement Lot' as the area placed during a production lot. Allows the Engineer to perform multiple tests on a given lot.
30. (Pg. 25) Requires obtaining cores at each location that the Engineer selects for in-place air void determination.
31. (Pg. 26) Specifies that cores not meeting the minimum core height listed in Table 12 will not be tested.
32. (Pg. 26) Requires the Engineer to use the corresponding theoretical maximum specific gravity to determine the air void content of each core.
33. (Pg. 27) Requires taking corrective action if the in-place air void content determined by the Engineer is below 5% or greater than 9%.
34. (Pg. 27) Allows the Engineer to take density profiles and longitudinal join densities as often as deemed necessary to verify conformance.

SPECIAL SPECIFICATION

3XXX for Item 340

Dense-Graded Hot-Mix Asphalt (Method)

1. Description. Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant.

2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance.

A. Aggregate. Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

1. Coarse Aggregate. Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve.
Provide aggregate from sources listed in the BRSQC located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Use only the rated values for hot mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot mix. Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Do not add material to a stockpile that has been tested and approved, for sources not listed on the Department's *Bituminous Rated Source Quality Catalog* (BRSQC). Provide coarse aggregate with at least the minimum SAC as shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.

a. Blending Class A and Class B Aggregates. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. For blending purposes, coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate.

When the Contractor blends Class A and B aggregates to meet a Class A requirement, the Engineer may perform tests at any time during production to ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. In such cases where the Engineer elects to verify conformance, the Engineer will use the Department's mix design program to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the program; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

b. Micro-Deval Abrasion. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing prior to the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer will estimate the magnesium sulfate soundness loss ($Mg_{est.}$) for each coarse aggregate source by multiplying the RSSM value by the ratio of the actual Micro-Deval percent loss ($MD_{act.}$) divided by the Rated Source Micro-Deval (RSMD) using the formula $Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$. When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Geotechnical, Soils, & Aggregates

Branch of the Construction Division. Additional testing may be required prior to granting approval.

2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. When used, supply intermediate aggregates that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. When used, supply intermediate aggregate from coarse aggregate sources that meet the requirements shown in Table 1~~,~~ unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

3. **Fine Aggregate.** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed fine aggregate. With the exception of field sand, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 1~~,~~ unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.5
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	30
Coarse aggregate angularity, 2 crushed faces, %, min	Tex-460-A, Part I	85[2]
Flat and elongated particles @ 5:1, %, max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107-E	3
Combined Aggregate[3]		
Sand equivalent, %, min	Tex-203-F	45

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3XXX.2.A.1, "Coarse Aggregate."
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

B. Mineral Filler. Mineral filler consists of finely divided mineral matter, such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% mineral hydrated lime unless otherwise shown on the plans. If a substitute binder is used, do not use more than 1% hydrated lime unless otherwise shown on the plans or allowed by the Engineer. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- is sufficiently dry, free-flowing, and free from clump and foreign matter;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

C. Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

D. Asphalt Binder. Furnish the type and grade of performance-graded (PG) asphalt specified on the plans. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 4 in lieu of the PG binder originally specified, if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.J, “Performance-Graded Binders;”
- the substitute binder has an un-aged dynamic shear value less than or equal to 2.00 kPa and an RTFO aged dynamic shear value less than or equal to 5.00 kPa at the PG test temperature; and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 4
Allowable Substitute PG Binders

PG Binder Originally Specified	Allowable Substitute PG Binders
PG 76-22	PG 70-22 or PG 64-28
PG 70-22	PG 64-22 or PG 58-28
PG 64-22	PG 58-22
PG 76-28	PG 70-28 or PG 64-34
PG 70-28	PG 64-28 or PG 58-34
PG 64-28	PG 58-28

E. Tack Coat. ~~Unless otherwise shown on the plans or approved,~~ Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed by the Engineer or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least 1 sample of the tack coat binder per project in accordance with Tex-500-C, Part III and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

F. Additives. Use the type and rate of additive specified when shown on the plans. Other additives that facilitate mixing, compaction, or improve the quality of the mixture may be allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

1. Lime and Liquid Antistripping Agent. When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

2. Warm Mix Asphalt (WMA). Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215ºF and 275ºF using Department approved WMA additives or processes. The Department's approved list of WMA additives and processes is located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm.

WMA is allowed for use on all projects and is required when shown on plans. The maximum placement or target discharge temperature for WMA may be set at a value less than 275ºF when shown on the plans.

Department approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures greater than 275ºF; however, such mixtures will not be defined as WMA.

G. Recycled Materials. Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 5. The allowable percentages shown in Table 5 may be decreased or increased

when shown on the plans. Determine asphalt content and gradation of the RAP and RAS material for mixture design purposes in accordance with Tex-236-F. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. When RAP or RAS is used, calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production. During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve.

   Use of Contractor-owned RAP including HMA plant waste is permitted~~,~~ unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. This allowance does not apply to a Contractor using unfractionated RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

   Fractionated RAP is defined as having 2 or more RAP stockpiles, divided into coarse and fine fractions. The coarse RAP stockpile will contain only material retained by processing over a 3/8 in. screen or 1/2 in. screen~~,~~ unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8 in. screen or 1/2 in. screen~~,~~ unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8 in. screen or 1/2 in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

   Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

   Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

2. **RAS.** Use of post-manufactured RAS or post-consumer RAS is permitted unless otherwise shown on the plans. RAS are defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS are processed manufacturer's shingle scrap by-product. Post-consumer RAS, or tear-offs, are processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the Texas Commission on Environmental Quality (TCEQ). RAS may be used separately or in conjunction with RAP.

   Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material prior to extraction (or ignition) of the asphalt.

   Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. For any stockpile that contains RAS, the entire stockpile will be considered to be a RAS stockpile and limited to no more than 5.0% of the HMA mixture in accordance with Table 5.

   Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials (NRM) Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established NRM. Use RAS from shingle sources on the Construction Division's "Nonhazardous Recycled Materials" approved list at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Prior to use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval to the Engineer prior to submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

Table 5
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder[1] to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
		Unfractionated RAP[2]	Fractionated RAP[3]	RAS[4]
Surface Mixes[5]	30.0	10.0	20.0	5.0
Non-Surface Mixes[6] < 8 in. From Final Riding Surface	35.0	10.0	30.0	5.0
Non-Surface Mixes[6] > 8 in. From Final Riding Surface	40.0	10.0	40.0	5.0

1. Combined recycled binder from RAP and RAS.
2. Do not use in combination with RAS or fractionated RAP.
3. May not be used in addition to unfractionated RAP; however, up to 5% of fractionated RAP may be replaced with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.
5. "Surface" mixes are defined as mixtures that will be the final lift or riding surface of the pavement structure.
6. "Non-Surface" mixes are defined as mixtures that will be an intermediate or base layer in the pavement structure.

3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. Construction. Produce, haul, place, and compact the specified paving mixture. On or before the first day of paving, schedule and participate in a pre-paving meeting with the Engineer unless otherwise directed.

A. Certification. Personnel certified by the Department-approved Hot Mix Asphalt Center Certification Program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design that is developed and signed by a Level 2 certified specialist. The Department's Level 1A certified specialist will conduct production tests. The Department's Level 1B certified specialist will conduct placement tests.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level
1. Aggregate and Recycled Material Testing				
Sampling	Tex-400-A	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Parts I & III	✓	✓	2
Decantation	Tex-217-F, Part II	✓	✓	2
Los Angeles abrasion	Tex-410-A		✓	
Magnesium sulfate soundness	Tex-411-A		✓	
Micro-Deval abrasion	Tex-461-A		✓	
Coarse aggregate angularity	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors[1]	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Hamburg wheel test	Tex-242-F	✓	✓	2
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Mixture sampling	Tex-222-F		✓	1A
Molding (TGC)	Tex-206-F		✓	1A
Molding (SGC)	Tex-241-F		✓	1A
Laboratory-molded density	Tex-207-F		✓	1A
VMA (calculation only)	Tex-207-F		✓	1A
Rice gravity	Tex-227-F		✓	1A
Gradation & asphalt content[1]	Tex-236-F		✓	1A
Moisture content	Tex-212-F		✓	1A
Hamburg Wheel test	Tex-242-F		✓	2
Micro-Deval abrasion	Tex-461-A		✓	
Boil test	Tex-530-C		✓	1A
Aging ratio	Tex-211-F		✓	
5. Placement Testing				
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F		✓	1A/1B
Establish rolling pattern	Tex-207-F	✓		1B
Ride quality measurement	Tex-1001-S	✓	✓	Note 2
Segregation (density profile)	Tex-207-F, Part V		✓	1B
Longitudinal joint density	Tex-207-F, Part VII		✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Tack coat adhesion	Tex-243-F		✓	1B

1. Refer to Section 3XXX.4.I.3 for exceptions to using an ignition oven.
2. Profiler and operator are required to be certified at the Texas Transportation Institute facility when Surface Test Type B is specified.

B. Reporting, Testing and Responsibilities. Use Department-provided templates to record and calculate all test data pertaining to the mixture design. The Engineer will use

Department templates for any production and placement testing. Obtain the latest version of the templates at http://www.txdot.gov/txdot_library/consultants_contractors/forms/site_manager.htm or from the Engineer.

The Engineer may perform any tests listed in Table 7 at any time during the project to verify specification compliance. The allowable time for the Engineer to exchange test data with the Contractor is as given in Table 7 unless otherwise determined. The Contractor is not required but may perform any tests listed in Table 7 at any time during the project for quality control purposes. The Engineer will report to the Contractor any test result that requires production or placement to be suspended or fails to meet the specification requirements.

Subsequent mix placed after test results are available to the Contractor, which require them to suspend operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3, "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Testing			
Gradation Asphalt content Laboratory-molded density VMA (calculation) Hamburg wheel test Moisture content Boil test Binder tests	Engineer	Contractor	1 working day of completion of the test
Placement Testing			
In-place air voids Segregation Longitudinal joint density Thermal profile Aging ratio	Engineer	Contractor	1 working day of completion of the test

C. QCP. Develop and follow the QCP in detail. Submit a written QCP to the Engineer before the prepaving meeting. Include the following items in the QCP.

1. Project Personnel. For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action; and
- contact information for each individual listed.

2. Material Delivery and Storage. For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;

- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

3. **Production.** For production, include:
   - loader operation procedures to avoid contamination in cold bins;
   - procedures for calibrating and controlling cold feeds;
   - procedures to eliminate debris or oversized material;
   - procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip);
   - procedures for reporting job control test results; and
   - procedures to avoid segregation and drain-down in the silo.

4. **Loading and Transporting.** For loading and transporting, include:
   - type and application method for release agents; and
   - truck loading procedures to avoid segregation.

5. **Placement and Compaction.** For placement and compaction, include:
   - proposed agenda for prepaving meeting, including date and location;
   - type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
   - procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
   - process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
   - paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
   - procedures to construct quality longitudinal and transverse joints.

D. Mixture Design.

1. **Design Requirements**. The Contractor may elect to design the mixture using a Texas Gyratory Compactor (TGC) or a Superpave Gyratory Compactor (SGC) unless otherwise shown on the plans. Use the typical weight design example given in Tex-204-F, Part I, when using a TGC. Use the Superpave mixture design procedure given in Tex-204-F, Part IV, when using a SGC. Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

   a. **Target Laboratory Molded Density When The TGC Is Used.** Design the mixture at a 96.5% target laboratory-molded density or as noted in Table 9. The target laboratory-molded density may be increased 0.5%, not to exceed 97.0%, at the Contractor's discretion. When electing to raise the target laboratory-molded density from the specified value, document the target value

on the JMF1 submittal. Perform Hamburg and indirect tensile strength tests at the corresponding optimum asphalt content.

b. Design Number of Gyrations (Ndesign) When The SGC Is Used. Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion. When electing to reduce the Ndesign level from the specified value, document the target value on the JMF1 submittal. Perform Hamburg and indirect tensile strength tests at the corresponding optimum asphalt content.

Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at anytime during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA[1] Requirements

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2”	100.0[2]	–	–	–	–
1-1/2"	98.0–100.0	100.0[2]	–	–	–
1"	78.0–94.0	98.0–100.0	100.0[2]	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	100.0[2]	–
1/2"	50.0–70.0	–	–	98.0–100.0	100.0[2]
3/8"	–	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum					
–	11.0	12.0	13.0	14.0	15.0

1. Voids in mineral aggregates.
2. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.5[1]
Design gyrations (Ndesign)	Tex-241-F	50[2]
Indirect tensile strength (dry), psi	Tex-226-F	85–200[3]
Boil test[4]	Tex-530-C	–

1. May be adjusted down to 96.0 or up to 97.0% when shown on the plans or specification or allowed by the Engineer when using the TGC (Tex-204-F, Part I).
2. May be adjusted within a range of 35–100 gyrations when shown on the plans or specification or allowed by the Engineer.
3. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 4.0 mm and less than 12.5 mm.
4. Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes[1] @ 12.5 mm[2] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000
PG 70		15,000
PG 76 or higher		20,000

1. May be decreased or waived when shown on the plans.
2. A minimum rut depth may also be required when shown on the plans.

2. Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation, target laboratory molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot mix production. JMF1 is

the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommend rate on the JMF1 submittal. The Engineer will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise determined. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.

a. Contractor's Responsibilities.

(1) Providing Gyratory Compactor. If the Superpave Gyratory Compactor (SGC) is used to design the mix, provide an SGC at the Engineer's field laboratory for use in molding production samples.

(2) Gyratory Compactor Correlation Factors. If electing to perform optional production tests, use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different gyratory compactor. Apply the correlation factor to all subsequent production test results.

(3) Submitting JMF1. Furnish the Engineer a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. If opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, provide the Engineer with approximately 10,000 g of the design mixture and request that the Department perform the Hamburg Wheel test.

(4) Supplying Aggregate. Provide the Engineer with approximately 40 lb. of each aggregate stockpile unless otherwise directed.

(5) Supplying Asphalt. Provide the Engineer at least 1 gal. of the asphalt material and sufficient quantities of any additives proposed for use.

(6) Ignition Oven Correction Factors. If electing to perform optional production tests, determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F. Prior to the trial batch production, provide the Engineer with samples of the mixtures, including all additives (except water), and blank samples used to determine the correction factors unless otherwise directed. Correction factors established from a previously approved mixture design may be used for the current mixture design, if the mixture design and ignition oven are the same as previously used unless otherwise directed. Correction factors may be waived based on past experience when approved by the Engineer.

(7) Trial Batch Production. Upon receiving conditional approval of JMF1 and authorization from the Engineer to produce a trial batch, provide a plant-produced trial batch, including the WMA additive or process, if

applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 5 and Table 11. In lieu of a new trial batch, the Engineer may accept test results from recent production of the same mixture.

(8) Trial Batch Production Equipment. To produce the trial batch, use only equipment and materials proposed for use on the project.

(9) Trial Batch Quantity. Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

(10) Number of Trial Batches. Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

(11) Development of JMF2. After the Engineer grants full approval of JMF1 based on the Engineer's results from the trial batch, evaluate the Engineer's trial batch test results, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt content or gradation to achieve the specified target laboratory-molded density. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements for production shown in Table 8. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 5.

(12) Mixture Production. After receiving approval for JMF2 and receiving a passing result from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch, use JMF2 to produce Lot 1 as described in Section 3XXX.4.I.3.a.(1)"Lot 1 Placement." As an option, once JMF2 is approved, proceed to Lot 1 production at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

If electing to proceed without Hamburg Wheel test results from the trial batch, notify the Engineer. Note that the Engineer may require up to the entire lot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

(13) Development of JMF3. Evaluate the Engineer's test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

(14) JMF Adjustments. If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start on a new lot;
- be numbered in sequence to the previous JMF;

- meet the mixture requirements in Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of JMF2 listed in Table 11.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[1,2]
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[1,2]
% passing the #200 sieve			±2.0[1,2]
Asphalt content, %	Tex-236-F	±0.5	±0.3[2]
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0
VMA, %, min		Note 3	Note 3

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
2. Only applies to mixture produced for Lot 1 and higher.
3. Mixture is required to meet Table 8 requirements.

b. Engineer's Responsibilities.

(1) Gyratory Compactor. For mixtures designed in accordance with Tex-204-F, Part I, the Engineer will use a Department TGC, calibrated according to Tex-914-K, to mold samples for trial batch and production testing. The Engineer will make the Department TGC and the Department field laboratory available if the Contractor elects to mold production samples.

For mixtures designed in accordance with Tex-204-F, Part IV, the Engineer will use a Department SGC, calibrated in accordance with Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available if the Contractor elects to mold production samples.

(2) Conditional Approval of JMF1 and Authorizing Trial Batch. Within 2 working days of receiving the mixture design report (JMF1) and all required materials and Contractor-provided Hamburg Wheel test results, the Engineer will review the Contractor's mix design report and verify conformance with all aggregates, asphalt, additives, recycled materials, and mixture specifications. The Engineer will grant the Contractor conditional approval of JMF1, if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel

test results with laboratory mixture design, a total of 10 working days is allowed for conditional approval of JMF 1. The Engineer will base full approval of JMF1 on test results on mixture from the trial batch.

The Engineer will determine the Micro-Deval abrasion loss and will estimate the magnesium sulfate soundness loss for each coarse aggregate source in accordance with Section 3XXX.2.A.1, "Coarse Aggregate." In addition to Micro-Deval testing, the Engineer may sample and test project materials at any time during the project to verify specification compliance. If the Engineer's test results are pending after 2 working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

(3) Hamburg Wheel Testing of JMF1. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 10.

(4) Ignition Oven Correction Factors. When applicable, the Engineer will use the samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for testing during production in accordance with Tex-236-F.

(5) Testing the Trial Batch. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in Table 11. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 10.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 9;
- Tex-461-A, to determine the need for additional magnesium sulfate soundness testing; and
- Tex-530-C, to retain and use for comparison purposes during production.

(6) Full Approval of JMF1. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in Table 11.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

(7) Approval of JMF2. The Engineer will approve JMF2 within 1 working day if the mixture meets the requirements in Table 5 and the gradation meets the master grading limits shown in Table 8. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

(8) Approval of Lot 1 Production. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch. The Contractor may proceed at their own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire lot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

(9) Approval of JMF3 and Subsequent JMF Changes. JMF3 and subsequent JMF changes are approved if they meet the mixture requirements in Table 5, the master grading limits shown in Table 8, and are within the operational tolerances of JMF2 listed in Table 11.

E. Production Operations. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

1. Storage and Heating of Materials. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernable increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr unless otherwise approved.

2. Mixing and Discharge of Materials. Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not

exceed 350°F (or 275ºF for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F.

When WMA is required, produce the WMA within the target temperature discharge range of 215ºF and 275ºF. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. The Engineer may determine the moisture content by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. The Engineer will obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

F. Hauling Operations. Before use, clean all truck beds to ensure that mixture is not contaminated. When a release agent is necessary, use a release agent on the approved list maintained by the Construction Division to coat the inside bed of the truck.

Use only equipment for hauling as defined in Section 3XXX.4.G.3.c, "Hauling Equipment." Other hauling equipment may be used when allowed by the Engineer.

G. Placement Operations. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed by the Engineer. When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly. Place mixture within the compacted lift thickness shown in Table 12 unless otherwise shown on the plans or allowed. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans.

Table 12
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
A	3.00	6.00	2.00
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

1. Weather Conditions.

a. When Using a Pave-IR System for Specification Compliance. The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 32°F; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving. Operate the Pave-IR system in accordance with Tex-244-F and demonstrate to the Engineer that no recurring severe thermal segregation exists. Provide the Engineer with the automated report described in Tex-244-F on a daily basis unless otherwise directed.

b. When Not Using a Pave-IR System for Specification Compliance. Place mixture when the roadway surface temperature is equal to or higher than the temperatures listed in Table 13 unless otherwise approved ~~or as shown on the plans~~. Measure the roadway surface temperature with a handheld infrared thermometer. The Engineer may allow mixture placement to begin prior to the roadway surface reaching the required temperature requirements, if conditions are such that the roadway surface will reach the required temperature within 2 hours of beginning placement operations. ~~Unless otherwise shown on the plans,~~ Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.

Table 13
Minimum Pavement Surface Temperatures

Originally Specified High Temperature Binder Grade	Minimum Pavement Surface Temperatures in Degrees Fahrenheit	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64 or lower	45	50
PG 70	55[1]	60[1]
PG 76 or higher	60[1]	60[1]

1. Contractors may pave at temperatures 10°F lower than the values shown in Table 13 when utilizing a paving process including WMA or equipment that eliminates thermal segregation. In such cases, the Contractor must use either a hand held thermal camera or a hand held infrared thermometer operated in accordance with Tex-244-F to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal segregation.

2. **Tack Coat.** Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply the tack coat in a uniform manner such that streaks and other irregular patterns are avoided. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely prior to placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

3. **Lay-Down Operations.**

   a. **Thermal Profile.** The Engineer may use an infrared thermometer or thermal camera to obtain thermal profiles in accordance with Tex-244-F. The Engineer may obtain as many thermal profiles as deemed necessary. Thermal profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.J.1.b, "Miscellaneous Areas."

      (1) **Moderate Thermal Segregation.** Any areas that have a maximum temperature differential greater than 25°F but not exceeding 50°F are deemed as having moderate thermal segregation. Take immediate corrective action to eliminate the moderate thermal segregation. The Engineer may evaluate areas with moderate thermal segregation by performing density profiles in accordance with Section 3XXX.4.J.3.b, "Segregation (Density Profile)."

      (2) **Severe Thermal Segregation.** Any areas that have a maximum temperature differential greater than 50°F are deemed as having severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Item. The Engineer may evaluate areas with severe thermal segregation by performing density profiles in accordance with Section 3XXX.4.J.3.b, "Segregation (Density Profile)." Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed.

      (3) **Use of the Pave-IR System.** The Contractor may use the Pave-IR system (paver mounted infrared bar) to obtain a continuous thermal profile in accordance with Tex-244-F. When electing to use the Pave-IR system, notify the Engineer prior to beginning placement operations and specify if using the Pave-IR system for information only or for specification compliance to meet the requirements noted in Section 3XXX.4.G.1,"Weather Conditions" or Section 3XXX.4.G.3.c."Hauling Equipment."

When using the Pave-IR system for specification compliance, review the output results on a daily basis. Unless otherwise directed, provide the automated report described in Tex-244-F to the Engineer for review. Modify the paving process as necessary to eliminate any (moderate or severe) thermal segregation identified by the Pave-IR system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and are not applicable when using the Pave-IR system for specification compliance. Upon completion of use of the Pave-IR system for specification compliance or as requested by the Engineer, provide the Engineer with electronic copies of all daily data files that can be used with the Pave-IR system software to generate temperature profile plots.

b. Windrow Operations. When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

c. Hauling Equipment. The Contractor may elect to use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with a MTD with remixing capability or when a Pave-IR system is used for specification compliance unless otherwise allowed by the Engineer.

d. Screed Heaters. If the paver stops for more than 5 minutes, turn off screed heaters to prevent overheating of the mat. If the screed heater remains on for more than 5 minutes while the paver is stopped, the Engineer may evaluate the suspect area in accordance with Section 3XXX.4.J.3.d, "Recovered Asphalt Dynamic Shear Rheometer (DSR)."

H. Compaction. Furnish the type, size, and number or rollers required for compaction as approved. Uniformly compact the pavement to contain from 5% to 9% in-place air voids. Use the control strip method given in Tex-207-F, Part IV, to establish the rolling pattern. On the first day of production, provide the Engineer with control strip results that indicate the selected rolling pattern will produce the desired in-place air voids unless otherwise directed. Use a pneumatic-tire roller to seal the surface unless otherwise directed. Use additional rollers as required to remove any roller marks. Do not use pneumatic-tire rollers if excessive pickup of fines by roller tires occurs. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic~~,~~ unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

I. Production Acceptance.

1. Production Lot. Each day of production is defined as a production lot. Lots will be sequentially numbered and will correspond to each new day of production. Note that lots are not subdivided into sublots for this specification; however, the Engineer may perform multiple tests on any given lot.

2. Production Sampling.

a. Mixture Sampling. The Engineer may obtain mixture samples at any time during production. These samples will be obtained in accordance with Tex-222-F.

b. Asphalt Binder Sampling. The Engineer may obtain or require the Contractor to obtain 1 qt. samples of the asphalt binder at any time during production. These samples will be obtained in accordance with Tex-500-C, Part II, from a port located immediately upstream from the mixing drum or pug mill. The Engineer may test any of the asphalt binder samples to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

3. Production Testing. The Engineer may perform any production testing listed in Table 14 at any time during the project to verify specification compliance. The Engineer may suspend production if production tests do not meet specifications or are not within operational tolerances listed in Table 11. The Contractor is not required but may perform any test listed in Table 14 for quality control purposes.

If the Engineer's laboratory-molded density on any sample is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may use alternate methods for determining the asphalt content and aggregate gradation. The applicable test procedure will be used if an alternate test method is selected.

Table 14
Production and Placement Testing

Description	Test Method
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F
Individual % retained for sieves smaller than #8 and larger than #200	
% passing the #200 sieve	
Laboratory-molded density	Tex-207-F
VMA	
Laboratory-molded bulk specific gravity	
In-Place air voids	
Segregation (density profile)[2]	Tex-207-F, Part V
Longitudinal joint density	Tex-207-F, Part VII
Moisture content	Tex-212-F, Part II
Theoretical maximum specific (Rice) gravity	Tex-227-F
Asphalt content	Tex-236-F
Hamburg Wheel test	Tex-242-F
Recycled Asphalt Shingles (RAS)[1]	Tex-217-F, Part III
Thermal profile[2]	Tex-244-F
Asphalt binder sampling and testing	Tex-500-C
Boil test	Tex-530-C

1. Testing performed by the Construction Division or designated laboratory.
2. Not required when the Pave-IR system is used for specification compliance.

a. Voids in the Mineral Aggregate (VMA). The Engineer may determine the VMA for any production lot. Take immediate corrective action if the VMA value for any lot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the lot to be left in place without payment.

b. Hamburg Wheel Test. The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. When the production or core samples fail the Hamburg Wheel test criteria in Table 10, suspend production until further Hamburg Wheel tests meet the specified values. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire lot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by retesting the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

4. **Individual Loads of Hot Mix.** The Engineer can reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load and the Engineer may require removal.

J. Placement Acceptance.

1. **Placement Lot.** A placement lot is defined as the area placed during a production lot (one day's production). Placement lot numbers will correspond with production lot numbers. The Engineer may perform multiple tests on any given lot.

   a. **Shoulders, Ramps, Etc.** Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination unless designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

   b. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Intersections and temporary detours will be considered miscellaneous areas when shown on the plans. Miscellaneous areas also include level-ups and thin overlays, if the layer thickness designated on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 12. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans. Miscellaneous areas are not eligible for random placement sampling locations. Compact areas that are not subject to in-place air void determination in accordance with Section 3XXX.4.H, "Compaction."

2. **Placement Sampling.** Provide the equipment and means to obtain and trim roadway cores on-site. On-site is hereby defined as in close proximity to where the cores are taken. Obtain the cores within 1 working day of the time the placement lot is completed unless otherwise approved. Unless otherwise shown on the plans, obtain two 6-in. diameter cores side by side at each location selected by the Engineer for in-place air void determination. For Type D and Type F mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to ensure that an adequate bond will be achieved during subsequent placement operations.

Immediately after obtaining the cores from the roadway, trim the cores in accordance with Tex-207-F if the core heights meets the minimum untrimmed values listed in Table 12. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the date and lot number on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until testing by the Department is completed. Prior to turning the trimmed cores over to the Engineer, the Contractor may elect to wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may elect to have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use the Construction Division's protocol to provide a secure means and process that protects the integrity of the cores during transport.

In lieu of the Contractor trimming the cores on-site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Trimming of the cores may be performed by either the Department or Contractor representative. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Immediately after obtaining the cores, dry the core holes and tack the sides and bottom. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

3. **Placement Testing.** The Engineer may perform any placement testing listed in Table 14 at any time during the project to verify specification compliance. The Engineer may suspend production if placement tests do not meet specifications or are not within operational tolerances listed in Table 11. The Contractor is not required but may perform any test listed in Table 14 for quality control purposes.

   a. **In-Place Air Voids.** The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Cores not meeting the height requirements in Table 12 will not be tested. Before drying to a constant weight, cores may be pre-dried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the corresponding theoretical maximum specific gravity to determine the air void content of each core. The Engineer will use the average air void content of the 2 cores to determine the in-place air voids at the selected location.

The Engineer will use the vacuum method to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core to if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

If the in-place air void content determined by the Engineer is below 5% or greater than 9%, take immediate corrective action to bring the operation within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow paving to resume when the proposed corrective action is likely to yield acceptable results.

b. Segregation (Density Profile). The Engineer may measure the density profile any time the screed stops, on areas that have thermal segregation, on areas that have visible segregation, and as often as deemed necessary to verify conformance. These profiles will be performed in accordance with Tex-207-F, Part V. Density profiles are not applicable when the Contractor uses a Pave-IR system for specification compliance or when paving ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.J.1.b, "Miscellaneous Areas."

The density profile is considered failing if it exceeds the tolerances in Table 15. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3XXX.4.J.4, "Irregularities."

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. The Engineer may suspend production if a density profiles fails. Resume production after the Engineer approves changes to production or placement methods.

Table 15
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
Type A & Type B	8.0 pcf	5.0 pcf
Type C, Type D & Type F	6.0 pcf	3.0 pcf

c. Longitudinal Joint Density. The Engineer may perform a joint density evaluation as often as deemed necessary to verify conformance. These evaluations will be performed at each pavement edge that is or will become a longitudinal joint in accordance with Tex-207-F, Part VII. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core location, and the correlated joint density is less than 90.0%.

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. The Engineer may suspend production if an evaluation fails. Resume production after the Engineer approves changes to production or placement methods.

d. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** When the Pave-IR system is not used for specification compliance, the Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Construction Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. DSR values are obtained according to AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4. **Irregularities.** Identify and correct irregularities including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does not bond to the existing pavement. If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than 1 day while the Contractor is taking appropriate corrective action.

5. **Ride Quality.** Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces" unless otherwise shown on the plans.

5. Measurement. Hot mix will be measured by the ton of composite hot mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under Article 5, "Measurement," will be paid for at the unit price bid for "Dense Graded Hot-Mix Asphalt (Method)" of the type, surface aggregate classification, and binder specified. These prices are full compensation for surface preparation; materials including tack coat; placement; equipment; labor; tools; and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Pay adjustment for ride quality if applicable will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

SPECIAL SPECIFICATION

3XXX for Item 341 / Special Specification 3224

Dense-Graded Hot-Mix Asphalt (QC/QA)

1. **Description.** Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant.

2. **Materials.** Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

   Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance.

   A. Aggregate. Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

      1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve.
         Provide aggregate from sources listed in the BRSQC located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Use only the rated values for hot mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot mix. Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Do not add material to a stockpile that has been tested and approved, for sources not listed on the Department's *Bituminous Rated Source Quality Catalog* (BRSQC). Provide coarse aggregate with at least the minimum SAC as shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.

a. Blending Class A and Class B Aggregates. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. For blending purposes, coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate.

When the Contractor blends Class A and B aggregates to meet a Class A requirement, the Engineer may perform tests at any time during production to ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. In such cases where the Engineer elects to verify conformance, the Engineer will use the Department's mix design program to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the program; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

b. Micro-Deval Abrasion. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing prior to the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer will estimate the magnesium sulfate soundness loss ($Mg_{est.}$) for each coarse aggregate source by multiplying the RSSM value by the ratio of the actual Micro-Deval percent loss ($MD_{act.}$) divided by the Rated Source Micro-Deval (RSMD) using the formula $Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$. When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use~~,~~ unless otherwise approved by the Geotechnical, Soils, & Aggregates

Branch of the Construction Division. Additional testing may be required prior to granting approval.

2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. When used, supply intermediate aggregates that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. When used, supply intermediate aggregate from coarse aggregate sources that meet the requirements shown in Table 1~~,~~ unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

3. **Fine Aggregate.** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed fine aggregate. With the exception of field sand, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 1~~,~~ unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.5
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	30
Coarse aggregate angularity, 2 crushed faces, %, min	Tex-460-A, Part I	85[2]
Flat and elongated particles @ 5:1, %, max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107-E	3
Combined Aggregate[3]		
Sand equivalent, %, min	Tex-203-F	45

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3XXX.2.A.1, "Coarse Aggregate."
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

B. Mineral Filler. Mineral filler consists of finely divided mineral matter, such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% mineral hydrated lime unless otherwise shown on the plans. If a substitute binder is used, do not use more than 1% hydrated lime unless otherwise shown on the plans or allowed by the Engineer. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- is sufficiently dry, free-flowing, and free from clump and foreign matter;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

C. Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

D. Asphalt Binder. Furnish the type and grade of performance-graded (PG) asphalt specified on the plans. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 4 in lieu of the PG binder originally specified, if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.J, “Performance-Graded Binders;”
- the substitute binder has an un-aged dynamic shear value less than or equal to 2.00 kPa and an RTFO aged dynamic shear value less than or equal to 5.00 kPa at the PG test temperature; and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 4
Allowable Substitute PG Binders

PG Binder Originally Specified	Allowable Substitute PG Binders
PG 76-22	PG 70-22 or ~~PG 64-22~~ PG 64-28
PG 70-22	PG 64-22 or ~~PG 58-22~~ PG 58-28
PG 64-22	PG 58-22
PG 76-28	PG 70-28 or ~~PG 64-28~~ PG 64-34
PG 70-28	PG 64-28 or ~~PG 58-28~~ PG 58-34
PG 64-28	PG 58-28

E. Tack Coat. ~~Unless otherwise shown on the plans or approved,~~ Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed by the Engineer or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least 1 sample of the tack coat binder per project in accordance with Tex-500-C, Part III and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

F. Additives. Use the type and rate of additive specified when shown on the plans. Other additives that facilitate mixing, compaction, or improve the quality of the mixture may be allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

1. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

2. **Warm Mix Asphalt (WMA).** Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215ºF and 275ºF using Department approved WMA additives or processes. The Department's approved list of WMA additives and processes is located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm.

   WMA is allowed for use on all projects and is required when shown on plans. The maximum placement or target discharge temperature for WMA may be set at a value less than 275ºF when shown on the plans.

   Department approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures greater than 275ºF; however, such mixtures will not be defined as WMA.

G. Recycled Materials. Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 5. The allowable percentages shown in Table 5 may be decreased or increased

when shown on the plans. Determine asphalt content and gradation of the RAP and RAS material for mixture design purposes in accordance with Tex-236-F. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. When RAP or RAS is used, calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production. During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve.

   Use of Contractor-owned RAP including HMA plant waste is permitted~~,~~ unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. This allowance does not apply to a Contractor using unfractionated RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

   Fractionated RAP is defined as having 2 or more RAP stockpiles, divided into coarse and fine fractions. The coarse RAP stockpile will contain only material retained by processing over a 3/8 in. screen or 1/2 in. screen~~,~~ unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8 in. screen or 1/2 in. screen~~,~~ unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8 in. screen or 1/2 in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

   Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

   Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

2. **RAS.** Use of post-manufactured RAS or post-consumer RAS is permitted unless otherwise shown on the plans. RAS are defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS are processed manufacturer's shingle scrap by-product. Post-consumer RAS, or tear-offs, are processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the Texas Commission on Environmental Quality (TCEQ). RAS may be used separately or in conjunction with RAP.

   Process the RAS by ambient grinding or granulating such that 100% of the particles pass ~~the 1/2 in. sieve and 95% pass~~ the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material prior to extraction (or ignition) of the asphalt.

   Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. ~~When RAS is pre-blended with sand or fine RAP, show the materials as two separate bins on the mixture design job mix formula (JMF) even though the combined materials are added using a single cold feed bin.~~ For any stockpile that contains RAS, the entire stockpile will be considered to be a RAS stockpile and limited to no more than 5.0% of the HMA mixture in accordance with Table 5.

   Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials (NRM) Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established NRM. ~~Unless otherwise directed,~~ Use ~~only~~ RAS from shingle sources on the Construction Division's "Nonhazardous Recycled Materials" approved list at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Prior to use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than ~~1.5~~ 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval to the Engineer prior to submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

Table 5
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder[1] to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
		Unfractionated RAP[2]	Fractionated RAP[3]	RAS[4]
Surface Mixes[5]	30.0	10.0	20.0	5.0
Non-Surface Mixes[6] < 8 in. From Final Riding Surface	35.0	10.0	30.0	5.0
Non-Surface Mixes[6] > 8 in. From Final Riding Surface	40.0	10.0	40.0	5.0

1. Combined recycled binder from RAP and RAS.
2. Do not use in combination with RAS or fractionated RAP.
3. May not be used in addition to unfractionated RAP; however, up to 5% of fractionated RAP may be replaced with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.
5. "Surface" mixes are defined as mixtures that will be the final lift or riding surface of the pavement structure.
6. "Non-Surface" mixes are defined as mixtures that will be an intermediate or base layer in the pavement structure.

3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. Construction. Produce, haul, place, and compact the specified paving mixture. On or before the first day of paving, it is mandatory to schedule and participate in a pre-paving meeting with the Engineer unless otherwise shown on the plans.

A. Certification. Personnel certified by the Department-approved Hot Mix Asphalt Center Certification Program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design that is developed and signed by a Level 2 certified specialist. Provide a Level 1A certified specialist at the plant during production operations. Provide a Level 1B certified specialist to conduct placement tests.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level
1. Aggregate and Recycled Material Testing				
Sampling	Tex-400-A	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Parts I & III	✓	✓	2
Decantation	Tex-217-F, Part II	✓	✓	2
Los Angeles abrasion	Tex-410-A		✓	
Magnesium sulfate soundness	Tex-411-A		✓	
Micro-Deval abrasion	Tex-461-A		✓	
Coarse aggregate angularity	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors[1]	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Hamburg wheel test	Tex-242-F	✓	✓	2
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting random numbers	Tex-225-F, Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	1A
Rice gravity	Tex-227-F	✓	✓	1A
Gradation & asphalt content[1]	Tex-236-F	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	2
Micro-Deval abrasion	Tex-461-A		✓	
Boil test	Tex-530-C	✓	✓	1A
Aging ratio	Tex-211-F		✓	
Overlay test	Tex-248-F		✓	
Cantabro test	Tex-245-F		✓	
5. Placement Testing				
Selecting random numbers	Tex-225-F, Part II		✓	1A/1B
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F	✓	✓	1A/1B
Establish rolling pattern	Tex-207-F	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 2
Segregation (density profile)	Tex-207-F, Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F, Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Tack coat adhesion	Tex-243-F		✓	1B

1. Refer to Section 3XXX.4.I.2.c for exceptions to using an ignition oven.
2. Profiler and operator are required to be certified at the Texas Transportation Institute facility.

B. Reporting and Responsibilities. Use Department-provided ~~software~~ templates to record and calculate all test data including but not limited to mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the latest version of the ~~software~~ templates at http://www.txdot.gov/txdot_library/consultants_contractors/forms/site_manager.htm or from the Engineer. The Engineer and the Contractor shall provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 7 unless otherwise approved. The Engineer and the Contractor shall immediately report to the other party any test result that requires production or placement to be suspended, a payment penalty, or fails to meet the specification requirements. Record and submit all test results and pertinent information on Department-provided ~~software~~ templates to the Engineer electronically by means of a portable USB flash drive, compact disk, or via email.

Subsequent sublots placed after test results are available to the Contractor, which require them to suspend operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3, "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1] Asphalt content[1] Laboratory-molded density[2] Moisture content[3] Boil test[3]	Contractor	Engineer	1 working day of completion of the sublot
Production Quality Assurance			
Gradation[3] Asphalt content[3] Laboratory-molded density[1] Hamburg wheel test[2] Boil test[3] Binder tests[2]	Engineer	Contractor	1 working day of completion of the sublot
Placement Quality Control			
In-place air voids[2] Segregation[1] Longitudinal joint density[1] Thermal profile[1]	Contractor	Engineer	~~Reported at the completion of each lot~~ 1 working day of completion of the lot
Placement Quality Assurance			
In-place air voids[1] Segregation[2] Longitudinal joint density[2] Thermal profile[2] Aging ratio[2]	Engineer	Contractor	1 working day of receipt of the trimmed cores for in-place air voids[4]
Pay adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. To be reported as soon as results become available.
3. To be performed at the frequency specified on the plans.
4. 2 days are allowed if cores can not be dried to constant weight within 1 day.

The Engineer will use the Department-provided ~~software~~ template to calculate all pay adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the pay adjustment summary documentation for the lot.

Use the procedures described in Tex-233-F to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

C. QCP. Develop and follow the QCP in detail. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP to the Engineer before the mandatory prepaving meeting. Receive the Engineer's approval of the QCP before beginning production. Include the following items in the QCP.

1. **Project Personnel.** For project personnel, include:
   - a list of individuals responsible for QC with authority to take corrective action; and
   - contact information for each individual listed.
2. **Material Delivery and Storage.** For material delivery and storage, include:
   - the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
   - aggregate stockpiling procedures to avoid contamination and segregation;
   - frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
   - procedure for monitoring the quality and variability of asphalt binder.
3. **Production.** For production, include:
   - loader operation procedures to avoid contamination in cold bins;
   - procedures for calibrating and controlling cold feeds;
   - procedures to eliminate debris or oversized material;
   - procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip);
   - procedures for reporting job control test results; and
   - procedures to avoid segregation and drain-down in the silo.
4. **Loading and Transporting.** For loading and transporting, include:
   - type and application method for release agents; and
   - truck loading procedures to avoid segregation.
5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory prepaving meeting, including date and location;
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

D. Mixture Design.

1. Design Requirements. The Contractor may elect to design the mixture using a Texas Gyratory Compactor (TGC) or a Superpave Gyratory Compactor (SGC)~~,~~ unless otherwise shown on the plans. Use the typical weight design example given in Tex-204-F, Part I, when using a TGC. Use the Superpave mixture design procedure given in Tex-204-F, Part IV, when using a SGC. Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

a. Target Laboratory Molded Density When The TGC Is Used. Design the mixture at a 96.5% target laboratory-molded density or as noted in Table 9. The target laboratory-molded density may be increased 0.5%, not to exceed 97.0%, at the Contractor's discretion. When electing to raise the target laboratory-molded density from the specified value, document the target value on the JMF1 submittal. Perform Hamburg and indirect tensile strength tests at the corresponding optimum asphalt content.

b. Design Number of Gyrations (Ndesign) When The SGC Is Used. Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion. When electing to reduce the Ndesign level from the specified value, document the target value on the JMF1 submittal. Perform Hamburg and indirect tensile strength tests at the corresponding optimum asphalt content.

Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at anytime during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided ~~software~~ template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation ~~Band~~ Limits (% Passing by Weight or Volume) and VMA[1] Requirements

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2”	100.0[2]	–	–	–	–
1-1/2"	98.0–100.0	100.0[2]	–	–	–
1"	78.0–94.0	98.0–100.0	100.0[2]	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	100.0[2]	–
1/2"	50.0–70.0	–	–	98.0–100.0	100.0[2]
3/8"	–	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum					
–	11.0	12.0	13.0	14.0	15.0

1. Voids in mineral aggregates.
2. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.5[1]
Design gyrations (Ndesign)	Tex-241-F	50~~gyrations~~[2]
Indirect tensile strength (dry), psi ~~(molded to 93% ±1% density)~~	Tex-226-F	85–200[3]
Boil test[4]	Tex-530-C	–

1. May be adjusted down to 96.0 or up to 97.0% when shown on the plans or specification or allowed by the Engineer when using the TGC (Tex-204-F, Part I).
2. May be adjusted within a range of 35–100 gyrations when shown on the plans or specification or allowed by the Engineer.
3. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 4.0 mm and less than 12.5 mm.
4. Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes[1] @ 12.5 mm[2] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000
PG 70		15,000
PG 76 or higher		20,000

1. May be decreased or waived when shown on the plans.
2. A minimum rut depth may also be required when shown on the plans.

2. Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation, target laboratory molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommend rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch~~,~~ unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.

a. Contractor's Responsibilities.

(1) Providing Gyratory Compactor. Use a Texas Gyratory Compactor (TGC) calibrated in accordance with Tex-914-K when electing or required to design the mixture in accordance with Tex-204-F, Part I, for molding production samples. Furnish a Superpave Gyratory Compactor (SGC) calibrated in accordance with Tex-241-F when electing or required to design the mixture in accordance with Tex-204-F, Part IV, for molding production samples. If the SGC is used, locate the SGC at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples.

(2) **Gyratory Compactor Correlation Factors.** Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different gyratory compactor. Apply the correlation factor to all subsequent production test results.

(3) **Submitting JMF1.** Furnish the Engineer a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. If opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, provide the Engineer with approximately 10,000 g of the design mixture and request that the Department perform the Hamburg Wheel test.

(4) **Supplying Aggregate.** Provide the Engineer with approximately 40 lb. of each aggregate stockpile~~,~~ unless otherwise directed.

(5) **Supplying Asphalt.** Provide the Engineer at least 1 gal. of the asphalt material and sufficient quantities of any additives proposed for use.

(6) **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F. Prior to the trial batch production, provide the Engineer with split samples of the mixtures, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design, if the mixture design and ignition oven are the same as previously used~~,~~ unless otherwise directed. Correction factors may be waived based on past experience when approved by the Engineer.

(7) **Boil Test.** Perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed by the Engineer. Use this sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

(8) **Trial Batch Production.** Upon receiving conditional approval of JMF1 and authorization from the Engineer to produce a trial batch, provide a plant-produced trial batch, including the WMA additive or process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 5 and Table 11. In lieu of a new trial batch, the Engineer may accept test results from recent production of the same mixture.

(9) **Trial Batch Production Equipment.** To produce the trial batch, use only equipment and materials proposed for use on the project.

(10) **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

(11) **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

(12) Trial Batch Sampling. Obtain a representative sample of the trial batch and split it into three equal portions, in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

(13) Trial Batch Testing. Test the trial batch to ensure that the mixture produced using the proposed JMF1 meets the mixture requirements in Table 11. The trial batch mixture must also be in compliance with the Hamburg Wheel requirement in Table 10. Use an approved laboratory to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

(14) Development of JMF2. After the Engineer grants full approval of JMF1 based on results from the trial batch, evaluate the trial batch test results, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt content or gradation to achieve the specified target laboratory-molded density. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements for production shown in Table 8. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 5.

(15) Mixture Production. After receiving approval for JMF2 and receiving a passing result from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch, use JMF2 to produce Lot 1 as described in Section 3XXX.4.I.3.a.(1)"Lot 1 Placement." As an option, once JMF2 is approved, proceed to Lot 1 production at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

If electing to proceed without Hamburg Wheel test results from the trial batch, notify the Engineer. Note that the Engineer may require up to the entire sublot of any mixture failing ~~either~~ the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

(16) Development of JMF3. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

(17) JMF Adjustments. If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start on a new lot;

- be numbered in sequence to the previous JMF;
- meet the mixture requirements in Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of JMF2 listed in Table 11.

(18) Requesting Referee Testing. If needed, use referee testing in accordance with Section 3XXX.4.I.1, "Referee Testing," to resolve testing differences with the Engineer.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[2,3]	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[2,3]	±3.0
% passing the #200 sieve			±2.0[2,3]	±1.6
Asphalt content, %	Tex-236-F	±0.5	±0.3[3]	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±1.0
In-place air voids, %		N/A	N/A	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, %, min		Note 4	Note 4	N/A
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	N/A	±0.020

1. Contractor may request referee testing only when values exceed these tolerances.
2. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
3. Only applies to mixture produced for Lot 1 and higher.
4. Test and verify that Table 8 requirements are met.

b. Engineer's Responsibilities.

(1) Gyratory Compactor. For mixtures designed in accordance with Tex-204-F, Part I, the Engineer will use a Department TGC, calibrated according to Tex-914-K, to mold samples for trial batch and production testing. The Engineer will make the Department TGC and the Department field laboratory available to the Contractor for molding verification samples, if requested by the Contractor.

For mixtures designed in accordance with Tex-204-F, Part IV, the Engineer will use a Department SGC, calibrated in accordance with Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

(2) Conditional Approval of JMF1 and Authorizing Trial Batch. Within 2 working days of receiving the mixture design report (JMF1) and all

required materials and Contractor-provided Hamburg Wheel test results, the Engineer will review the Contractor's mix design report and verify conformance with all aggregates, asphalt, additives, recycled materials, and mixture specifications. The Engineer will grant the Contractor conditional approval of JMF1, if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test results with laboratory mixture design, a total of 10 working days is allowed for conditional approval of JMF 1. The Engineer will base full approval of JMF1 on test results on mixture from the trial batch.

The Engineer will determine the Micro-Deval abrasion loss and will estimate the magnesium sulfate soundness loss for each coarse aggregate source in accordance with Section 3XXX.2.A.1, "Coarse Aggregate." In addition to Micro-Deval testing, the Engineer may sample and test project materials at any time during the project to verify specification compliance. If the Engineer's test results are pending after 2 working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

(3) Hamburg Wheel Testing of JMF1. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 10.

(4) Ignition Oven Correction Factors. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for quality assurance testing during production in accordance with Tex-236-F.

(5) Testing the Trial Batch. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in Table 11. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 10.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 9;
- Tex-461-A, to determine the need for additional magnesium sulfate soundness testing; and

- Tex-530-C, to retain and use for comparison purposes during production.

(6) Full Approval of JMF1. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in Table 11. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

(7) Approval of JMF2. The Engineer will approve JMF2 within 1 working day if the mixture meets the requirements in Table 5 and the gradation meets the master grading limits shown in Table 8. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

(8) Approval of Lot 1 Production. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch. ~~As an option,~~ The Contractor may proceed at their own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

(9) Approval of JMF3 and Subsequent JMF Changes. ~~The Engineer will approve JMF3 within 1 working day if it meets~~ JMF3 and subsequent JMF changes are approved if they meet the mixture requirements in Table 5, the master grading limits shown in Table 8, and are within the operational tolerances of JMF2 listed in Table 11.

E. Production Operations. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

1. Storage and Heating of Materials. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernable increments) in accordance with Item 320, "Equipment for Asphalt

Concrete Pavement." Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr unless otherwise approved.

2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F (or 275ºF for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F.

   When WMA is required, produce the WMA within the target temperature discharge range of 215ºF and 275ºF. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

   Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. If requested, determine the moisture content by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

F. Hauling Operations. Before use, clean all truck beds to ensure that mixture is not contaminated. When a release agent is necessary, use a release agent on the approved list maintained by the Construction Division to coat the inside bed of the truck.

Use only equipment for hauling as defined in Section 3XXX.4.G.3.c, "Hauling Equipment." Other hauling equipment may be used when allowed by the Engineer.

G. Placement Operations. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed by the Engineer. When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain

properly. Place mixture within the compacted lift thickness shown in Table 12~~,~~ unless otherwise shown on the plans or allowed. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans.

Table 12
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
A	3.00	6.00	2.00
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

1. Weather Conditions.

a. When Using a Pave-IR System for Specification Compliance. The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 32°F; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving. Operate the Pave-IR system in accordance with Tex-244-F and demonstrate to the Engineer that no recurring severe thermal segregation exists. Provide the Engineer with the automated report described in Tex-244-F on a daily basis unless otherwise directed.

b. When Not Using a Pave-IR System for Specification Compliance. Place mixture when the roadway surface temperature is equal to or higher than the temperatures listed in Table 13 unless otherwise approved~~ or as shown on the plans~~. Measure the roadway surface temperature with a handheld infrared thermometer. The Engineer may allow mixture placement to begin prior to the roadway surface reaching the required temperature requirements, if conditions are such that the roadway surface will reach the required temperature within 2 hours of beginning placement operations. ~~Unless otherwise shown on the plans,~~ Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.

Table 13
Minimum Pavement Surface Temperatures

	Minimum Pavement Surface Temperatures in Degrees Fahrenheit	
Originally Specified High Temperature Binder Grade	**Subsurface Layers or Night Paving Operations**	**Surface Layers Placed in Daylight Operations**
PG 64 or lower	45	50
PG 70	55[1]	60[1]
PG 76 or higher	60[1]	60[1]

1. Contractors may pave at temperatures 10°F lower than these values ~~shown in Table 13~~ when utilizing a paving process including WMA or equipment that eliminates thermal segregation. In such cases, the Contractor must use either a hand held thermal camera or a hand held infrared thermometer operated in accordance with Tex-244-F to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal segregation.

2. Tack Coat. Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply the tack coat in a uniform manner such that streaks and other irregular patterns are avoided. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely prior to placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

3. Lay-Down Operations.

a. Thermal Profile. Use an infrared thermometer or thermal camera to obtain ~~a~~ thermal profiles on each sublot in accordance with Tex-244-F. The Engineer will obtain a thermal profile at least once per project and may obtain as many thermal profiles as deemed necessary. Thermal profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas."

At the completion of each lot, provide the Engineer with the thermal profile of every sublot within the lot. Report the results of each thermal profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

(1) Moderate Thermal Segregation. Any areas that have a maximum temperature differential greater than 25°F but not exceeding 50°F are deemed as having moderate thermal segregation. Take immediate corrective action to eliminate the moderate thermal segregation. Evaluate areas with moderate thermal segregation by performing ~~a~~ density profiles in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile)."

(2) Severe Thermal Segregation. Any areas that have a maximum temperature differential greater than 50°F are deemed as having severe thermal segregation. When the Pave-IR system is not used for specification compliance, no production or placement bonus will be paid for any sublot that contains severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Item. Evaluate areas with severe thermal segregation by performing ~~a~~ density profiles in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile)." Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed. The sublot in question may receive a production and placement bonus if applicable when the defective material is successfully removed and replaced.

(3) Use of the Pave-IR System. In lieu of obtaining thermal profiles on each sublot using an infrared thermometer or thermal camera, the Contractor may use the Pave-IR system (paver mounted infrared bar) to obtain a continuous thermal profile in accordance with Tex-244-F. When electing to use the Pave-IR system, notify the Engineer prior to beginning placement operations and specify if using the Pave-IR system for specification compliance or for information only. When electing to use the Pave-IR system for information only, use an infrared thermometer or thermal camera to obtain thermal profiles in accordance with Tex-244-F. When electing to use the Pave-IR system for information only, segregation density profiles are applicable.

When using the Pave-IR system for specification compliance, review the output results on a daily basis. ~~and,~~ Unless otherwise directed, provide the automated report described in Tex-244-F to the Engineer for review. Modify the paving process as necessary to eliminate any (moderate or severe) thermal segregation identified by the Pave-IR system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles ~~in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile),"~~ are not required and are not applicable when using the Pave-IR system for specification compliance. Upon completion of use of the Pave-IR system for specification compliance or as requested by the Engineer, provide the Engineer with electronic copies of all daily data files that can be used with the Pave-IR system software to generate temperature profile plots.

b. Windrow Operations. When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

c. **Hauling Equipment.** The Contractor may elect to use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with a MTD with remixing capability or when a Pave-IR system is used for specification compliance~~,~~ unless otherwise allowed by the Engineer.

d. **Screed Heaters.** If the paver stops for more than 5 minutes, turn off screed heaters to prevent overheating of the mat. If the screed heater remains on for more than 5 minutes while the paver is stopped, the Engineer may evaluate the suspect area in accordance with Section 3XXX.4.I.3.c(4),"Recovered Asphalt Dynamic Shear Rheometer (DSR)."

H. Compaction. Uniformly compact the pavement to the density requirements of the specification. Use the control strip method given in Tex-207-F, Part IV, to establish the rolling pattern. Do not use pneumatic-tire rollers if excessive pickup of fines by roller tires occurs. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Where specific in-place air void requirements are waived, furnish and operate compaction equipment as approved. Monitor the paving operation and ensure that the compacted mat has between 2.7% and 9.9% in-place air voids. When the in-place air voids are outside this range, take immediate corrective action to bring the operation within these tolerances. The Engineer may suspend operations or require removal and replacement if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow paving to resume when the proposed corrective action is likely to yield acceptable results. Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F~~,~~ unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic~~,~~ unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

I. Acceptance Plan. Pay adjustments for the material will be in accordance with Article 6, "Payment."

Sample and test the hot mix on a lot and sublot basis. If the production pay factor given in Section 3XXX.6.A, "Production Pay Adjustment Factors," for 2 consecutive lots or the placement pay factor given in Section 3XXX.6.B, "Placement Pay Adjustment Factors," for 2 consecutive lots is below 1.000, suspend production until test results or other information indicate to the satisfaction of the Engineer that the next material produced or placed will result in pay factors of at least 1.000.

1. **Referee Testing.** The Construction Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 11 and the differences cannot be resolved. Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the samples are received at the referee laboratory for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than 3 referee tests per project are required and the Engineer's test results are closer than the Contractor's test results to the referee test results.

   The Construction Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory and the Engineer's average maximum theoretical specific gravity for the lot. With the exception of "remove and replace" conditions, referee test results are final and will establish pay adjustment factors for the sublot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement pay adjustment factor for any sublot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with Section 3XXX.6.B.2, "Placement Sublots Subject to Removal and Replacement."

2. **Production Acceptance.**

   a. **Production Lot.** A production lot consists of 4 equal sublots. The default quantity for Lot 1 is 1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately 3 to 4 sublots are produced each day. The lot size will be between 1,000 tons and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

      If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. If the indirect tensile strength exceeds 200 psi, take corrective action to bring the mixture within specification compliance unless otherwise directed.

      (1) ~~**Small Quantity**~~ **Exempt Production.** When the anticipated daily production is less than 1,000 tons, the total production for the project is less than 5,000 tons, ~~when paving miscellaneous areas,~~ or when mutually agreed between the Engineer and the Contractor, the Engineer may deem the mixture as exempt production. Production may also be exempt when shown on the plans. All quality control and quality assurance (QC/QA) sampling and testing requirements are waived for exempt production and

the production and placement pay factors are 1.000. However, the Engineer will retain the right to perform random acceptance tests for production and placement and may reject objectionable materials and workmanship.

For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer;
- when not using the Pave-IR system for specification compliance, perform segregation (density profiles) and thermal profiles in accordance with the specification;
- control mixture production ~~to yield a laboratory-molded density that is~~ within ± 1.0% of the target laboratory-molded density as tested by the Engineer; and
- compact the mixture to yield in-place air voids that are greater than or equal to 2.7% and less than or equal to 9.9% as tested by the Engineer.

(2) Incomplete Production Lots. If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 3XXX.6.A, "Production Pay Adjustment Factors." Close all lots within 5 working days~~,~~ unless otherwise allowed by the Engineer.

b. Production Sampling.

(1) Mixture Sampling. Obtain hot mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until testing by the Department is completed.

(a) Random Sample. At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. For each sublot, take one sample at the location randomly selected. The Engineer will perform or witness the sampling of production sublots.

(b) Blind Sample. For ~~at least~~ 1 sublot per lot, the Engineer will obtain and test a "blind" sample in lieu of the random sample collected by the Contractor. The Contractor may test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor.

The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. ~~for no more than 1 sublot per lot at any time during production of the lot.~~ The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

(2) Informational Cantabro and Overlay Testing. During the first week of production, randomly select 1 sublot from Lot 2 or higher for Cantabro and Overlay testing. Obtain and provide the Engineer with approximately 150 lb. (70 kg) of mixture in sealed containers, boxes, or bags labeled with CSJ, mixture type, lot, and sublot number. The Engineer will ship the mixture to the Construction Division for Cantabro and Overlay testing. Results from these tests will not be used for specification compliance.

(3) Asphalt Binder Sampling. Obtain a 1 qt. sample of the asphalt binder for each lot of mixture produced. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill. Take the sample in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers and deliver the sample to the Engineer. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample, the Engineer will split a sample of the asphalt binder with the Contractor. The Engineer will test at least one asphalt binder sample per project to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

c. Production Testing. The Contractor and Engineer must perform production tests in accordance with Table 14. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in Table 11 for all sublots.

If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractors corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. ~~Unless otherwise allowed, the Engineer will require the Contractor to~~ Provide evidence that results from Tex-236-F are not reliable before requesting ~~permitting~~ permission to use an alternate method unless otherwise directed. If an alternate test method is allowed, use the applicable test procedure as directed.

Table 14
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot
VMA			
Laboratory-molded bulk specific gravity			
In-place air voids			
Segregation (density profile)[5]	Tex-207-F, Part V	1 per sublot	1 per project
Longitudinal joint density	Tex-207-F, Part VII		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	1 per sublot
Asphalt content	Tex-236-F	1 per sublot	1 per lot
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Recycled Asphalt Shingles (RAS)[2]	Tex-217-F, Part III	N/A	
Thermal profile[5]	Tex-244-F	1 per sublot	
Asphalt binder sampling and testing[1]	Tex-500-C	1 per lot (sample only)	
Boil test[3]	Tex-530-C	1 per lot	
Cantabro Test[4]	Tex-245-F	1 per project (sample only)	
Overlay Test[4]	Tex-248-F		

1. The Engineer may perform as many additional tests as deemed necessary.
2. Testing performed by the Construction Division or designated laboratory.
3. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
4. Testing performed by the Construction Division and for informational purposes only.
5. Not required when the Pave-IR system is used for specification compliance.

d. Operational Tolerances. Control the production process within the operational tolerances listed in Table 11. When production is suspended, the Engineer will allow production to resume when test results or other information indicates that the next mixture produced will be within the operational tolerances.

(1) Gradation. Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Unless otherwise directed, suspend production when test results for gradation exceed the operational tolerances for three consecutive sublots on the same sieve or four consecutive sublots on any sieve. The consecutive sublots may be from more than one lot.

(2) Asphalt Content. A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 11. No production or placement bonus will be paid for any sublot that is out of operational tolerance for asphalt content. Suspend production and shipment of mixture if the Engineer's or the Contractor's

asphalt content deviates from the current JMF by more than 0.5% for any sublot.

(3) Voids in the Mineral Aggregate (VMA). The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt content, the Engineer will use the asphalt content results from quality control testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 8. No production or placement bonus will be paid for any sublot that does not meet the minimum VMA requirement for production listed in Table 8 based on the Engineer's VMA determination.

Suspend production and shipment of mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

(4) Hamburg Wheel Test. The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. When the production or core samples fail the Hamburg Wheel test criteria in Table 10, suspend production until further Hamburg Wheel tests meet the specified values. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by retesting the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

e. Individual Loads of Hot Mix. The Engineer can reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are

within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load and the Engineer may require removal.

3. Placement Acceptance.

a. Placement Lot. A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

(1) Lot 1 Placement. Placement bonuses for Lot 1 will be in accordance with Section 3XXX.6.B, "Placement Pay Adjustment Factors." However, no placement penalty will be assessed for any sublot placed in Lot 1 when the in-place air voids are greater than or equal to 2.7% and less than or equal to 9.9%. Remove and replace any sublot with in-place air voids less than 2.7% or greater than 9.9%.

(2) Incomplete Placement Lots. An incomplete placement lot consists of the area placed as described in Section 3XXX.4.I.2.a(2), "Incomplete Production Lots," excluding ~~miscellaneous~~ areas ~~as~~ defined in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production sublot.

(3) Shoulders, Ramps, Etc. Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination~~,~~ unless designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

(4) Miscellaneous Areas. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Intersections and temporary detours will be considered miscellaneous areas when shown on the plans. Miscellaneous areas also include level-ups and thin overlays, if the layer thickness designated on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 12. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans. Miscellaneous areas are not eligible for random placement sampling locations. Compact areas that are not subject to in-place air void determination in accordance with Section 3XXX.4.H, "Compaction."

b. Placement Sampling. At the beginning of the project, the Engineer will select random numbers for all placement sublots. The Engineer will provide the Contractor with the placement random numbers immediately after the sublot is completed. Mark the roadway location at the completion of each sublot and record the station number. Determine 1 random sample location for each placement sublot in accordance with Tex-225-F. If the randomly generated

sample location is within 2 ft. of a joint or pavement edge, adjust the location by no more than necessary to achieve a 2-ft. clearance.

Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; however, if a random sample location falls on one of these areas and the area is designated on the plans as not subject to in-place air void determination, cores will not be taken for the sublot and a 1.000 pay factor will be assigned to that sublot.

Provide the equipment and means to obtain and trim roadway cores on-site. On-site is hereby defined as in close proximity to where the cores are taken. Obtain the cores within 1 working day of the time the placement sublot is completed unless otherwise approved. Obtain two 6-in. diameter cores side by side from within 1 ft. of the random location provided for the placement sublot. For Type D and Type F mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to ensure that an adequate bond will be achieved during subsequent placement operations.

Immediately after obtaining the cores from the roadway, trim the cores in accordance with Tex-207-F if the core heights ~~exceed~~ meets the minimum untrimmed values listed in Table 12. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the lot and sublot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until testing by the Department is completed. Prior to turning the trimmed cores over to the Engineer, the Contractor may elect to wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may elect to have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use the Construction Division's protocol to provide a secure means and process that protects the integrity of the cores during transport.

If the core height before trimming is less than the minimum untrimmed value shown in Table 12, decide whether to include the pair of cores in the air void determination for that sublot. If electing to have the cores included in air void determination, trim the cores as described above before delivering to the Engineer. If electing to not have the cores included in air void determination,

deliver untrimmed cores to the Engineer and inform the Engineer of the decision to not have the cores included in air void determination. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.

In lieu of the Contractor trimming the cores on-site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Trimming of the cores may be performed by either the Department or Contractor representative. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Immediately after obtaining the cores, dry the core holes and tack the sides and bottom. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

c. Placement Testing. Perform placement tests in accordance with Table 14. After the Engineer returns the cores, the Contractor has the option to test the cores to verify the Engineer's test results for in-place air voids. The allowable differences between the Contractor's and Engineer's test results are listed in Table 11.

(1) In-Place Air Voids. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be pre-dried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content for in-place air voids.

The Engineer will use the vacuum method to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core to determine the placement pay adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

When specific air-void requirements are waived, the Engineer may measure the in-place air voids to verify conformance with Section 3XXX.4.H, "Compaction."

(2) Segregation (Density Profile). Test for segregation using density profiles in accordance with Tex-207-F, Part V. Density profiles are not required and are not applicable when using the Pave-IR system for specification compliance. Density profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas."

Unless otherwise approved, perform a density profile every time the screed stops, on areas that are identified by either the Contractor or the Engineer as having thermal segregation, and on any visibly segregated areas. If the screed does not stop, and there are no visibly segregated areas or areas that are identified as having thermal segregation, perform a minimum of 1 profile per sublot.

At the completion of each lot, provide the Engineer with the density profile of every sublot within the lot. Report the results of each density profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances in Table 15. No production or placement bonus will be paid for any sublot that contains a failing density profile. When the Pave-IR system is not used for specification compliance, the Engineer will measure the density profile at least once per project and may measure the density profile at any time, at any location, and as often as deemed necessary to verify conformance. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3XXX.4.I.3.c(5), "Irregularities." The sublot in question may receive a production and placement bonus if applicable when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if 2 consecutive density profiles fail~~,~~ unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 15
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
Type A & Type B	8.0 pcf	5.0 pcf
Type C, Type D & Type F	6.0 pcf	3.0 pcf

(3) Longitudinal Joint Density.

(a) Informational Tests. While establishing the rolling pattern, perform joint density evaluations, and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern, if needed, to achieve the desired joint density. Perform additional joint density evaluations at least once per sublot~~,~~ unless otherwise directed.

(b) Record Tests. For each sublot, perform a joint density evaluation at each pavement edge that is or will become a longitudinal joint. Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results on Department forms to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location, and the correlated joint density is less than 90.0%. The Engineer will make an independent joint density verification at least once per project and may make independent joint density verifications at the random sample locations and as often as deemed necessary to verify conformance. The Engineer's joint density test results will be used when available.

At the completion of each lot, provide the Engineer with the joint density of every sublot within the lot. Report the results of each joint density in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if two consecutive evaluations fail~~,~~ unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

(4) Recovered Asphalt Dynamic Shear Rheometer (DSR). When the Pave-IR system is not used for specification compliance, the Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Construction Division. The aging ratio is the ~~dynamic shear rheometer (~~DSR~~)~~ value of the extracted binder divided by the DSR value of the original unaged binder. DSR values are obtained according to AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

(5) Irregularities. Identify and correct irregularities including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does not bond to the existing pavement. If irregularities are detected, the Engineer

may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than 1 day while the Contractor is taking appropriate corrective action.

4. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces" unless otherwise shown on the plans.

5. **Measurement.** Hot mix will be measured by the ton of composite hot mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

6. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under Article 5, "Measurement," will be paid for at the unit price bid for "Dense Graded Hot-Mix Asphalt (QC/QA)" of the type, surface aggregate classification, and binder specified. These prices are full compensation for surface preparation; materials including tack coat; placement; equipment; labor; tools; and incidentals.

   Pay adjustments for bonuses and penalties will be applied as determined in this Item; however, a pay adjustment factor of 1.000 will be assigned for all placement sublots for "level ups" only when "level up" is listed as part of the item bid description code.

   Applicable pay adjustment bonuses will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint density in accordance with Section 3XXX.4.B, "Reporting and Responsibilities." If the Contractor uses the Pave-IR system for specification compliance, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the Pave-IR system automated reports described in Tex-244-F are required.

   Trial batches will not be paid for unless they are included in pavement work approved by the Department.

   Pay adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

   ~~When WMA is specified on the plans, at the Contractor's request, the Engineer has the option to assign all sublots a production pay adjustment factor of 1.000. When the Engineer elects to assign all sublots a production pay adjustment factor of 1.000, control mixture production to yield a laboratory-molded density with an absolute deviation no greater than 1.0 percent from the target laboratory-molded density as defined in Table 9 or as shown on plans, as tested by the Engineer. The Engineer may suspend production and shipment of mixture if the laboratory-molded density deviates more than 1.0 percent from the target laboratory-molded density for two consecutive sublots.~~

   A. **Production Pay Adjustment Factors.** The production pay adjustment factor is based on the laboratory-molded density using the Engineer's test results. A pay adjustment factor will be determined from Table 16 for each sublot using the deviation from the target laboratory-molded density defined in Table 9. The production pay adjustment factor for completed lots will be the average of the pay adjustment factors for the 4 sublots sampled within that lot.

Table 16
Production Pay Adjustment Factors for Laboratory-Molded Density[1]

Absolute Deviation from Target Laboratory-Molded Density	Production Pay Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.965
1.2	0.930
1.3	0.895
1.4	0.860
1.5	0.825
1.6	0.790
1.7	0.755
1.8	0.720
> 1.8	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractors corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

1. **Payment for Incomplete Production Lots.** Production pay adjustments for incomplete lots, described under Section 3XXX.4.I.2.a(2), "Incomplete Production Lots," will be calculated using the average production pay factors from all sublots sampled. A production pay factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples.

2. **Production Sublots Subject to Removal and Replacement.** If after referee testing, the laboratory-molded density for any sublot results in a "remove and replace" condition as listed in Table 16, the Engineer may require removal and replacement, or may allow the sublot to be left in place without payment. The Engineer may also elect to accept the sublot in accordance with Item 5 "Control of the Work" Article 5.3.A "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Article.

B. Placement Pay Adjustment Factors. The placement pay adjustment factor is based on in-place air voids using the Engineer's test results. A pay adjustment factor will be determined from Table 17 for each sublot that requires in-place air void measurement. A placement pay adjustment factor of 1.000 will be assigned to the entire sublot when the random sample location falls in an area designated on the plans as not subject to in-place air void determination. A placement pay adjustment factor of 1.000 will be assigned to quantities placed in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas." The placement pay adjustment factor

for completed lots will be the average of the placement pay adjustment factors up to 4 sublots within that lot.

Table 17
Placement Pay Adjustment Factors for In-place Air Voids

In-place Air Voids	Placement Pay Adjustment Factor	In-place Air Voids	Placement Pay Adjustment Factor
< 2.7	Remove and Replace	6.4	1.042
2.7	0.705	6.5	1.040
2.8	0.720	6.6	1.038
2.9	0.735	6.7	1.036
3.0	0.750	6.8	1.034
3.1	0.765	6.9	1.032
3.2	0.780	7.0	1.030
3.3	0.795	7.1	1.028
3.4	0.810	7.2	1.026
3.5	0.825	7.3	1.024
3.6	0.840	7.4	1.022
3.7	0.855	7.5	1.020
3.8	0.870	7.6	1.018
3.9	0.885	7.7	1.016
4.0	0.900	7.8	1.014
4.1	0.915	7.9	1.012
4.2	0.930	8.0	1.010
4.3	0.945	8.1	1.008
4.4	0.960	8.2	1.006
4.5	0.975	8.3	1.004
4.6	0.990	8.4	1.002
4.7	1.005	8.5	1.000
4.8	1.020	8.6	0.998
4.9	1.035	8.7	0.996
5.0	1.050	8.8	0.994
5.1	1.050	8.9	0.992
5.2	1.050	9.0	0.990
5.3	1.050	9.1	0.960
5.4	1.050	9.2	0.930
5.5	1.050	9.3	0.900
5.6	1.050	9.4	0.870
5.7	1.050	9.5	0.840
5.8	1.050	9.6	0.810
5.9	1.050	9.7	0.780
6.0	1.050	9.8	0.750
6.1	1.048	9.9	0.720
6.2	1.046	> 9.9	Remove and Replace
6.3	1.044		

1. **Payment for Incomplete Placement Lots.** Pay adjustments for incomplete placement lots described under Section 3XXX.4.I.3.a.(2), "Incomplete Placement Lots," will be calculated using the average of the placement pay factors from all sublots sampled and sublots where the random location falls in an area designated on the plans as not eligible for in-place air void determination. A placement pay adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples.

2. **Placement Sublots Subject to Removal and Replacement.** If after referee testing, the placement pay adjustment factor for any sublot results in a "remove and replace" condition as listed in Table 17, the Engineer will choose the location of two cores to be taken within 3 ft. of the original failing core location. The Contractor will obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Pavements Section of the Construction Division, where they will be trimmed if necessary and tested for bulk specific gravity within 10 working days of receipt. The average bulk specific gravity of the cores will be divided by the Engineer's average maximum theoretical specific gravity for that lot to determine the new pay adjustment factor of the sublot in question. If the new pay adjustment factor is 0.700 or greater, the new pay adjustment factor will apply to that sublot. If the new pay adjustment factor is less than 0.700, no payment will be made for the sublot. Remove and replace the failing sublot, or the Engineer may allow the sublot to be left in place without payment. The Engineer may also elect to accept the sublot in accordance with Item 5 "Control of the Work" Article 5.3.A "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Article.

C. Total Adjustment Pay Calculation. Total adjustment pay (TAP) will be based on the applicable pay adjustment factors for production and placement for each lot.

$TAP = (A+B)/2$

Where:

A = Bid price × production lot quantity × average pay adjustment factor for the production lot
B = Bid price × placement lot quantity × average pay adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous ~~quantities~~ areas × 1.000)
Production lot quantity = Quantity actually placed - quantity left in place without payment
Placement lot quantity = Quantity actually placed - quantity left in placed without payment – quantity placed in miscellaneous areas

SPECIAL SPECIFICATION

3XXX for Item 342

Permeable Friction Course (PFC)

1. **Description.** Construct a hot-mix asphalt (HMA) surface course composed of a compacted permeable mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant.

2. **Materials.** Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

   Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance.

   A. Aggregate. Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section~~, unless otherwise shown on the plans~~. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse aggregate. Do not use intermediate or fine aggregate ~~or reclaimed asphalt pavement (RAP)~~ in PFC mixtures. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for ~~mechanically~~ crushed gravel or crushed stone ~~aggregates that meet the definitions in Tex-100-E~~. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II. ~~Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) unless otherwise approved.~~

      1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Provide aggregates from sources listed in the BRSQC located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Use only the rated values for hot mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregates sources used in hot mix. Provide

aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Do not add material to a stockpile that has been tested and approved, for sources not listed on the Department's *Bituminous Rated Source Quality Catalog* (BRSQC). Provide coarse aggregate with at least the minimum SAC as shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes~~, unless otherwise shown on the plans~~. When shown on the plans, SAC requirements apply to aggregates used on surfaces other than travel lanes. The SAC for sources on the Department's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.

a. Blending Class A and Class B Aggregates. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials; however, Class B virgin (non-recycled) aggregate may be disallowed when shown on the plans. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. ~~When blending, do not use Class C or D aggregates.~~ Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate.

When the Contractor blends Class A and B aggregates to meet a Class A requirement, the Engineer may perform tests at any time during production to ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. In such cases where the Engineer elects to verify conformance, the Engineer will use the Department's mix design program to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the program; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

b. Micro-Deval Abrasion. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing prior to the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer will estimate the magnesium sulfate soundness loss ($Mg_{est.}$) for each coarse aggregate source by multiplying the RSSM value by the ratio of the actual Micro-Deval percent

loss ($MD_{act.}$) divided by the Rated Source Micro-Deval (RSMD) using the formula $Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$. When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Geotechnical, Soils, & Aggregates Branch of the Construction Division. Additional testing may be required prior to granting approval.

Table 1
Coarse Aggregate Quality Requirements

Property	Test Method	Requirement
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.0
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	35
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	25
Coarse aggregate angularity, 2 crushed faces, %, min	Tex-460-A, Part I	95[2]
Flat and elongated particles @ 5:1, %, max	Tex-280-F	10

1. ~~Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.~~ Used to estimate the magnesium sulfate soundness loss in accordance with Section 3XXX.2.A.1, "Coarse Aggregate."
2. Only applies to crushed gravel.

~~**2. RAP.** Do not use RAP in PFC mixtures.~~

B. Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

C. Asphalt Binder. ~~Furnish performance-graded (PG) asphalt binder and fibers unless the plans specify asphalt-rubber (A-R) binder. Provide asphalt binder that meets~~ Furnish the type and grade of binder specified on the plans that meet the requirements of Item 300, "Asphalts, Oils, and Emulsions."

1. **PG Binder.** When PG binder is specified, provide an asphalt binder with a high-temperature grade of PG 76 and low-temperature grade as shown on the plans in accordance with Section 300.2.J, "Performance-Graded Binders."

2. **A-R Binder.** When A-R is specified, provide A-R binder that meets the Type I or Type II requirements of Section 300.2.I, "Asphalt-Rubber Binders," unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.G, "Crumb Rubber Modifier," unless otherwise shown on the plans. Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.

D. Tack Coat. ~~Unless otherwise shown on the plans or approved,~~ Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed by the Engineer or required when shown on the

plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least 1 sample of the tack coat binder per project in accordance with Tex-500-C, Part III and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

E. Additives. Use the type and rate of additive specified when shown on the plans. Other additives that facilitate mixing, compaction, or improve the quality of the mixture may be allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

1. Fibers. When PG binder is specified, provide cellulose or mineral fibers. Do not use fibers when A-R binder is specified. Submit written certification to the Engineer that the fibers proposed for use meet the requirements of DMS-9204, "Fiber Additives for Bituminous Mixtures." Fibers may be pre-blended into the binder at the asphalt supply terminal unless otherwise shown on the plans.

When at least 3% RAS is used in the mixture, the Contractor may reduce the amount of fibers as specified in Note 3 of Table 4.

2. Lime Mineral Filler. When PG binder is specified, add lime as mineral filler at a rate of 1.0% by weight of the total dry aggregate in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

3. Lime and Liquid Antistripping Agent. ~~If~~When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a bag house or dust collection system that reintroduces the lime back into the drum. When the plans require lime to be added as an antistripping agent, lime added as mineral filler will count towards the total quantity of lime specified.

4. Warm Mix Asphalt (WMA). Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215ºF and 275ºF using Department approved WMA additives or processes. The Department's approved list of WMA additives and processes is located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm.

WMA is allowed for use on all projects and is required when shown on plans. The maximum placement or target discharge temperature for WMA may be set at a value less than 275ºF when shown on the plans.

Department approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures greater than 275ºF; however, such mixtures will not be defined as WMA.

F. Recycled Materials. Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 2. The allowable percentages shown in Table 2 may be decreased or increased when shown on the plans. Determine asphalt content and gradation of the RAP and RAS material for mixture design purposes in accordance with Tex-236-F. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. When RAP or RAS is used, calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 2 during mixture design and HMA production. During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

1. RAP. RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve.

Use of Contractor-owned RAP including HMA plant waste is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Unfractionated RAP is not allowed in PFC mixtures. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Fractionated RAP is defined as having 2 or more RAP stockpiles, divided into coarse and fine fractions. The coarse RAP stockpile will contain only material retained by processing over a 3/8 in. screen or 1/2 in. screen unless otherwise approved. Fine RAP is not allowed in PFC mixtures. The Engineer may allow the Contractor to use an alternate to the 3/8 in. screen or 1/2 in. screen to fractionate the RAP.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

2. RAS. Use of post-manufactured RAS or post-consumer RAS is permitted unless otherwise shown on the plans. RAS are defined as processed asphalt shingle

material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS are processed manufacturer's shingle scrap by-product. Post-consumer RAS, or tear-offs, are processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the Texas Commission on Environmental Quality (TCEQ). RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material prior to extraction (or ignition) of the asphalt.

For any stockpile that contains RAS, the entire stockpile will be considered to be a RAS stockpile and limited to no more than 5.0% of the HMA mixture in accordance with Table 2.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials (NRM) Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established NRM. Use RAS from shingle sources on the Construction Division's "Nonhazardous Recycled Materials" approved list at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Prior to use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval to the Engineer prior to submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

Table 2
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Maximum Ratio of Recycled Binder[1] to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
	Unfractionated RAP[2]	Fractionated RAP[3]	RAS[4]
15.0	0.0	10.0	5.0

1. Combined recycled binder from fractionated RAP and RAS.
2. Unfractionated RAP is not allowed in PFC mixtures.
3. May replace up to 5% fractionated RAP with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.

3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." When A-R binder is specified, equip the hot mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. When an asphalt mass flow meter is used, provide a means to calibrate the meter on site.

4. Construction. Produce, haul, place, and compact the specified paving mixture. On or before the first day of paving, it is mandatory to schedule and participate in a pre-paving meeting with the Engineer ~~as required in the Quality Control Plan (QCP)~~ unless otherwise shown on the plans.

A. Certification. Personnel certified by the Department-approved ~~hot-mix asphalt~~ Hot Mix Asphalt Center Certification Program must conduct all mixture designs, sampling, and testing in accordance with Table 3. ~~In addition to meeting the certification requirements in Table 2, all Level II certified specialists must successfully complete an approved Superpave training course.~~ Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design that is developed and signed by a Level 2 certified specialist. Provide a Level A certified specialist at the plant during production operations. Provide a Level B certified specialist to conduct placement tests.

Table 3
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level
1. Aggregate and Recycled Material Testing				
Sampling	Tex-400-A	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Parts I & III	✓	✓	2
Decantation	Tex-217-F, Part II	✓	✓	2
Los Angeles abrasion	Tex-410-A		✓	
Magnesium sulfate soundness	Tex-411-A		✓	
Micro-Deval abrasion	Tex-461-A		✓	
Coarse aggregate angularity	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven ~~calibration~~ correction factors[1]	Tex-236-F	✓	✓	2
Drain-down	Tex-235-F	✓	✓	1A
Hamburg Wheel test[2]	Tex-242-F	✓	✓	2
Overlay test[2]	Tex-248-F		✓	
Boil test	Tex-530-C	✓	✓	1A
Cantabro loss	Tex-245-F	✓	✓	2
4. Production Testing				
Control charts	Tex-233-F	✓	✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A
Gradation & asphalt content[1]	Tex-236-F	✓	✓	1A
Moisture content	Tex-212-F	✓	✓	1A
Micro-Deval abrasion	Tex-461-A		✓	
Drain-down	Tex-235-F	✓	✓	1A
Boil test	Tex-530-C	✓	✓	1A
Aging ratio	Tex-211-F		✓	
Hamburg Wheel test	Tex-242-F	✓	✓	2
Overlay test	Tex-248-F		✓	
5. Placement Testing				
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Tack coat adhesion	Tex-243-F		✓	1B
Permeability	Tex-246-F	✓	✓	1B

1. Refer to Section XXX.4.I.2.c for exceptions to using an ignition oven.
2. Only applies to PFC-F.
3. Profiler and operator are required to be certified at the Texas Transportation Institute facility.

B. Reporting and Responsibilities. Use Department-provided templates to record and calculate all test data including but not limited to mixture design, production and placement tests, control charts, and thermal profiles. Obtain the latest version of the templates at http://www.txdot.gov/txdot_library/consultants_contractors/forms/site_manager.htm or from the Engineer. The Engineer and the Contractor shall provide any available test results to the other party when requested. The Engineer and the Contractor shall

immediately report to the other party any test result that requires production or placement to be suspended or fails to meet the specification requirements. ~~Use the approved communication method (e.g., email, diskette, hard copy) to submit test results to the Engineer.~~ Record and submit all test results and pertinent information on Department-provided templates to the Engineer electronically by means of a portable USB flash drive, compact disk, or via email.

Subsequent sublots placed after test results are available to the Contractor, which require them to suspend operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3, "Conformity with Plans, Specifications, and Special Provisions."

When directed, use the procedures described in Tex-233-F to plot the results of all production and placement testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

C. QCP. Develop and follow the QCP in detail. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

When directed, submit a written QCP to the Engineer before the mandatory prepaving meeting. Receive the Engineer's approval of the QCP before beginning production. Include the following items in the QCP.

1. **Project Personnel.** For project personnel, include:
   - a list of individuals responsible for QC with authority to take corrective action; and
   - contact information for each individual listed.
2. **Material Delivery and Storage.** For material delivery and storage, include:
   - the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
   - aggregate stockpiling procedures to avoid contamination and segregation;
   - frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
   - procedure for monitoring the quality and variability of asphalt binder.
3. **Production.** For production, include:
   - loader operation procedures to avoid contamination in cold bins;
   - procedures for calibrating and controlling cold feeds;
   - procedures to eliminate debris or oversized material;
   - procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip);

- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4. **Loading and Transporting.** For loading and transporting, include:
   - type and application method for release agents; and
   - truck loading procedures to avoid segregation.

5. **Placement and Compaction.** For placement and compaction, include:
   - proposed agenda for mandatory prepaving meeting, including date and location;
   - type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
   - procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
   - process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
   - paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
   - procedures to construct quality longitudinal and transverse joints.

D. Mixture Design.

1. **Design Requirements**. Use the PFC design procedure given in Tex-204-F, Part V, unless otherwise shown on the plans. ~~to~~ Design ~~a~~ the mixture ~~e meeting~~ to meet the requirements listed in Tables 1, 2, and 4. Use a Superpave Gyratory Compactor (SGC) at 50 gyrations as the design number of gyrations (Ndesign). ~~Use Ndes =50 as the design number of gyrations.~~

   The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

   Provide the Engineer with a mixture design report using the Department-provided ~~software~~ template. Include the following items in the report:
   - the combined aggregate gradation, source, specific gravity, and percent of each material used;
   - the Ndesign level used;
   - results of all applicable tests;
   - the mixing and molding temperatures;
   - the signature of the Level 2 person or persons that performed the design;
   - the date the mixture design was performed; and
   - a unique identification number for the mixture design.

Table 4
Master Gradation ~~Band~~ Limits (% Passing by Weight or Volume)
and ~~Binder Content~~ Laboratory Mixture Design Properties

Sieve Size	PG 76 Mixtures		A-R Mixtures (PFC-AR)	Test Procedure
	Fine (PFC-F)	Coarse (PFC-C)		
3/4"	–	100.0[1]	100.0[1]	Tex-200-F
1/2"	100.0[1]	80.0-100.0	95.0-100.0	
3/8"	95.0-100.0	35.0-60.0	50.0-80.0	
#4	20.0-55.0	1.0-20.0	0.0-8.0	
#8	1.0-15.0	1.0-10.0	0.0-4.0	
#200	1.0-4.0	1.0-4.0	0.0-4.0	
Mixture Properties				
Binder content, %	6.5-7.5	6.0-7.0	8.0-10.0	–
Design gyrations (Ndesign)	50	50	50	Tex-241-F
Lab-molded density, %	78.0 max	82.0 max	82.0 max	Tex-207-F
Hamburg Wheel test[2], passes at 12.5 mm rut depth	10,000 min	–	–	Tex-242-F
Overlay tester[2], number of cycles	300 min	–	–	Tex-248-F
Drain-down, %	0.20 max	0.20 max	0.20 max	Tex-235-F
Fiber content, % by wt. of total PG 76 mixture	0.20[3]-0.50	0.20[3]-0.50	–	Calculated
Lime content, % by wt. of total aggregate	1.0	1.0	–	Calculated
CRM content, % by wt. of A-R binder	–	–	15.0 min	Calculated
Boil test[4]	–	–	–	Tex-530-C
Cantabro loss, %	20.0 max	20.0 max	20.0 max	Tex-245-F

1. Defined as maximum sieve size. No tolerance allowed.
2. Mold test specimens to Ndesign at the optimum asphalt content (JMF1).
3. ~~By weight of total mixture. Not required when using A-R.~~When at least 3% RAS is used in the mixture, the Contractor may reduce the amount of fibers to no less than 0.10% provided the mixture meets the drain-down requirement.
4. Used to establish baseline for comparison to production results. May be waived when approved.

2. Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommend rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.

a. Contractor's Responsibilities.

(1) Providing Superpave Gyratory Compactor. Furnish a Superpave Gyratory Compactor (SGC)~~,~~ calibrated in accordance with Tex-241-F~~,~~ for

molding production samples. Locate the SGC at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples.

(2) Gyratory Compactor Correlation Factors. Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

(3) Hamburg and Overlay Testing for PFC-F. Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide 10,000 g of the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories at http://www.txdot.gov/business/contractors_consultants/producer_list.htm.

Provide 25,000 g of the laboratory mixture and request that the Department perform the Overlay test.

The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel and Overlay test results on the laboratory mixture design.

(4) Submitting JMF1. Furnish the Engineer a complete mix design report (JMF1) including Hamburg and Overlay results for PFC-F when used. Provide representative samples of all component materials and request approval to produce the trial batch.

(5) Supplying Aggregate. Provide the Engineer with approximately 40 lb. of each aggregate stockpile unless otherwise directed.

(6) Supplying Asphalt. Provide the Engineer at least 1 gal. of the asphalt material and sufficient quantities of any additives proposed for use.

(7) Ignition Oven Correction Factors. Determine the aggregate and asphalt correction factors from the ignition oven ~~using~~ in accordance with Tex-236-F. Prior to the trial batch production, provide the Engineer with split samples of the mixtures, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design, if the mixture design and ignition oven are the same as previously used unless otherwise directed. Correction factors may be waived based on past experience when approved by the Engineer.

(8) Boil Test. Perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed by the Engineer. Use this sample for comparison purposes during production. The Engineer may

waive the requirement for the boil test. If signs of stripping exist, add lime or liquid antistripping agent as directed.

(9) Trial Batch ~~Approval~~ Production. Upon receiving conditional approval of JMF1 and authorization from the Engineer to produce a trial batch, provide a plant-produced trial batch, including the WMA additive or process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 2 and Table 5. In lieu of a new trial batch, the Engineer may accept test results from recent production of the same mixture.

(10) Trial Batch Production Equipment. To produce the trial batch, use only equipment and materials proposed for use on the project. Provide documentation to verify the calibration or accuracy of the asphalt mass flow meter to measure the binder content, %, of A-R mixtures. When required, verify that asphalt mass flow meters for A-R binder meet the requirements of 0.4 % accuracy in accordance with Item 520, "Weighing and Measuring Equipment." The Engineer may require that the accuracy of the flow mass meter be verified based on quantities used.

(11) Trial Batch Quantity. Produce enough quantity of the trial batch to ensure that the mixture ~~is representative of JMF1~~ meets the specification requirements.

(12) Number of Trial Batches. Produce trial batches as necessary to obtain a mixture that meets the ~~requirements in Table 5~~ specification requirements.

(13) Trial Batch Sampling. Obtain a representative sample of the trial batch and split it into ~~3~~ three equal portions in accordance with Tex-222-F. Label these portions as “Contractor,” “Engineer,” and “Referee.” Deliver samples to the appropriate laboratory as directed.

(14) Trial Batch Testing. Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in Table 5. ~~verification testing requirements for gradation, binder content, laboratory-molded density, and drain-down listed in Table 5.~~ Provide the Engineer with a copy of the trial batch test results.

(15) Development of JMF2. After the Engineer grants full approval of JMF1 based on results from the trial batch, evaluate the trial batch test results, determine the ~~optimum~~ target mixture proportions, and submit as JMF2. Verify that JMF2 meets the mixture requirements in Table 2.

(16) Mixture Production. After receiving approval for JMF2, use JMF2 to produce Lot 1.

(17) Development of JMF3. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

(18) JMF Adjustments. If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start on a new lot~~,~~;
- be numbered in sequence to the previous JMF~~,~~;
- meet the mixture requirements in Table 2;
- meet the master gradation and binder content limits shown in Table 4~~,~~; and
- be within the operational tolerances of JMF2 listed in Table 5.

(19) Requesting Referee Testing. If needed, use referee testing in accordance with Section 3XXX.4.I.1, "Referee Testing," to resolve testing differences with the Engineer.

Table 5
Testing Frequency and Mixture Production Tolerances

Test Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency[1]	Operational Tolerance from Current JMF
Individual % retained for sieve size larger than #200	Tex-200-F	1 per sublot	1 per 12 sublots	±5.0[2]
% passing the #200 sieve				±2.0[2]
Laboratory-molded density, %	Tex-207-F, Part VIII	1 per sublot	1 per lot	Table 4
Binder content, %	Tex-236-F[4]	1 per sublot	1 per lot[3]	±0.3
Drain-down, %	Tex-235-F	1 per sublot	1 per 12 sublots	Table 4
Boil test[5]	Tex-530-C	1 per project	1 per project	N/A
Asphalt binder sampling[5]	Tex-500-C	1 per sublot (sample only)	1 per project	N/A
Thermal profile	Tex-244-F	1 per sublot	Optional	N/A
Hamburg Wheel test	Tex-242-F	1 per project (sample only)	1 per project	N/A
Overlay test[6]	Tex-248-F			N/A

1. The Engineer may perform as many additional tests as deemed necessary.
2. Only applies to mixture produced for Lot 1 and higher. Aggregate gradation will not exceed limits shown in Table 4.
3. May be obtained from asphalt mass flow meter readouts.
4. Determine binder asphalt content, % from asphalt mass flow meter readouts for A-R mixtures.
5. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
6. Testing performed by the Department and for informational purposes only.

b. Engineer's Responsibilities.

(1) Gyratory Compactor. The Engineer will use a Department SGC, calibrated according to Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production samples, the Engineer will use the Contractor-provided SGC at the ~~Contractor's~~ field laboratory or provide and use a Department SGC~~, calibrated according to Tex-241-F,~~ at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

(2) Hamburg Wheel and Overlay Testing for PFC-F. At the Contractor's request, the Department will perform the Hamburg Wheel test on the laboratory mixture in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 4. The Department will perform the Overlay test in accordance with Tex-248-F to verify compliance with the Overlay test requirements in Table 4. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel and Overlay test results on the laboratory mixture design.

(3) Conditional Approval of JMF1 and Authorizing Trial Batch. ~~Within 2 working days of receiving the mixture design report (JMF1) and all required materials,~~ The Engineer will review the Contractor's mix design report and verify specification conformance ~~with all aggregates, asphalt, additives, and mixture specifications~~ of the mixture and component materials. ~~The Engineer may perform tests to verify the aggregates meet the requirements listed in Table 1.~~ The Engineer will grant ~~the Contractor~~ conditional approval of JMF1 within 2 working days of receiving the complete mixture design report (JMF1) and all required materials ~~if the information provided on the paper copy of JMF1 indicates the Contractor's mixture design meets the specifications. Full approval of JMF1 will be based on the Enginer's test results on mixture from the trial batch.~~

The Engineer will determine the Micro-Deval abrasion loss and will estimate the magnesium sulfate soundness loss for each coarse aggregate source in accordance with Section 3XXX.2.A.1, "Coarse Aggregate." In addition to Micro-Deval testing, the Engineer may sample and test project materials at any time during the project to verify specification compliance. If the Engineer's test results are pending after 2 working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

~~**(3) Authorizing Trial Batch.** After conditionally approving JMF1, the Engineer will authorize the Contractor to produce a trial batch.~~

(4) Ignition Oven Correction Factors. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for quality assurance testing during production in accordance with Tex-236-F.

(5) Testing the Trial Batch. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that ~~the gradation, asphalt content, laboratory molded density, and VMA meet~~ the mixture meets the requirements ~~listed~~ in Table 5.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-235-F, to verify that drain-down meets the requirements shown in Table 4.;
- Tex-461-A, to determine the need for additional magnesium sulfate soundness testing.;
- Tex-530-C, to retain and use for comparison purposes during production.; and
- Tex-245-F, to verify the Cantabro loss meets the requirement shown in Table 4.

(6) Full Approval of JMF1. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for gradation, asphalt content, and laboratory-molded density confirm that for the trial batch meets the requirements in Table 5.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements in Table 5.

(7) Approval of JMF2. The Engineer will approve JMF2 within 1 working day if it the mixture meets the requirements in Table 2 as well as the master grading limits and binder content shown in Table 4 and is within the operational tolerances of JMF1 listed in Table 5.

(8) Approval of Lot 1 Production. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) after approving JMF2.

(9) Approval of JMF3 and Subsequent JMF Changes. The Engineer will approve JMF3 and subsequent JMF changes are approved if they meet the within 1 working day if it meets mixture requirements in Table 2, the master grading and binder content limits shown in Table 4, and is are within the operational tolerances of JMF2 listed in Table 5.

(10) Binder Content Adjustments. For JMF2 and above, the Engineer may require the Contractor to adjust the target binder content by no more than 0.3% from the current JMF.

3. JMF Adjustments. Produce the mixture within the operational tolerances listed in Table 5. The Engineer may suspend production if corrective actions are not taken when operational tolerances are exceeded. With approval from the Engineer, the JMF target values may be adjusted as needed. Document any changes to the JMF with a subsequent JMF number. The Engineer may adjust the target asphalt percentage or fiber percentage within the operational tolerances of the JMF.

E. Production Operations. Perform a new trial batch when the plant or plant location is changed. Perform QC at the frequency and within the tolerances listed in Table 5. Take

corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

At any time during production, the Engineer may require the Contractor to verify the following based on quantities used:

- lime content (within ±0.1% of JMF), when PG binder is specified;
- fiber content (within ±0.03% of JMF), when PG binder is specified; and
- CRM content (within ±1.5% of JMF), when A-R binder is specified.

When A-R binder is specified, maintain the in-line measuring device to verify the A-R binder viscosity between 2,500 and 4,000 centipoise at 350°F unless otherwise approved. Record A-R binder viscosity at least once an hour and provide the Engineer with a daily summary unless otherwise directed.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. The Engineer will require the Contractor to provide evidence that results from Tex-236-F are not reliable before permitting an alternate method unless otherwise allowed. Use the applicable test procedure as directed if an alternate test method is allowed.

1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot mix asphalt discharge temperatures (in legible and discernable increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr unless otherwise approved.

2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F (or 275ºF for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F.

   When WMA is required, produce the WMA within the target temperature discharge range of 215ºF and 275ºF. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

   Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. If requested, determine the moisture content by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by

weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

F. Hauling Operations. Before use, clean all truck beds to ensure mixture is not contaminated. When a release agent is necessary ~~to coat the truck bed~~, use a release agent on the approved list maintained by the Construction Division to coat the inside bed of the truck.

Use only equipment for hauling as defined in Section 3XXX.4.G.3.c, "Hauling Equipment." Other hauling equipment may be used when allowed by the Engineer.

G. Placement Operations. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed by the Engineer. When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly.

1. Weather Conditions.

a. When Using a Pave-IR System for Specification Compliance. The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 50°F; however, the Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving. Operate the Pave-IR system in accordance with Tex-244-F and demonstrate to the Engineer that no recurring severe thermal segregation exists. Provide the Engineer with the automated report described in Tex-244-F on a daily basis unless otherwise directed.

b. When Not Using a Pave-IR System for Specification Compliance. Place mixture when the roadway surface temperature is 70°F or higher unless otherwise approved. Measure the roadway surface temperature with a handheld infrared thermometer. The Engineer may allow mixture placement to begin prior to the roadway surface reaching the required temperature requirements, if conditions are such that the roadway surface will reach the required temperature within 2 hours of beginning placement operations. ~~Unless otherwise shown on the plans,~~ Place mixtures only when weather conditions

and moisture conditions of the roadway surface are suitable in the opinion of the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.

2. **Tack Coat.** Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply the tack coat in a uniform manner such that streaks and other irregular patterns are avoided. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely prior to placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

3. **Lay-Down Operations.** ~~Measure the temperature of mixture delivered to the paver and take corrective action if needed to ensure the temperature does not drop below 280°F. For each sublot use a hand held infrared thermometer to obtain a thermal profile of the uncompacted mat immediately behind the paver.~~

   ~~Record the information on Department QC/QA forms and submit the forms to the Engineer.~~

   a. **Thermal Profile.** ~~For each sublot,~~ Use an infrared thermometer or thermal camera to obtain ~~a~~ thermal profiles on each sublot in accordance with ~~using~~ Tex-244-F. ~~The Engineer may reduce the testing frequency based on a satisfactory test history. The Engineer may also obtain as many thermal profiles as deemed necessary. If the temperature differential is greater than 25°F, the area will be deemed as having thermal segregation. Take corrective action to eliminate areas that have thermal segregation. Unless otherwise directed, suspend operations if the maximum temperature differential exceeds 50°F. Resume operations when the Engineer determines that subsequent production will meet the requirements of this item.~~ The Engineer will obtain a thermal profile at least once per project and may obtain as many thermal profiles as deemed necessary. Thermal profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.5, "Miscellaneous Areas."

      At the completion of each lot, provide the Engineer with the thermal profile of every sublot within the lot. Report the results of each thermal profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

      (1) **Moderate Thermal Segregation.** Any areas that have a maximum temperature differential greater than 25°F but not exceeding 50°F are deemed as having moderate thermal segregation. Take immediate corrective action to eliminate the moderate thermal segregation.

(2) **Severe Thermal Segregation.** Any areas that have a maximum temperature differential greater than 50°F are deemed as having severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Item.

(3) **Use of the Pave-IR System.** In lieu of obtaining thermal profiles on each sublot using an infrared thermometer or thermal camera, the Contractor may use the Pave IR system (paver mounted infrared bar) to obtain a continuous thermal profile in accordance with Tex-244-F. When electing to use the Pave-IR system, notify the Engineer prior to beginning placement operations and specify if using the Pave-IR system for specification compliance or for information only. When electing to use the Pave-IR system for information only, use an infrared thermometer or thermal camera to obtain thermal profiles in accordance with Tex-244-F. When electing to use the Pave-IR system for information only, segregation density profiles are applicable.

When using the Pave-IR system for specification compliance, review the output results on a daily basis. Unless otherwise directed, provide the automated report described in Tex-244-F to the Engineer for review. Modify the paving process as necessary to eliminate any (moderate or severe) thermal segregation identified by the Pave-IR system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Upon completion of use of the Pave-IR system for specification compliance or as requested by the Engineer, provide the Engineer with electronic copies of all daily data files that can be used with the Pave-IR system software to generate temperature profile plots.

b. Windrow Operations. When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

c. Hauling Equipment. The Contractor may elect to use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with a MTD with remixing capability or when a Pave-IR system is used for specification compliance unless otherwise allowed by the Engineer.

d. Screed Heaters. If the paver stops for more than 5 minutes, turn off screed heaters to prevent overheating of the mat. If the screed heater remains on for more than 5 minutes while the paver is stopped, the Engineer may evaluate the suspect area in accordance with Section 3XXX.4.I.6, "Recovered Asphalt Dynamic Shear Rheometer (DSR)."

H. Compaction. Roll the freshly placed PFC with a steel-wheeled roller, operated in static mode, to seat the mixture without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Do not use pneumatic rollers. Thoroughly moisten the roller drums with a soap-and-water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

The Engineer may use or require the Contractor to use Tex-246-F to test and verify that the compacted mixture has adequate permeability. Adjust the mixture design or construction methods if the compacted mixture does not exhibit adequate permeability.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

I. Acceptance Plan. Sample and test the hot mix on a lot and sublot basis. A production lot consists of 4 equal sublots. Lot 1 will be ~~1,000~~ 2,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production. The lot size will be between ~~1,000~~ 2,000 and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot. If the production or placement test results are not within the acceptable tolerances listed in Table 5, suspend production until test results or other information indicate to the satisfaction of the Engineer that the next material produced or placed will meet the specified values.

1. Referee Testing. The Construction Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the operational tolerances shown in Table 5 and the differences cannot be resolved. Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the samples are received at the referee laboratory for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than 3 referee tests per project are required and the Engineer's test results are closer than the Contractor's test results to the referee test results.

2. Informational Hamburg Wheel and Overlay Testing. During the first week of production, randomly select 1 sublot from Lot 2 or higher for Hamburg Wheel and Overlay testing. Obtain and provide the Engineer with approximately 150 lb. (70 kg) of mixture in sealed containers, boxes, or bags labeled with CSJ, mixture type, lot, and sublot number. The Engineer will ship the mixture to the Construction Division for Hamburg Wheel and Overlay testing. Results from these production tests will not be used for specification compliance; however, the laboratory mixture design must meet the Hamburg Wheel and Overlay test requirement in Table 4.

3. **Asphalt Binder Sampling.** Obtain a 1-qt. (1-gal. for A-R binder) sample of the asphalt binder for each ~~sublot~~lot of mixture produced. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill. Take the sample in accordance with ~~the pipeline sampling procedure given in~~ Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers~~,~~ and deliver the sample to the Engineer. The Engineer may also obtain independent samples. ~~If the Engineer chooses to obtain~~ If obtaining an independent asphalt binder sample, the Engineer will split a sample of the asphalt binder with the Contractor. The Engineer will test at least ~~1~~one asphalt binder sample per project to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

4. **Operational Tolerances.** Control the production process within the operational tolerances listed in Table 5. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

5. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, ~~are not generally subject to primary traffic,~~ such as driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Intersections and temporary detours will be considered miscellaneous areas when shown on the plans. The thickness determined is based on the rate of 90 lb./sy for each inch of pavement unless otherwise shown on the plans.

6. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** When the Pave-IR system is not used for specification compliance, the Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Construction Division. The aging ratio is the ~~dynamic shear rheometer (~~DSR~~)~~ value of the extracted binder divided by the DSR value of the original unaged binder. DSR values are obtained according to AASHTO T 315 at the specified high temperature ~~PG~~ performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores using Tex-211-F.

7. **Irregularities.** ~~Immediately take corrective action if surface~~ Identify and correct irregularities including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, ~~or~~ uncoated aggregate particles, ~~are detected~~ or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does not bond to the existing pavement. If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations

for no more than 1 day while the Contractor is taking appropriate corrective action. ~~The Engineer may allow placement to continue for at most 1 day of production while taking appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.~~

8. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. **Measurement.** PFC will be measured by the ton of composite PFC. The composite PFC is defined as the asphalt, aggregate, and additives. The weights of asphalt and aggregate will be calculated based on the measured weight of PFC and the target percentage of asphalt and aggregate. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

   A. **Asphalt.** The asphalt weight in tons will be determined from the total weight of PFC. Measured asphalt percentage will be obtained using Tex-236-F or asphalt mass flow meter readings for PG 76 mixtures, as determined by the Engineer. Measured asphalt percentage will be obtained using asphalt mass flow meter readings for A-R Mixtures. Provide the Engineer with a daily summary of the asphalt mass flow meter readings for A-R mixtures unless otherwise directed.

      1. **Target Percentage**. The JMF target asphalt percentage will be used to calculate the weight of asphalt binder unless the measured asphalt binder percentage is more than 0.3 percentage points below the JMF target asphalt percentage. Volumetric meter readings will be adjusted to 140°F and converted to weight.

      2. **Measured Percentage.** The averaged measured asphalt percentage from each sublot will be used for payment for that lot's production when the measured percentage for any sublot is more than 0.3 percentage points below the JMF target asphalt percentage.

   B. **Aggregate.** The aggregate weight in tons will be determined from the total weight of PFC less the weight of the asphalt.

6. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under Article 5, "Measurement," will be paid for at the unit price bid for "PFC (Asphalt)" of the binder specified and for "PFC (Aggregate)" of the grade and surface aggregate classification specified. These prices are full compensation for surface preparation; materials including tack coat; placement; equipment; labor; tools; and incidentals.

   Trial batches will not be paid for unless they are included in pavement work approved by the Department.

   Pay adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

SPECIAL SPECIFICATION

3XXX for Item 344

~~Performance-Designed~~ Superpave Mixtures

1. **Description.** Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted~~, performance-designed~~ Superpave (SP) mixture of aggregate and asphalt binder mixed hot in a mixing plant. ~~Performance-designed mixtures are defined as either Superpave (SP) or coarse-matrix high-binder (CMHB) mixtures.~~

2. **Materials.** Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

   Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance.

   A. **Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section~~, unless otherwise shown on the plans~~. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for ~~either a~~ coarse, intermediate~~, aggregate~~ or fine aggregate. ~~When reclaimed asphalt pavement (RAP) is allowed by plan note, provide RAP stockpiles in accordance with this Section.~~ Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for ~~mechanically~~ crushed gravel or crushed stone~~ aggregates that meet the definitions in Tex-100-E~~. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II. ~~Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) unless otherwise approved.~~

      1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Provide aggregates from sources listed in the BRSQC located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Use only the rated values for hot mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregates sources used in hot mix. Provide aggregate

from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Do not add material to a stockpile that has been tested and approved, for sources not listed on the Department's *Bituminous Rated Source Quality Catalog* (BRSQC). Provide coarse aggregate with at least the minimum SAC as shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes~~, unless otherwise shown on the plans~~. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.

a. Blending Class A and Class B Aggregates. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. ~~When blending, do not use Class C or D aggregates.~~ For blending purposes, coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate.

When the Contractor blends Class A and B aggregates to meet a Class A requirement, the Engineer may perform tests at any time during production to ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. In such cases where the Engineer elects to verify conformance, the Engineer will use the Department's mix design program to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the program; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

b. Micro-Deval Abrasion. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing prior to the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer will estimate the magnesium sulfate soundness loss ($Mg_{est.}$) for each coarse aggregate source by multiplying the RSSM value by the ratio of the actual Micro-Deval percent loss ($MD_{act.}$) divided by the Rated Source Micro-Deval (RSMD) using the formula $Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$. When the estimated magnesium sulfate soundness loss

is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Geotechnical, Soils, & Aggregates Branch of the Construction Division. Additional testing may be required prior to granting approval.

2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. When used, supply intermediate aggregates that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. When used, supply intermediate aggregate from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

3. **Fine Aggregate.** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed fine aggregate. With the exception of field sand ~~and fine aggregates used in CMHB mixtures~~, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 1~~,~~ unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.0
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	35
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	25
Coarse aggregate angularity, 2 crushed faces, %, min	Tex 460-A, Part I	95[2]
Flat and elongated particles @ 5:1, %, max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107-E	3
Combined Aggregate[3]		
Sand equivalent, %, min	Tex-203-F	45

1. ~~Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.~~Used to estimate the magnesium sulfate soundness loss in accordance with Section 3XXX.2.A.1, "Coarse Aggregate."
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8”	100
#8	70–100
#200	0–30

B. Mineral Filler. Mineral filler consists of finely divided mineral matter, such as agricultural lime, crusher fines, hydrated lime, ~~cement,~~ or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% hydrated lime ~~or cement~~ unless otherwise shown on the plans. If a substitute binder is used, do not use more than 1% hydrated lime unless otherwise shown on the plans or allowed by the Engineer. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

C. Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

D. Asphalt Binder. Furnish the type and grade of performance-graded (PG) asphalt ~~binder~~ specified on the plans~~, in accordance with Section 300.2.J, “Performance-Graded Binders.”~~. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 4 in lieu of the PG binder originally specified, if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.J, “Performance-Graded Binders;”
- the substitute binder has an un-aged dynamic shear value less than or equal to 2.00 kPa and an RTFO aged dynamic shear value less than or equal to 5.00 kPa at the PG test temperature; and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 4
Allowable Substitute PG Binders

PG Binder Originally Specified	Allowable Substitute PG Binders
PG 76-22	PG 70-22 or PG 64-28
PG 70-22	PG 64-22 or PG 58-28
PG 64-22	PG 58-22
PG 76-28	PG 70-28 or PG 64-34
PG 70-28	PG 64-28 or PG 58-34
PG 64-28	PG 58-28

E. Tack Coat. ~~Unless otherwise shown on the plans or approved,~~ Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed by the Engineer or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least 1 sample of the tack coat binder per project in accordance with Tex-500-C, Part III and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

F. Additives. Use the type and rate of additive specified when shown on the plans. Other additives that facilitate mixing, compaction, or improve the quality of the mixture may be allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

1. **Lime and Liquid Antistripping Agent.** ~~If~~When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream~~,~~ unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.
2. **Warm Mix Asphalt (WMA).** Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215ºF and 275ºF using Department approved WMA additives or processes. The Department's approved list of WMA additives and processes is located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm.

   WMA is allowed for use on all projects and is required when shown on plans. The maximum placement or target discharge temperature for WMA may be set at a value less than 275ºF when shown on the plans.

   Department approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures greater than 275ºF; however, such mixtures will not be defined as WMA.

G. Recycled Materials. Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 5. The allowable percentages shown in Table 5 may be decreased or increased when shown on the plans. Determine asphalt content and gradation of the RAP and RAS material for mixture design purposes in accordance with Tex-236-F. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. When RAP or RAS is used, calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the

percentages shown in Table 5 during mixture design and HMA production. During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve.

   Use of Contractor-owned RAP including HMA plant waste is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. This allowance does not apply to a Contractor using unfractionated RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

   Fractionated RAP is defined as having 2 or more RAP stockpiles, divided into coarse and fine fractions. The coarse RAP stockpile will contain only material retained by processing over a 3/8 in. screen or 1/2 in. screen unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8 in. screen or 1/2 in. screen unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8 in. screen or 1/2 in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

   Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

   Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

2. **RAS.** Use of post-manufactured RAS or post-consumer RAS is permitted unless otherwise shown on the plans. RAS are defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS are processed manufacturer's shingle scrap by-product. Post-consumer RAS, or tear-offs, are processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the Texas Commission on Environmental Quality (TCEQ). RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material prior to extraction (or ignition) of the asphalt.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. For any stockpile that contains RAS, the entire stockpile will be considered to be a RAS stockpile and limited to no more than 5.0% of the HMA mixture in accordance with Table 5.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials (NRM) Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established NRM. Use RAS from shingle sources on the Construction Division's "Nonhazardous Recycled Materials" approved list at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Prior to use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval to the Engineer prior to submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

Table 5
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder[1] to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
		Unfractionated RAP[2]	Fractionated RAP[3]	RAS[4]
Surface Mixes[5]	25.0	10.0	20.0	5.0
Non-Surface Mixes[6] < 8 in. From Final Riding Surface	30.0	10.0	25.0	5.0
Non-Surface Mixes[6] > 8 in. From Final Riding Surface	35.0	10.0	30.0	5.0

1. Combined recycled binder from RAP and RAS.
2. Do not use in combination with RAS or fractionated RAP.
3. May not be used in addition to unfractionated RAP; however, up to 5% of fractionated RAP may be replaced with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.
5. "Surface" mixes are defined as mixtures that will be the final lift or riding surface of the pavement structure.
6. "Non-Surface" mixes are defined as mixtures that will be an intermediate or base layer in the pavement structure.

3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. Construction. Produce, haul, place, and compact the specified paving mixture. On or before the first day of paving, it is mandatory to schedule and participate in a pre-paving meeting with the Engineer ~~as required in the Quality Control Plan (QCP)~~ unless otherwise shown on the plans.

A. Certification. Personnel certified by the Department-approved ~~hot-mix asphalt~~ Hot Mix Asphalt Center Certification Program must conduct all mixture designs, sampling, and

testing in accordance with Table 6. ~~In addition to meeting the certification requirements in Table 4, all Level II certified specialists must successfully complete an approved SP training course.~~ Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made.
Provide a mixture design that is developed and signed by a Level 2 certified specialist.
Provide a Level 1A certified specialist at the plant during production operations.
Provide a Level 1B certified specialist to conduct placement tests.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level
1. Aggregate and Recycled Material Testing				
Sampling	Tex-400-A	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Part I & III	✓	✓	2
Decantation	Tex-217-F, Part II	✓	✓	2
Los Angeles abrasion	Tex-410-A		✓	
Magnesium sulfate soundness	Tex-411-A		✓	
Micro-Deval abrasion	Tex-461-A		✓	
Coarse aggregate angularity	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors[1]	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Hamburg Wheel test	Tex-242-F	✓	✓	2
Boil test	Tex-530-C	✓	✓	1A
3. Production Testing				
Selecting random numbers	Tex-225-F, Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	1A
Rice gravity	Tex-227-F	✓	✓	1A
Gradation & asphalt content[1]	Tex-236-F	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	2
Micro-Deval abrasion	Tex-461-A		✓	
Boil test	Tex-530-C	✓	✓	1A
Aging ratio	Tex-211-F		✓	
Overlay test	Tex-248-F		✓	
Cantabro test	Tex-245-F		✓	
4. Placement Testing				
Selecting random numbers	Tex-225-F, Part II		✓	1A/1B
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F	✓	✓	1A/1B
Establish rolling pattern	Tex-207-F	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 2
Segregation (density profile)	Tex-207-F, Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F, Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Tack coat adhesion	Tex-243-F		✓	1B

1. Refer to Section 3XXX.4.I.2.c for exceptions to using an ignition oven.
2. Profiler and operator are required to be certified at the Texas Transportation Institute facility.

B. Reporting and Responsibilities. Use Department-provided templates to record and calculate all test data including but not limited to mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the latest version of the templates at http://www.txdot.gov/txdot_library/consultants_contractors/forms/site_manager.htm or from the Engineer. The Engineer and the Contractor shall provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 7 unless otherwise approved. The Engineer and the Contractor shall immediately report to the other party any test result that requires production or placement to be suspended, a payment penalty, or fails to meet the specification requirements. ~~Use the approved communication method (e.g., email, diskette, hard copy) to submit test results to the Engineer.~~ Record and submit all test results and pertinent information on Department-provided templates to the Engineer electronically by means of a portable USB flash drive, compact disk, or via email.

Subsequent sublots placed after test results are available to the Contractor, which require them to suspend operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3, "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1] Asphalt content[1] Laboratory-molded density[2] Moisture content[3] Boil test[3]	Contractor	Engineer	1 working day of completion of the sublot
Production Quality Assurance			
Gradation[3] Asphalt content[3] Laboratory-molded density[1] Hamburg Wheel test[2] Boil test[3] Binder tests[2]	Engineer	Contractor	1 working day of completion of the sublot
Placement Quality Control			
In-place air voids[2] Segregation[1] Longitudinal joint density[1] Thermal profile[1]	Contractor	Engineer	~~1 hr. of performing the test for segregation, longitudinal joint density, and thermal profile~~ 1 working day of completion of the lot
Placement Quality Assurance			
In-place air voids[1] Segregation[2] Longitudinal joint density[2] Thermal profile[2] Aging ratio[2]	Engineer	Contractor	1 working day of receipt of the trimmed cores for in-place air voids[4]
Pay adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. To be reported as soon as results become available.
3. To be performed at the frequency ~~shown in Table 12~~ specified on the plans.
4. ~~Additional time is~~2 days are allowed if cores ~~cannot~~ can not be dried to constant weight within 1 day.

The Engineer will use the Department-provided template to calculate all pay adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the pay adjustment summary documentation for the lot.

Use the procedures described in Tex-233-F to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

C. QCP. Develop and follow the QCP in detail. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP to the Engineer before the mandatory prepaving meeting. Receive the Engineer's approval of the QCP before beginning production. Include the following items in the QCP.

1. Project Personnel. For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action; and
- contact information for each individual listed.

2. **Material Delivery and Storage.** For material delivery and storage, include:
   - the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
   - aggregate stockpiling procedures to avoid contamination and segregation;
   - frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
   - procedure for monitoring the quality and variability of asphalt binder.
3. **Production.** For production, include:
   - loader operation procedures to avoid contamination in cold bins;
   - procedures for calibrating and controlling cold feeds;
   - procedures to eliminate debris or oversized material;
   - procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip);
   - procedures for reporting job control test results; and
   - procedures to avoid segregation and drain-down in the silo.
4. **Loading and Transporting.** For loading and transporting, include:
   - type and application method for release agents; and
   - truck loading procedures to avoid segregation.
5. **Placement and Compaction.** For placement and compaction, include:
   - proposed agenda for mandatory prepaving meeting, including date and location;
   - type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
   - procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
   - process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
   - paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
   - procedures to construct quality longitudinal and transverse joints.

D. Mixture Design.

1. **Design Requirements.** Use the Superpave design procedure given in Tex-204-F, Part IV unless otherwise shown on the plans. ~~to~~ Design ~~a~~ the mixture ~~meeting~~ to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, 10, and 11.

   Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 10. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion. When electing to reduce the Ndesign level from the specified value, document the target value on the JMF1 submittal. Perform Hamburg and indirect tensile strength tests at the corresponding optimum asphalt content.

   Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories at

http://www.txdot.gov/business/contractors_consultants/producer_list.htm. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

~~Design the mixture at the number of gyrations (Ndesign) shown on the plans.~~ The aggregate gradation may pass above, below, or through the reference zone shown in Table 9 unless otherwise shown on the plans. Design a mixture with a gradation that has stone-on-stone contact and passes below the reference zone shown in Table 9 when shown on the plans. Verify stone-on-stone contact using the method given in the Superpave design procedure in Tex-204-F, Part IV.

~~For mixture designated on the plans as a "rich bottom layer" (RBL), design for a target laboratory molded density of 98.0% at Ndes = 50. Design the RBL with a gradation that does not pass below the reference zone shown in Table 7. RBL will only be designated as the bottom lift on perpetual pavement designs.~~

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the Ndesign level used;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation ~~Band~~ Limits (% Passing by Weight or Volume)
and ~~Volumetric Properties~~ VMA[1] Requirements

Sieve Size	SP-A Base	SP-B Intermediate	SP-C Surface	SP-D Fine Mixture	~~CMHB-C Coarse Surface~~	~~CMHB-F Fine Surface~~
2”	100.0[2]	–	–	–	~~–~~	~~–~~
1-1/2”	98.0–100.0	100.0[2]	–	–	~~–~~	~~–~~
1”	90.0–100.0	98.0–100.0	100.0[2]	–	~~100.0~~	~~–~~
3/4”	Note 3	90.0–100.0	98.0–100.0	100.0[2]	~~98.0–100.0~~	~~100.0~~
1/2”	–	Note 3	90.0–100.0	98.0–100.0	~~72.0–85.0~~	~~98.0–100.0~~
3/8”	–	–	Note 3	90.0–100.0	~~50.0–70.0~~	~~85.0–100.0~~
#4	19.0–90.0	23.0–90.0	28.0-90.0	32.0-90.0	~~30.0–45.0~~	~~40.0–60.0~~
#8	19.0–45.0	23.0–49.0	28.0–58.0	32.0–67.0	~~17.0–27.0~~	~~17.0–27.0~~
#16	1.0–45.0	2.0–49.0	2.0–58.0	2.0–67.0	~~5.0–27.0~~	~~5.0–27.0~~
#30	1.0–45.0	2.0–49.0	2.0–58.0	2.0–67.0	~~5.0–27.0~~	~~5.0–27.0~~
#50	1.0–45.0	2.0–49.0	2.0–58.0	2.0–67.0	~~5.0–27.0~~	~~5.027.0~~
#200	1.0–7.0	2.0–8.0	2.0–10.0	2.0–10.0	~~5.0–9.0~~	~~5.0–9.0~~
Design VMA[2], % Minimum						
	13.0	14.0	15.0	16.0	~~14.0~~	~~15.0~~
Production (Plant-Produced) VMA, % Minimum						
	12.5	13.5	14.5	15.5	~~13.0~~	~~14.0~~
~~**Design VFA[3], %**~~						
	~~65–75~~	~~65–75~~	~~73–76~~	~~73–76~~	~~–~~	~~–~~

1. Voids in mineral aggregates.
2. Defined as maximum sieve size. No tolerance allowed.
~~3. Voids filled with asphalt.~~ Must retain at least 10% cumulative.

Table 9
Reference Zones (% Passing by Weight or Volume)

Sieve Size	SP-A Base	SP-B Intermediate	SP-C Surface	SP-D Fine Mixture	~~CMHB-C Coarse Surface~~	~~CMHB-F Fine Surface~~
2”	–	–	–	–		
1-1/2”	–	–	–	–		
1”	–	–	–	–		
3/4”	–	–	–	–		
1/2”	–	–	–	–		
3/8”	–	–	–	–		
#4	39.5–39.5	–	–	–	~~N/A~~	~~N/A~~
#8	26.8–30.8	34.6–34.6	39.1–39.1	47.2–47.2		
#16	18.1–24.1	22.3–28.3	25.6–31.6	31.6–37.6		
#30	13.6–17.5	16.7–20.7	19.1–23.1	23.5–27.5		
#50	11.4–11.4	13.7–13.7	15.5–15.5	18.7–18.7		
#200	–	–	–	–		

Table 10
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.0
Design gyrations (Ndesign)	Tex-241-F	50[1]
Indirect tensile strength (dry), psi ~~(molded to 93% ±1% density)~~	Tex-226-F	85–200[2]
Dust/asphalt ratio[3]		0.6–1.6
Boil test[4]	Tex-530-C	–
~~**Hamburg Wheel Test Requirements**~~		
~~**High-Temperature Binder Grade**~~	~~**Test Method**~~	~~**Minimum # of Passes @ 0.5" Rut Depth, Tested @122°F**~~[4]
~~PG 64 or lower~~	~~Tex-242-F~~	~~10,000~~
~~PG 70~~		~~15,000~~
~~PG 76 or higher~~		~~20,000~~

1. May be adjusted within a range of 35–100 gyrations when shown on the plans or specification or allowed by the Engineer.
2. ~~May exceed 200 psi when approved and may be waived when approved.~~ The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 4.0 mm and less than 12.5 mm.
3. Defined as % passing #200 sieve divided by asphalt content. ~~Not required for CMHB mixtures.~~
4. Used to establish baseline for comparison to production results. May be waived when approved.
~~4. May be decreased or waived when shown on the plans. Test not required for RBL.~~

Table 11
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes[1] @ 12.5 mm[2] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000
PG 70		15,000
PG 76 or higher		20,000

1. May be decreased or waived when shown on the plans. ~~Test not required for RBL.~~
2. A minimum rut depth may also be required when shown on the plans.

2. Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommend rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.

a. Contractor's Responsibilities.

(1) Providing Superpave Gyratory Compactor. Furnish a Superpave Gyratory Compactor (SGC)~~,~~ calibrated in accordance with Tex-241-F~~,~~ for

molding production samples. Locate the SGC at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples.

(2) Gyratory Compactor Correlation Factors. Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

(3) Submitting JMF1. Furnish the Engineer a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. If opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, provide the Engineer with approximately 10,000 g of the design mixture and request that the Department perform the Hamburg Wheel test.

(4) Supplying Aggregates. Provide the Engineer with approximately 40 lb. of each aggregate stockpile unless otherwise directed.

(5) Supplying Asphalt. Provide the Engineer at least 1 gal. of the asphalt material and sufficient quantities of any additives proposed for use.

(6) Ignition Oven Correction Factors. Determine the aggregate and asphalt correction factors from the ignition oven ~~using~~ in accordance with Tex-236-F. Prior to the trial batch production, provide the Engineer with split samples of the mixtures, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design, if the mixture design and ignition oven are the same as previously used unless otherwise directed. Correction factors may be waived based on past experience when approved by the Engineer.

(7) Boil Test. Perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed by the Engineer. Use this sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

(8) Trial Batch ~~Approval~~ Production. Upon receiving conditional approval of JMF1 and authorization from the Engineer to produce a trial batch, provide a plant-produced trial batch, including the WMA additive or process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 5 and Table 12. In lieu of a new trial batch, the Engineer may accept test results from recent production of the same mixture.

(9) Trial Batch Production Equipment. To produce the trial batch, use only equipment and materials proposed for use on the project.

(10) Trial Batch Quantity. Produce enough quantity of the trial batch to ensure that the mixture ~~is representative of JMF1~~ meets the specification requirements.

(11) Number of Trial Batches. Produce trial batches as necessary to obtain a mixture that meets the ~~requirements in Table 9~~ specification requirements.

(12) Trial Batch Sampling. Obtain a representative sample of the trial batch and split it into ~~3~~ three equal portions in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

(13) Trial Batch Testing. Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the ~~verification testing requirements for gradation, asphalt content, laboratory-molded density, and VMA listed in Table 9 and is~~ mixture requirements in Table 12. The trial batch mixture must also be in compliance with the Hamburg Wheel ~~test~~ requirement in Table 11. Use an approved laboratory to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

(14) Development of JMF2. After the Engineer grants full approval of JMF1 based on results from the trial batch, evaluate the trial batch test results, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt content or gradation to achieve the specified target laboratory-molded density. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements for production shown in Table 8. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 5.

(15) Mixture Production. After receiving approval for JMF2 and receiving a passing result from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch, use JMF2 to produce Lot 1 as described in Section 3XXX.4.I.3.a.(1), "Lot 1 Placement." As an option, once JMF2 is approved, proceed to Lot 1 production at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

If electing to proceed without Hamburg Wheel test results from the trial batch, notify the Engineer. Note that the Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

(16) Development of JMF3. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

(17) JMF Adjustments. If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot~~,~~;

- be numbered in sequence to the previous JMF~~,~~;
- meet the mixture requirements in Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of JMF2 listed in Table 12.

(18) Requesting Referee Testing. If needed, use referee testing in accordance with Section 3XXX.4.I.1, "Referee Testing," to resolve testing differences with the Engineer.

Table 12
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[2,3]	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[2,3]	±3.0
% passing the #200 sieve			±2.0[2,3]	±1.6
Asphalt content, %	Tex-236-F	±0.5	±0.3[3]	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±0.5
In-place air voids, %		N/A	N/A	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, % min		Note 4	Note 4	N/A
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	N/A	± 0.020

1. Contractor may request referee testing only when values exceed these tolerances.
2. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
3. ~~Tolerance between JMF1 and JMF2 may exceed ±0.3%.~~ Only applies to mixture produced for Lot 1 and higher.
4. Test and verify that Table 8 requirements are met.

b. Engineer's Responsibilities.

(1) Gyratory Compactor. The Engineer will use a Department SGC, calibrated according to Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

(2) Conditional Approval of JMF1 and Authorizing Trial Batch. Within 2 working days of receiving the mixture design report (JMF1) and all required materials and Contractor-provided Hamburg Wheel test results, the Engineer will review the Contractor's mix design report and verify conformance with all aggregates, asphalt, additives, recycled materials, and mixture specifications. ~~The Engineer may perform tests to verify the aggregates meet the requirements listed in Table 1.~~ The Engineer will grant the Contractor conditional approval of JMF1, if the information provided on the paper copy of JMF1 indicates the Contractor's mixture design meets the specifications. When the Contractor does not provide

Hamburg Wheel test results with laboratory mixture design, a total of 10 working days is allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 ~~will be based~~ on the ~~Engineer's~~ test results on mixture from the trial batch.

The Engineer will determine the Micro-Deval abrasion loss and will estimate the magnesium sulfate soundness loss for each coarse aggregate source in accordance with Section 3XXX.2.A.1, "Coarse Aggregate." In addition to Micro-Deval testing, the Engineer may sample and test project materials at any time during the project to verify specification compliance. If the Engineer's test results are pending after 2 working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

(3) Hamburg Wheel Testing of JMF1. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 11.

~~**(4) Authorizing Trial Batch.** After conditionally approving JMF1, which will include either Contractor- or Department-supplied Hamburg Wheel test results, the Engineer will authorize the Contractor to produce a trial batch.~~

(4) Ignition Oven Correction Factors. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for quality assurance testing during production in accordance with Tex-236-F.

(5) Testing the Trial Batch. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that ~~the gradation, asphalt content, laboratory-molded density, and VMA meet~~ the mixture meets the requirements ~~listed~~ in Table 12. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 11.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 10~~.~~;
- Tex-461-A, to determine the need for additional magnesium sulfate soundness testing~~.~~; and
- Tex-530-C, to retain and use for comparison purposes during production.

(6) Full Approval of JMF1. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the

Engineer's results for ~~gradation, asphalt content, laboratory-molded density, and VMA confirm that~~ the trial batch meet~~s~~ the requirements in Table 12. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements ~~in Table 9~~.

(7) Approval of JMF2. The Engineer will approve JMF2 within 1 working day if ~~it~~ the mixture meets the requirements in Table 5 and the gradation meets the master grading limits shown in Table 8 ~~and is within the operational tolerances of JMF1 listed in Table 9~~. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

(8) Approval of Lot 1 Production. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a~~n~~ Department-approved laboratory's Hamburg Wheel test on the trial batch. ~~As an option,~~ The Contractor may proceed at their own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test ~~to~~ be removed and replaced at the Contractor's expense.

(9) Approval of JMF3 and Subsequent JMF Changes. ~~The Engineer will approve~~ JMF3 and subsequent JMF changes are approved if they meet the ~~within 1 working day if it meets~~ mixture requirements in Table 5, the master grading limits shown in Table 8, and are within the operational tolerances of JMF2 listed in Table 12.

E. Production Operations. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot mix asphalt discharge temperatures (in legible and discernable increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr unless otherwise approved.

2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F (or 275ºF for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F.

   When WMA is required, produce the WMA within the target temperature discharge range of 215ºF and 275ºF. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

   Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. If requested, determine the moisture content by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

F. Hauling Operations. Before use, clean all truck beds to ensure mixture is not contaminated. When a release agent is necessary, use a release agent on the approved list maintained by the Construction Division to coat the inside bed of the truck.

Use only equipment for hauling as defined in Section 3XXX.4.G.3.c, "Hauling Equipment." Other hauling equipment may be used when allowed by the Engineer.

G. Placement Operations. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed by the Engineer. When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly. Place mixture within the compacted lift thickness shown in Table 13 unless otherwise shown on the plans or allowed. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans.

Table 13
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
SP-A	3.00	5.0	2.50
SP-B	2.25	4.0	2.00
SP-C	1.50	3.0	1.25
SP-D	1.25	2.0	1.25
~~CMHB-C~~	~~2.00~~	~~4.0~~	~~1.75~~
~~CMHB-F~~	~~1.50~~	~~3.0~~	~~1.25~~

1. **Weather Conditions.**

   a. **When Using a Pave-IR System for Specification Compliance.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 32°F; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving. Operate the Pave-IR system in accordance with Tex-244-F and demonstrate to the Engineer that no recurring severe thermal segregation exists. Provide the Engineer with the automated report described in Tex-244-F on a daily basis unless otherwise directed.

   b. **When Not Using a Pave-IR System for Specification Compliance.** Place mixture when the roadway surface temperature is ~~60°F~~ equal to or higher than the temperatures listed in Table 14 unless otherwise approved. Measure the roadway surface temperature with a handheld infrared thermometer. The Engineer may allow mixture placement to begin prior to the roadway surface reaching the required temperature requirements, if conditions are such that the roadway surface will reach the required temperature within 2 hours of beginning placement operations. ~~Unless otherwise shown on the plans,~~ Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.

Table 14
Minimum Pavement Surface Temperatures

Originally Specified High Temperature Binder Grade	Minimum Pavement Surface Temperatures in Degrees Fahrenheit	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64 or lower	45	50
PG 70	55[1]	60[1]
PG 76 or higher	60[1]	60[1]

1. Contractors may pave at temperatures 10°F lower than these values ~~shown in Table 14~~ when utilizing a paving process including WMA or equipment that eliminates thermal segregation. In such cases, the Contractor must use either a hand held thermal camera or a hand held infrared thermometer operated in accordance with Tex-244-F to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal

2. **Tack Coat.** Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The

Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply the tack coat in a uniform manner such that streaks and other irregular patterns are avoided. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely prior to placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

3. **Lay-Down Operations.** ~~Use the guidelines in Table 11 to establish the temperature of mixture delivered to the paver. Record the information on Department QC/QA forms and submit the forms to the Engineer.~~

   a. **Thermal Profile.** ~~For each sublot,~~ Use an infrared thermometer or thermal camera to obtain ~~a~~ thermal profiles on each sublot in accordance with ~~using~~ Tex-244-F. ~~The Engineer may reduce the testing frequency based on a satisfactory test history. The Engineer may also obtain as many thermal profiles as deemed necessary. If the temperature differential is greater than 25°F, the area will be deemed as having thermal segregation. Evaluate areas with thermal segregation by performing a density profile in accordance with Section 344.4.I.3.c(2), "Segregation (Density Profile)." Take corrective action to eliminate areas that have thermal segregation. Unless otherwise directed, suspend operations if the maximum temperature differential exceeds 50°F. Resume operations when the Engineer determines that subsequent production will meet the specifications.~~ The Engineer will obtain a thermal profile at least once per project and may obtain as many thermal profiles as deemed necessary. Thermal profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas."

      At the completion of each lot, provide the Engineer with the thermal profile of every sublot within the lot. Report the results of each thermal profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

      (1) Moderate Thermal Segregation. Any areas that have a maximum temperature differential greater than 25°F but not exceeding 50°F are deemed as having moderate thermal segregation. Take immediate corrective action to eliminate the moderate thermal segregation. Evaluate areas with moderate thermal segregation by performing ~~a~~ density profiles in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile)."

      (2) Severe Thermal Segregation. Any areas that have a maximum temperature differential greater than 50°F are deemed as having severe thermal segregation. When the Pave-IR system is not used for specification compliance, no production or placement bonus will be paid for any sublot that contains severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Item. Evaluate areas with severe thermal segregation by performing ~~a~~ density profiles in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile)."

Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed. The sublot in question may receive a production and placement bonus if applicable when the defective material is successfully removed and replaced.

(3) Use of the Pave-IR System. In lieu of obtaining thermal profiles on each sublot using an infrared thermometer or thermal camera, the Contractor may use the Pave IR system (paver mounted infrared bar) to obtain a continuous thermal profile in accordance with Tex-244-F. When electing to use the Pave-IR system, notify the Engineer prior to beginning placement operations and specify if using the Pave-IR system for specification compliance or for information only. When electing to use the Pave-IR system for information only, use an infrared thermometer or thermal camera to obtain thermal profiles in accordance with Tex-244-F. When electing to use the Pave-IR system for information only, segregation density profiles are applicable.

When using the Pave-IR system for specification compliance, review the output results on a daily basis. ~~and,~~ Unless otherwise directed, provide the automated report described in Tex-244-F to the Engineer for review. Modify the paving process as necessary to eliminate any (moderate or severe) thermal segregation identified by the Pave-IR system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles ~~in accordance with Section 3XXX. 4.I.3.c(2), "Segregation (Density Profile),"~~ are not required and are not applicable when using the Pave-IR system for specification compliance. Upon completion of use of the Pave-IR system for specification compliance or as requested by the Engineer, provide the Engineer with electronic copies of all daily data files that can be used with the Pave-IR system software to generate temperature profile plots.

b. Windrow Operations. When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

~~**Table 11**~~
~~**Suggested Minimum Mixture Placement Temperature**~~

~~High-Temperature Binder Grade~~	~~Minimum Placement Temperature (Before Entering Paver)~~
~~PG 64 or lower~~	~~260°F~~
~~PG 70~~	~~270°F~~
~~PG 76~~	~~280°F~~
~~PG 82 or higher~~	~~290°F~~

c. Hauling Equipment. The Contractor may elect to use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with a MTD with remixing capability or when a Pave-IR system is used for specification compliance unless otherwise allowed by the Engineer.

d. Screed Heaters. If the paver stops for more than 5 minutes, turn off screed heaters to prevent overheating of the mat. If the screed heater remains on for

more than 5 minutes while the paver is stopped, the Engineer may evaluate the suspect area in accordance with Section 3XXX.4.I.3.c(4),"Recovered Asphalt Dynamic Shear Rheometer (DSR)."

H. Compaction. Uniformly compact the pavement to the density requirements of the specification. Use the control strip method given in Tex-207-F, Part IV, to establish the rolling pattern. Do not use pneumatic-tire rollers if excessive pickup of fines by roller tires occurs. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Where specific in-place air void requirements are waived, furnish and operate compaction equipment as approved. Monitor the paving operation and ensure that the compacted mat has between 2.7% and 9.0% in-place air voids. When the in-place air voids are outside this range, take immediate corrective action to bring the operation within these tolerances. The Engineer may suspend operations or require removal and replacement if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow paving to resume when the proposed corrective action is likely to yield acceptable results. Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

~~Compact RBL mixtures to achieve a maximum in-place air void value of 4.0%. Core each sublot of the RBL and determine the in-place air voids. Investigate air void deficiencies and take corrective actions during production and placement to achieve required air voids. Suspend production if 2 consecutive sublots fail to meet the air void requirement, unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.~~

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

I. Acceptance Plan. ~~Sample and test the hot mix on a lot and sublot basis. If the production pay factor for 3 consecutive lots or the placement pay factor for 3 consecutive lots is below 1.000, suspend production until test results or other information indicate, to the satisfaction of the Engineer, that the next material produced or placed will meet the specified values.~~ Pay adjustments for the material will be in accordance with Article ~~344.~~6, "Payment."

Sample and test the hot mix on a lot and sublot basis. If the production pay factor given in Section 3XXX.6.A, "Production Pay Adjustment Factors," for 2 consecutive lots or the placement pay factor given in Section 3XXX.6.B, "Placement Pay Adjustment Factors," for 2 consecutive lots is below 1.000, suspend production until test results or other information indicate to the satisfaction of the Engineer that the next material produced or placed will result in pay factors of at least 1.000.

1. **Referee Testing.** The Construction Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is

determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 12 and the differences cannot be resolved. Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the samples are received at the referee laboratory for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than 3 referee tests per project are required and the Engineer's test results are closer than the Contractor's test results to the referee test results.

The Construction Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory, and the Engineer's average maximum theoretical specific gravity for the lot. With the exception of remove and replace conditions, referee test results are final and will establish pay adjustment factors for the sublot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement pay adjustment factor for any sublot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with ~~Article 344.6, "Payment."~~ Section 3XXX.6.B.2, "Placement Sublots Subject to Removal and Replacement."

2. Production Acceptance.

a. Production Lot. A production lot consists of 4 equal sublots. The default quantity for Lot 1 ~~will be~~ is1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately 3 to 4 sublots are produced each day. The lot size will be ~~at least~~ between 1,000 tons~~, but no greater than~~ and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. If the indirect tensile strength exceeds 200 psi, take corrective action to bring the mixture within specification compliance unless otherwise directed.

~~The production pay factor for RBL mixtures is 1.000. Produce and test each production sublot of RBL mix to ensure the laboratory-molded density is between 97.0% to 99.0%. The Engineer may suspend production if laboratory-molded density exceeds the range on 2 consecutive sublots.~~

(1) ~~Small Quantity~~ Exempt Production. When the anticipated daily production is less than ~~500~~ 1,000 tons, ~~or~~ the total production for the project is less than 5,000 tons, or when mutually agreed between the Engineer and the Contractor, the Engineer may ~~waive~~ deem the mixture as exempt production. Production may also be exempt when shown on the plans. All quality control and quality assurance (QC/QA) sampling and testing

requirements are waived for exempt production and ~~If the Engineer~~ ~~waives QC/QA sampling and testing~~, ~~both~~ the production and placement pay factors ~~will be~~ are 1.000. However, the Engineer will retain the right to perform random acceptance tests for production and placement and may reject objectionable materials and workmanship.

~~When the Engineer waives all QC/QA sampling and testing requirements~~ For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer;
- when not using the Pave-IR system for specification compliance, perform segregation (density profiles) and thermal profiles in accordance with the specification;
- control mixture production within ±1.0% of the target laboratory-molded density as tested by the Engineer; and
- compact the mixture to yield in-place air voids that are greater than or equal to 2.7% and less than or equal to 9.0% as tested by the Engineer.

(2) Incomplete Production Lots. If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 3XXX.6.A, "Production Pay Adjustment Factors." Close all lots within 5 working days unless otherwise allowed by the Engineer.

b. Production Sampling.

(1) Mixture Sampling. Obtain hot mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until testing by the Department is completed.

(a) Random Sample. At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. For each sublot, take ~~1~~one sample at the location randomly selected. The Engineer will perform or witness the sampling of production sublots.

(b) Blind Sample. For ~~each lot~~ 1 sublot per lot, the Engineer will ~~randomly select~~ obtain and test a "blind" sample ~~from at least 1 sublot~~ in lieu of the random sample collected by the Contractor. The Contractor may test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or

selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

~~Deliver the samples to the appropriate party's laboratory. Deliver referee samples to the Engineer. Discard unused samples after accepting pay adjustment factors for that lot.~~

(2) Informational Cantabro and Overlay Testing. During the first week of production, randomly select 1 sublot from Lot 2 or higher for Cantabro and Overlay testing. Obtain and provide the Engineer with approximately 150 lb. (70 kg) of mixture in sealed containers, boxes, or bags labeled with CSJ, mixture type, lot, and sublot number. The Engineer will ship the mixture to the Construction Division for Cantabro and Overlay testing. Results from these tests will not be used for specification compliance.

(3) Asphalt Binder Sampling. Obtain a 1-qt. sample of the asphalt binder for each ~~sublot~~lot of mixture produced. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill. Take the sample in accordance with ~~the pipeline sampling procedure given in~~ Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers~~,~~ and deliver the sample to the Engineer. The Engineer may also obtain independent samples. ~~If the Engineer chooses to obtain an independent asphalt binder sample,~~ If obtaining an independent asphalt binder sample, the Engineer will split a sample of the asphalt binder with the Contractor. The Engineer will test at least ~~1~~one asphalt binder sample per project to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

c. Production Testing. The Contractor and Engineer must perform production tests in accordance with Table15. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in Table 12 for all sublots.

If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractors corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. Provide evidence that results from Tex-236-F are not reliable before requesting permission to use an alternate method unless otherwise directed. If an alternate test method is allowed, use the applicable test procedure as directed.

Table 15
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot
VMA			
Laboratory-molded bulk specific gravity			
In-place air voids			
Segregation (density profile)[5]	Tex-207-F, Part V	1 per sublot	1 per project
Longitudinal joint density	Tex-207-F, Part VII		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	1 per sublot
Asphalt content	Tex-236-F	1 per sublot	1 per lot
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Recycled Asphalt Shingles (RAS)[2]	Tex-217-F, Part III	N/A	
Thermal profile[5]	Tex-244-F	1 per sublot	
Asphalt binder sampling and testing[1]	Tex-500-C	1 per sublot (sample only)	
Boil test[3]	Tex-530-C	1 per lot	
Cantabro Test[4]	Tex-245-F	1 per project (sample only)	
Overlay Test[4]	Tex-248-F		

1. The Engineer may perform as many additional tests as deemed necessary.
2. Testing performed by the Construction Division or designated laboratory.
3. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
4. Testing performed by the Construction Division and for informational purposes only.
5. Not required when the Pave-IR system is used for specification compliance.

d. Operational Tolerances. Control the production process within the operational tolerances listed in Table 12. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

(1) Gradation. Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Unless otherwise directed, suspend production when either the Contractor's or the Engineer's test results for gradation exceed the operational tolerances for 3 consecutive sublots on the same sieve or 4 consecutive sublots on any sieve. The consecutive sublots may be from more than ~~1~~one lot.

(2) Asphalt Content. A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 12. No production or placement bonus will be paid for any ~~lot that has 2 or more sublots within a lot that are~~ sublot that is out of operational tolerance for asphalt content ~~based on either the Contractor's or the Engineer's test results~~. Suspend production and shipment of mixture if the

Engineer's or the Contractor's asphalt content deviates from the current JMF by more than 0.5% for any sublot.

(3) Voids in the Mineral Aggregate (VMA). The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt content, the Engineer will use the asphalt content results from quality control testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 8. No production or placement bonus will be paid for any sublot that does not meet the minimum VMA requirement for production listed in Table 8 based on the Engineer's VMA determination.

Suspend production and shipment of mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

(4) Hamburg Wheel Test. The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any area of the roadway where rutting is observed. When the production or core samples fail the Hamburg Wheel test criteria in Table 11, suspend production until further Hamburg Wheel tests meet the specified values. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel path. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by retesting the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

e. Individual Loads of Hot Mix. The Engineer can reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 12, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load and the Engineer may require removal.

3. **Placement Acceptance.**

   a. **Placement Lot.** A placement lot consists of 4 placement sublots. A placement sublot consists of the area placed during a production sublot. ~~The placement pay factor for RBL mixtures is 1.000. The Engineer may suspend production of the RBL if the in-place air voids exceed 4.0% on 2 consecutive sublots.~~

      (1) Lot 1 Placement. Placement bonuses for Lot 1 will be in accordance with Section 3XXX.6.B, "Placement Pay Adjustment Factors." However, no placement penalty will be assessed for any sublot placed in Lot 1 when the in-place air voids are greater than or equal to 2.7% and less than or equal to 9.0%. Remove and replace any sublot with in-place air voids less than 2.7% or greater than 9.0%.

      (2) Incomplete Placement Lots. An incomplete placement lot consists of the area placed as described in Section 3XXX.4.I.2.a(2), "Incomplete Production Lot," excluding ~~miscellaneous~~ areas ~~as~~ defined in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production sublot.

      (3) Shoulders~~, and~~ Ramps, Etc. Shoulders~~, and~~ ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination and pay adjustments~~,~~ unless ~~otherwise shown on the plans~~ designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

      (4) Miscellaneous Areas. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, ~~are not generally subject to primary traffic,~~ such as driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Intersections and temporary detours will be considered miscellaneous areas when shown on the plans. Miscellaneous areas also include level-ups and thin overlays if the layer thickness designated on the plans is less than the minimum untrimmed core height eligible for testing ~~compacted lift thickness~~ shown in Table 13. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans. Miscellaneous areas are not eligible for random placement sampling locations~~, and will receive a 1.000 placement pay factor~~. Compact areas that are not subject to in-place air void determination in accordance with Section 3XXX.4.H, "Compaction."

   b. **Placement Sampling.** At the beginning of the project, the Engineer will select random numbers for all placement sublots. The Engineer will provide the Contractor with the placement random numbers immediately after the sublot is completed. Mark the roadway location at the completion of each sublot and record the station number. Determine 1 random sample location for each placement sublot in accordance with Tex-225-F. If the randomly generated sample location is within 2 ft. of a joint or pavement edge, adjust the location by no more than necessary to achieve a 2-ft. clearance.

Shoulders, ~~and~~ ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; ~~H~~ however, if a random sample location falls on ~~a shoulder or ramp~~ one of these areas and the area ~~that~~ is designated on the plans as not subject to in-place air void ~~testing~~ determination, cores will not be taken for the sublot and a 1.000 pay factor will be assigned to that sublot.

Provide the equipment and means to obtain and trim roadway cores on-site. On-site is hereby defined as in close proximity to where the cores are taken. ~~Unless otherwise determined, the Engineer will witness the coring operation and measurement of the core thickness.~~ Obtain the cores within 1 working day of the time the placement sublot is completed unless otherwise approved. Obtain two 6-in. diameter cores side by side from within 1 ft. of the random location provided for the placement sublot. For SP-C and SP-D~~, and CMHB-F~~ mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to ~~insure~~ ensure that an adequate bond will be achieved during subsequent placement operations. ~~For SP-C, SP-D, and CMHB-F mixtures, 4-in. diameter cores are allowed.~~

Immediately after obtaining the cores from the roadway, trim the cores in accordance with Tex-207-F if the core heights meets the minimum untrimmed values listed in Table 13. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the lot and sublot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until testing by the Department is completed. Prior to turning the trimmed cores over to the Engineer, the Contractor may elect to wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may elect to have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use the Construction Division's protocol to provide a secure means and process that protects the integrity of the cores during transport.

If the core height before trimming is less than the minimum untrimmed value shown in Table 13, decide whether to include the pair of cores in the air void determination for that sublot. If electing to have the cores included in air void determination, trim the cores as described above before delivering to the Engineer. If electing to not have the cores included in air void determination, deliver untrimmed cores to the Engineer and inform the Engineer of the decision to not have the cores included in air void determination. The placement pay

factor for the sublot will be 1.000 if cores will not be included in air void determination.

In lieu of the Contractor trimming the cores on-site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Trimming of the cores may be performed by either the Department or Contractor representative. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Immediately after obtaining the cores, dry the core holes and tack the sides and bottom. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

~~If the core heights exceed the minimum untrimmed values listed in Table 10, trim and deliver the cores to the Engineer within 1 working day following placement operations unless otherwise approved.~~

~~If the core height before trimming is less than the minimum untrimmed value shown in Table 10, decide whether or not to include the pair of cores in the air void determination for that sublot. If the cores are to be included in air void determination, trim the cores before delivering to the Engineer. If the cores will not be included in air void determination, deliver untrimmed cores to the Engineer. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.~~

c. Placement Testing. Perform placement tests in accordance with Table 15. After the Engineer returns the cores, the Contractor has the option to test the cores to verify the Engineer's test results for in-place air voids. ~~Re-dry the cores to constant weight before testing.~~ The allowable differences between the Contractor's and Engineer's test results are listed in Table 12.

(1) In-Place Air Voids. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be predried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content ~~of the 2 cores to calculate a placement pay adjustment factor~~ for in-place air voids.

The Engineer will use ~~paraffin coating or~~ the vacuum method~~s~~ to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core to determine the placement pay adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

When specific air-void requirements are waived, the Engineer may measure the in-place air voids to verify conformance with Section 3XXX.4.H, "Compaction."

(2) Segregation (Density Profile). Test for segregation using density profiles in accordance with Tex-207-F, Part V. Density profiles are not required and are not applicable when using the Pave-IR system for specification compliance. ~~Provide the Engineer with the results of the density profiles as they are completed.~~ ~~Areas defined in Section 344.4.I.3.a(4), "Miscellaneous Areas," are not subject to density profile testing.~~ Density profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.1.3.a(4), "Miscellaneous Areas."

Unless otherwise approved, perform a density profile every time the screed stops, on areas that are identified by either the Contractor or the Engineer as having thermal segregation, and on any visibly segregated areas. If the screed does not stop, and there are no visibly segregated areas or areas that are identified as having thermal segregation, perform a minimum of 1 profile per sublot. ~~Reduce the test frequency to a minimum of 1 profile per lot if 4 consecutive profiles are within established tolerances. Continue testing at a minimum frequency of 1 per lot unless a profile fails, at which point resume testing at a minimum frequency of 1 per sublot. The Engineer may further reduce the testing frequency based on a consistent pattern of satisfactory results.~~

At the completion of each lot, provide the Engineer with the density profile of every sublot within the lot. Report the results of each density profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances in Table 16. No production or placement bonus will be paid for any sublot that contains a failing density profile. When the Pave-IR system is not used for specification compliance, the Engineer will measure the density profile at least once per project and ~~may make as many independent density profile verifications as deemed necessary~~ may measure the density profile at any time, at any location, and as often as deemed necessary to verify conformance. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3XXX.4.I.3.c(5), "Irregularities." The sublot in question may receive a production and placement bonus if applicable when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if 2 consecutive density profiles fail~~,~~ unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 16
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
SP-A & SP-B	8.0 pcf	5.0 pcf
SP-C & SP-D ~~CMHB-C & CMHB-F~~	6.0 pcf	3.0 pcf

(3) Longitudinal Joint Density.

(a) Informational Tests. While establishing the rolling pattern, perform joint density evaluations and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern, if needed, to achieve the desired joint density. Perform additional joint density evaluations at least once per sublot unless otherwise directed.

(b) Record Tests. For each sublot, perform a joint density evaluation at each pavement edge that is or will become a longitudinal joint. Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results on Department forms to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location, and the correlated joint density is less than 90.0%. The Engineer will make an independent joint density verification at least once per project and may make independent joint density verifications at the random sample locations and as often as deemed necessary to verify conformance. The Engineer's joint density test results will be used when available.

At the completion of each lot, provide the Engineer with the joint density of every sublot within the lot. Report the results of each joint density in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if ~~2~~ two consecutive evaluations fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

(4) Recovered Asphalt Dynamic Shear Rheometer (DSR). When the Pave-IR system is not used for specification compliance, the Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Construction Division. The aging ratio is the ~~dynamic shear rheometer (~~DSR~~)~~ value of the extracted binder divided by the DSR value of the original unaged binder ~~(including RAP binder)~~. DSR values are obtained according to AASHTO T 315 at the specified high temperature performance grade of the asphalt. ~~The binder from RAP will be included proportionally as part of the original unaged~~

~~binder.~~ The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores using Tex-211-F.

(5) Irregularities. ~~Immediately take corrective action if surface~~ Identify and correct irregularities including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, ~~or~~ uncoated aggregate particles, ~~are detected~~ or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does not bond to the existing pavement. If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than 1 day while the Contractor is taking appropriate corrective action.

~~The Engineer may allow placement to continue for at most 1 day of production while taking appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.~~

~~At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.~~

4. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces" unless otherwise shown on the plans.

5. **Measurement.** Hot mix will be measured by the ton of composite hot mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

6. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under Article ~~344.~~5, "Measurement," will be paid for at the unit price bid for "~~Performance Design~~ Superpave Mixtures~~,~~" of the mixture type, surface aggregate classification, and binder specified. These prices are full compensation for surface preparation; materials including tack coat; placement; equipment; labor; tools; and incidentals.

Pay adjustments for bonuses and penalties will be applied as determined in this Item; ~~These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.~~ however, a pay adjustment factor of 1.000 will be assigned for all placement sublots for "level ups" only when "level up" is listed as part of the item bid description code.

Applicable pay adjustment bonuses will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint density in

accordance with Section 3XXX.4.B, "Reporting and Responsibilities." If the Contractor uses the Pave-IR system for specification compliance, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the Pave-IR system automated reports described in Tex-244-F are required.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Pay adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

A. Production Pay Adjustment Factors. The production pay adjustment factor is based on the laboratory-molded density using the Engineer's test results. A pay adjustment factor will be determined from Table 17 for each sublot using the deviation from the target laboratory-molded density defined in Table 10. The production pay adjustment factor for completed lots will be the average of the pay adjustment factors for the 4 sublots sampled within that lot.

Table 17
Production Pay Adjustment Factors for Laboratory-Molded Density[1]

Absolute Deviation from Target Laboratory-Molded Density	Production Pay Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.075
0.1	1.075
0.2	1.075
0.3	1.066
0.4	1.057
0.5	1.047
0.6	1.038
0.7	1.029
0.8	1.019
0.9	1.010
1.0	1.000
1.1	0.900
1.2	0.800
1.3	0.700
> 1.3	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractors corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

1. **Payment for Incomplete Production Lots.** Production pay adjustments for incomplete lots, described under Section 3XXX.4.I.2.a(2), "Incomplete Production Lots," will be calculated using the average production pay factors from all sublots sampled. A production pay factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples.
2. **Production Sublots Subject to Removal and Replacement.** If after referee testing, the laboratory-molded density for any sublot results in a "remove and replace" condition as listed in Table 17, the Engineer may require removal and replacement, or may allow the sublot to be left in place without payment. The Engineer may also

elect to accept the sublot in accordance with Item 5 "Control of the Work" Article 5.3.A "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Article.

B. Placement Pay Adjustment Factors. The placement pay adjustment factor is based on in-place air voids using the Engineer's test results. A pay adjustment factor will be determined from Table 18 for each sublot that requires in-place air void measurement. A placement pay adjustment factor of 1.000 will be assigned to the entire sublot when the random sample location falls in an area designated on the plans as ~~on a ramp or shoulder~~ not subject to in-place air void ~~testing~~ determination. A placement pay adjustment factor of 1.000 will be assigned to quantities placed in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas." The placement pay adjustment factor for completed lots will be the average of the placement pay adjustment factors ~~for the~~ up to 4 sublots within that lot.

Table 18
Placement Pay Adjustment Factors for In-Place Air Voids

In-Place Air Voids	Placement Pay Adjustment Factor	In-Place Air Voids	Placement Pay Adjustment Factor
< 2.7	Remove and Replace	5.9	1.048
2.7	0.695	6.0	1.045
2.8	0.715	6.1	1.042
2.9	0.735	6.2	1.039
3.0	0.755	6.3	1.036
3.1	0.775	6.4	1.033
3.2	0.795	6.5	1.030
3.3	0.815	6.6	1.027
3.4	0.835	6.7	1.024
3.5	0.855	6.8	1.021
3.6	0.875	6.9	1.018
3.7	0.895	7.0	1.015
3.8	0.915	7.1	1.012
3.9	0.935	7.2	1.009
4.0	0.955	7.3	1.006
4.1	0.975	7.4	1.003
4.2	0.995	7.5	1.000
4.3	1.015	7.6	0.980
4.4	1.035	7.7	0.960
4.5	1.055	7.8	0.940
4.6	1.075	7.9	0.920
4.7	1.075	8.0	0.900
4.8	1.075	8.1	0.880
4.9	1.075	8.2	0.860
5.0	1.075	8.3	0.840
5.1	1.072	8.4	0.820
5.2	1.069	8.5	0.800
5.3	1.066	8.6	0.780
5.4	1.063	8.7	0.760
5.5	1.060	8.8	0.740
5.6	1.057	8.9	0.720
5.7	1.054	9.0	0.700
5.8	1.051	> 9.0	Remove and Replace

~~A placement pay adjustment factor of 1.000 will be assigned to all sublots for mixtures designated on the plans as "rich bottom layer." RBL Cores from "rich bottom layer" RBL mixtures are subject to specification requirements described in Section 3XXX.4.H, "Compaction."~~

1. **Payment for Incomplete Placement Lots.** Pay adjustments for incomplete placement lots described under Section 3XXX.4.I.3.a(2), "Incomplete Placement Lots," will be calculated using the average of the placement pay factors from all sublots sampled and sublots where the random location falls in an area designated on the plans as ~~on a ramp or shoulder~~ not eligible for ~~testing~~ in-place air void determination. A placement pay adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples.
2. **Placement Sublots Subject to Removal and Replacement.** If after referee testing, the placement pay adjustment factor for any sublot results in a "remove and replace" condition as listed in Table 18, the Engineer will choose the location of ~~2~~two cores to be taken within 3 ft. of the original failing core location. The Contractor will obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Pavements Section of the Construction Division, where they will be trimmed if necessary and tested for bulk specific gravity within 10 working days of receipt. The average bulk specific gravity of the cores will be divided by the Engineer's average maximum theoretical specific gravity for that lot to determine the new pay adjustment factor of the sublot in question. If the new pay adjustment factor is 0.700 or greater, ~~then~~ the new pay adjustment factor will apply to that sublot. If the new pay adjustment factor is less than 0.700, no payment will be made for the sublot. Remove and replace the failing sublot, or the Engineer may allow the sublot to be left in place without payment. The Engineer may also elect to accept the sublot in accordance with Item 5 "Control of the Work" Article 5.3.A "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Article.

C. Total Adjustment Pay Calculation. Total adjustment pay (TAP) will be based on the applicable pay adjustment factors for production and placement for each lot.

$$TAP = (A + B)/2$$

where:

A = Bid price × production lot quantity × average pay adjustment factor for the production lot

B = Bid price × placement lot quantity × average pay adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous ~~quantities~~ areas × 1.000)

Production lot quantity = Quantity actually placed - quantity left in place without payment

Placement lot quantity = Quantity actually placed - quantity left in placed without payment - quantity placed in miscellaneous areas

SPECIAL SPECIFICATION

3XXX for Item 346

Stone-Matrix Asphalt

1. **Description.** Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted stone-matrix asphalt (SMA) or stone-matrix asphalt rubber (SMAR) mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant.

2. **Materials.** Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

   Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the ~~requirements of this Item~~ specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify compliance.

   A. **Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section~~, unless otherwise shown on the plans~~. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for ~~either a~~ coarse, ~~aggregate~~ intermediate, or fine aggregate. ~~When reclaimed asphalt pavement (RAP) is allowed by plan note, provide RAP stockpiles in accordance with this Section.~~ Aggregate from RAP is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. ~~Supply mechanically crushed gravel or stone aggregates that meet the definitions in Tex-100-E.~~ The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II. ~~Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) unless otherwise approved.~~

      1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Provide aggregates from sources listed in the BRSQC located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Use only the rated values for hot mix listed in the BRSQC. Rated values for surface

treatment (ST) do not apply to coarse aggregate sources used in hot mix. Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Do not add material to an approved stockpile from sources that do not meet the aggregate quality requirements of the Department's *Bituminous Rated Source Quality Catalog* (BRSQC). Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes~~, unless otherwise shown on the plans~~. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.

a. Blending Class A and Class B Aggregates. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials; however, Class B virgin (non-recycled) aggregate may be disallowed when shown on the plans. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. ~~When blending, do not use Class C or D aggregates. For blending purposes,~~ Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate.

When the Contractor blends Class A and B aggregates to meet a Class A requirement, the Engineer may perform tests at any time during production to ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. In such cases where the Engineer elects to verify conformance, the Engineer will use the Department's mix design program to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the program; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

b. Micro-Deval Abrasion. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing prior to the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer will estimate the

magnesium sulfate soundness loss ($Mg_{est.}$) for each coarse aggregate source by multiplying the RSSM value by the ratio of the actual Micro-Deval percent loss ($MD_{act.}$) divided by the Rated Source Micro-Deval (RSMD) using the formula $Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$. When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Geotechnical, Soils, & Aggregates Branch of the Construction Division. Additional testing may be required prior to granting approval.

2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. When used, supply intermediate aggregates that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. When used, supply intermediate aggregate from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

3. **Fine Aggregate.** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. At most 15% of the total aggregate may be field sand or other uncrushed fine aggregate. With the exception of field sand, use fine aggregate from coarse aggregate sources that meet the requirements shown in Table 1~~,~~ unless otherwise approved.

   If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	AQMP	As shown on plans
Deleterious material, %, max	Tex-217-F, Part I	1.0
Decantation, %, max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %, max	Tex-461-A	Note 1
Los Angeles abrasion, %, max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, max	Tex-411-A	20
Coarse aggregate angularity, 2 crushed faces, %, min	Tex 460-A, Part I	95[2]
Flat and elongated particles @ 5:1, %, max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, max	Tex-107-E	3
Combined Aggregate[3]		
Sand equivalent, %, min	Tex-203-F	45

1. ~~Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.~~Used to estimate the magnesium sulfate soundness loss in accordance with Section 3XXX.2.A.1, "Coarse Aggregate."
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF)

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

B. Mineral Filler. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, ~~cement,~~ or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% hydrated lime ~~or cement,~~ unless otherwise shown on the plans. Do not use more than 5% fly ash unless otherwise shown on the plans. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

C. Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

D. Asphalt Binder. ~~For SMA mixtures, f~~Furnish the type and grade of ~~PG~~ binder ~~and fibers~~ specified on the plans~~. For SMAR mixtures, provide the A-R binder specified on the plans. Provide asphalt binder~~ that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions."

1. **PG Binder.** When SMA is specified, provide an asphalt binder with a high-temperature grade of PG 76 and low-temperature grade as shown on the plans in accordance with Section 300.2.J, "Performance-Graded Binders."

2. **A-R Binder.** When SMAR is specified, provide A-R binder that meets the Type I or Type II requirements of Section 300.2.I, "Asphalt-Rubber Binders," unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.G, "Crumb Rubber Modifier," unless otherwise shown on the plans. Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.

E. Tack Coat. ~~Unless otherwise shown on the plans or approved,~~ Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed by the Engineer or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least 1 sample of the tack coat binder per project in accordance with Tex-500-C, Part III and test it to verify compliance with Item 300. The Engineer will obtain the sample from the asphalt distributor immediately before use.

F. Additives. Use the type and rate of additive specified when shown on the plans. Other additives that facilitate mixing, compaction, or improve the quality of the mixture may be allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

1. **Fibers.** When PG binder is specified, provide cellulose or mineral fibers. Submit written certification to the Engineer that the fibers proposed for use meet the requirements of DMS-9204, "Fiber Additives for Bituminous Mixtures." Fibers may be pre-blended into the binder at the asphalt supply terminal unless otherwise shown on the plans.

   When at least 3% RAS is used in the mixture, the Contractor may reduce the amount of fibers as specified in Note 2 of Table 8.

2. **Lime and Liquid Antistripping Agent~~s~~.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream~~,~~ unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

3. **Warm Mix Asphalt (WMA).** Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215ºF and 275ºF using Department approved WMA additives or processes. The Department's approved list of WMA additives and processes is located at http://www.txdot.gov/business/contractors_consultants/producer_list.htm.

   WMA is allowed for use on all projects and is required when shown on plans. The maximum placement or target discharge temperature for WMA may be set at a value less than 275ºF when shown on the plans.

   Department approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures greater than 275ºF; however, such mixtures will not be defined as WMA.

G. Recycled Materials. Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine asphalt content and gradation of the RAP and RAS material for mixture design purposes in accordance with Tex-236-F. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. When RAP or RAS is used, calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 4 during mixture design and HMA production. During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve.

   Use of Contractor-owned RAP including HMA plant waste is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Unfractionated RAP is not allowed in SMA and SMAR mixtures. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

   Fractionated RAP is defined as having 2 or more RAP stockpiles, divided into coarse and fine fractions. The coarse RAP stockpile will contain only material retained by processing over a 3/8 in. screen or 1/2 in. screen unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8 in. screen or 1/2 in. screen unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8 in. screen or 1/2 in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse

or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

2. **RAS.** Use of post-manufactured RAS or post-consumer RAS is permitted unless otherwise shown on the plans. RAS are defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS are processed manufacturer's shingle scrap by-product. Post-consumer RAS, or tear-offs, are processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the Texas Commission on Environmental Quality (TCEQ). RAS may be used separately or in conjunction with RAP.

   Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material prior to extraction (or ignition) of the asphalt.

   Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. For any stockpile that contains RAS, the entire stockpile will be considered to be a RAS stockpile and limited to no more than 5.0% of the HMA mixture in accordance with Table 4.

   Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials (NRM) Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established NRM. Use RAS from shingle sources on the Construction Division's "Nonhazardous Recycled Materials" approved list at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Prior to use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval to the Engineer prior to submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

Table 4
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder[1] to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
		Unfractionated RAP[2]	Fractionated RAP[3]	RAS[4]
Surface Mixes[5]	15.0	0.0	15.0	5.0
Non-Surface Mixes[6]	20.0	0.0	20.0	5.0

1. Combined recycled binder from fractionated RAP and RAS.
2. Unfractionated RAP is not allowed in SMA or SMAR mixtures.
3. May replace up to 5% fractionated RAP with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.
5. "Surface" mixes are defined as mixtures that will be the final lift or riding surface of the pavement structure.
6. "Non-Surface" mixes are defined as mixtures that will be an intermediate or base layer in the pavement structure.

3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." When A-R binder is specified, equip the hot mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. When an asphalt mass flow meter is used, provide a means to calibrate the meter on site.

4. Construction. Produce, haul, place, and compact the specified paving mixture. On or before the first day of paving, it is mandatory to schedule and participate in a pre-paving meeting with the Engineer ~~as required in the Quality Control Plan (QCP)~~ unless otherwise shown on the plans.

A. Certification. Personnel, certified by the Hot Mix Asphalt Center Certification Program ~~Department-approved hot-mix asphalt certification program,~~ must conduct all mixture designs, sampling, and testing in accordance with Table 5. ~~In addition to meeting the certification requirements in Table 4, all Level II certified specialists must successfully complete an approved SP training course.~~ Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design that is developed and signed by a Level 2 certified specialist. Provide a Level 1A certified specialist at the plant during production operations. Provide a Level 1B certified specialist to conduct placement tests.

~~Provide the following:~~

- ~~a mixture design that is developed and signed by a Level II certified specialist,~~
- ~~a Level IA certified specialist at the plant during production operations, and~~
- ~~a Level IB certified specialist to conduct placement tests.~~

Table 5
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level
1. Aggregate and Recycled Material Testing				
Sampling	Tex-400-A	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Parts I & III	✓	✓	2
Decantation	Tex-217-F, Part II	✓	✓	2
Los Angeles abrasion	Tex-410-A		✓	
Magnesium sulfate soundness	Tex-411-A		✓	
Micro-Deval abrasion	Tex-461-A		✓	
Coarse aggregate angularity	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex 280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors[1]	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Drain-down	Tex-235-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	2
Overlay test	Tex-248-F		✓	
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting random numbers	Tex-225-F, Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA (calculation only)	Tex-207-F	✓	✓	1A
Rice gravity	Tex-227-F	✓	✓	1A
Gradation & asphalt content[1]	Tex-236-F	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	2
Micro-Deval abrasion	Tex-461-A		✓	
Drain-down	Tex-235-F	✓	✓	1A
Boil test	Tex-530-C	✓	✓	1A
Aging ratio	Tex-211-F		✓	
Overlay test	Tex-248-F		✓	
Cantabro test	Tex-245-F		✓	
5. Placement Testing				
Selecting random numbers	Tex-225-F, Part II		✓	1A/1B
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F	✓	✓	1A/1B
Establish rolling pattern	Tex-207-F	✓	✓	1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 2
Segregation (density profile)	Tex-207-F, Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F, Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Tack coat adhesion	Tex-243-F		✓	1B

1. Refer to Section 3XXX.4.I.2.c for exceptions to using an ignition oven.
2. Profiler and operator are required to be certified at the Texas Transportation Institute facility.

B. Reporting and Responsibilities. Use Department-provided templates to record and calculate all test data including but not limited to mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the latest version of the templates at http://www.txdot.gov/txdot_library/consultants_contractors/forms/site_manager.htm or from the Engineer. The Engineer and the Contractor shall provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 6~~,~~ unless otherwise approved. The Engineer and the Contractor shall immediately report to the other party any test result that requires production or placement to be suspended, a payment penalty, or fails to meet the specification requirements. ~~Use the approved communication method (e.g., email, diskette, hard copy) to submit test results to the Engineer.~~ Record and submit all test results and pertinent information on Department-provided templates to the Engineer electronically by means of a portable USB flash drive, compact disk, or via email.

Subsequent sublots placed after test results are available to the Contractor, which require them to suspend operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3, "Conformity with Plans, Specifications, and Special Provisions."

Table 6
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1] Asphalt content[1] Laboratory-molded density[2] Moisture content[3] Boil test[3]	Contractor	Engineer	1 working day of completion of the sublot
Production Quality Assurance			
Gradation[3] Asphalt content[3] Laboratory-molded density[1] Hamburg Wheel test[2] Boil test[3] Binder tests[2]	Engineer	Contractor	1 working day of completion of the sublot
Placement Quality Control			
In-place air voids[2] Segregation[1] Longitudinal joint density[1] Thermal profile[1]	Contractor	Engineer	~~1 hr. of performing the test for segregation, longitudinal joint density and thermal profile~~ 1 working day of completion of the lot
Placement Quality Assurance			
In-place air voids[1] Segregation[2] Longitudinal joint density[2] Thermal profile[2] Aging ratio[2]	Engineer	Contractor	1 working day of receipt of the trimmed cores for in-place air voids[4]
Pay adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. To be reported as soon as results become available.
3. To be performed at the frequency ~~shown in Table 12~~ specified on the plans.
4. ~~Additional time is~~2 days are allowed if cores ~~cannot~~ can not be dried to constant weight within 1 day.

The Engineer will use the Department-provided template to calculate all pay adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the pay adjustment summary documentation for the lot.

Use the procedures described in Tex-233-F to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

C. QCP. Develop and follow the QCP in detail. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP to the Engineer before the mandatory prepaving meeting. Receive the Engineer's approval of the QCP before beginning production. Include the following items in the QCP.

1. **Project Personnel.** For project personnel, include:
   - a list of individuals responsible for QC with authority to take corrective action; and
   - contact information for each individual listed.
2. **Material Delivery and Storage.** For material delivery and storage, include:
   - the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
   - aggregate stockpiling procedures to avoid contamination and segregation;
   - frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
   - procedure for monitoring the quality and variability of asphalt binder.
3. **Production.** For production, include:
   - loader operation procedures to avoid contamination in cold bins;
   - procedures for calibrating and controlling cold feeds;
   - procedures to eliminate debris or oversized material;
   - procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip);
   - procedures for reporting job control test results; and
   - procedures to avoid segregation and drain-down in the silo.
4. **Loading and Transporting.** For loading and transporting, include:
   - type and application method for release agents; and
   - truck loading procedures to avoid segregation.
5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory prepaving meeting, including date and location;
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver while avoiding segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

D. Mixture Design.

1. Design Requirements. Use the SMA or SMAR design procedure~~s~~ given in Tex-204-F, Part VI or Part VII unless otherwise shown in the plans.~~ to~~ Design ~~a~~ the mixture ~~meeting~~ to meet the requirements listed in Tables 1, 2, 3, 4, 7, 8 and 9.

Design SMA or SMAR mixtures using a Superpave Gyratory Compactor (SGC) at 75 gyrations as the design number of gyrations (Ndesign). The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion and may be increased to no more than 100 gyrations when shown on the plans or allowed by the Engineer. When electing to reduce the Ndesign level from the specified value, document the target value on the JMF1 submittal. Perform Hamburg and indirect tensile strength tests at the corresponding optimum asphalt content.

Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Construction Division maintains a list of approved laboratories at http://www.txdot.gov/business/contractors_consultants/producer_list.htm. Provide laboratory mixture and request that the Department perform the Overlay test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel and Overlay test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the Ndesign level used
- results of all applicable tests;

- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 7
Master Gradation ~~Band~~ Limits (% Passing by Weight or Volume)
and ~~Volumetric Properties~~ VMA[1] Requirements

Sieve Size	SMA-C Coarse	SMA-D Medium	SMA-F Fine	SMAR-C Coarse	SMAR-F Fine
3/4"	100.0[2]	100.0[2]	~~100.0~~	100.0	~~100.0~~
1/2"	80.0–90.0	85.0–99.0	100.0[2]	72.0–85.0	100.0[2]
3/8"	25.0–60.0	50.0–75.0	70.0–~~90~~100.0	50.0–70.0	95.0– 100.0
#4	20.0–28.0	20.0–32.0	30.0–~~50~~60.0	30.0–45.0	40.0–50.0
#8	14.0–20.0	16.0–28.0	20.0–~~30~~40.0	17.0–27.0	17.0–27.0
#16	8.0–20.0	8.0–28.0	~~8~~6.0–30.0	12.0–22.0	12.0–22.0
#30	8.0–20.0	8.0–28.0	~~8~~6.0–30.0	8.0–20.0	8.0–20.0
#50	8.0–20.0	8.0–28.0	~~8~~6.0–30.0	6.0–15.0	6.0–15.0
#200	8.0–12.0	8.0–12.0	~~8~~6.0–~~14~~12.0	5.0–9.0	5.0–9.0
Design VMA[1], % Minimum					
	17.5	17.5	17.5	19.0	19.0
Production (Plant-Produced) VMA[1], % Minimum					
	17.0	17.0	17.0	18.5	18.5

1. Voids in mineral aggregates.
2. Defined as maximum sieve size. No tolerance allowed.

Table 8
Laboratory Mixture Design Properties

Mixture Property	SMA Mixtures	SMAR Mixtures	Test Procedure
Design gyrations, (Ndesign)[1]	75	75	Tex-241-F
Target laboratory-molded density, %	96.0	~~97~~96.0	Tex-207-F
Asphalt binder content, %	6.0-7.0	7.0-10.0	–
Drain-down, %	0.20 max	0.20 max	Tex-235-F
Fiber content, % by wt. of total mixture	0.20[2]-0.50	–	Calculated
CRM content, % by wt. of A-R binder	–	15.0 min	Calculated
Hamburg Wheel test[3], rut depth @ 20,000 passes tested @ ~~122ºF~~50ºC, ~~in.~~mm	12.5 max	12.5 max	Tex-242-F
Indirect tensile strength (dry), psi ~~(molded to 93% ±1% density)~~	85-200[4]	85-200[4]	Tex-226-F
Overlay test, number of cycles	300	300	Tex-248-F
Boil test[5]	–	–	Tex-530-C

1. May be adjusted within a range of 35–100 gyrations when shown on the plans or specification or allowed by the Engineer. ~~When SMA mix cannot be designed with a minimum asphalt content of 6.0%, using the available aggregates, follow the guidelines in Table 8 to establish a minimum asphalt content requirement based on the combined aggregate bulk specific gravity.~~
2. When at least 3% RAS is used in the mixture, the Contractor may reduce the amount of fibers to no less than 0.10% provided the mixture meets the drain-down requirement.
3. For SMAR mixes, the number of passes required for the Hamburg Wheel test may be decreased. Other tests may be required for SMAR mixes instead of or in addition to the Hamburg Wheel test~~,~~ when shown on the plans.
4. ~~May exceed 200 psi when approved and may be waived when approved.~~ The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 4.0 mm and less than 12.5 mm.
5. Used to establish baseline for comparison to production results. May be waived when approved.

~~**Table 9**~~
~~**Guide to Adjust Minimum Asphalt Content**~~
~~**Based on Bulk Specific Gravity of Aggregates**~~

~~Combined Aggregate Bulk Specific Gravity~~	~~Minimum Asphalt Content %~~
~~≤ 2.75~~	~~6.0~~
~~2.80~~	~~5.9~~
~~2.85~~	~~5.8~~
~~2.90~~	~~5.7~~
~~2.95~~	~~5.6~~
~~3.00~~	~~5.5~~

2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommend rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.

a. Contractor's Responsibilities.

(1) Providing Superpave Gyratory Compactor. Furnish a Superpave Gyratory Compactor (SGC)~~,~~ calibrated in accordance with Tex-241-F~~,~~ for molding production samples. Locate the SGC at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples.

(2) Gyratory Compactor Correlation Factors. Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

(3) Submitting JMF1. Furnish the Engineer a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide the Engineer with approximately 25,000 g of the laboratory mixture and request the Department perform the Overlay test. If opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, provide the Engineer with ~~approximately~~ an additional 10,000 g of the design mixture and request that the Department also perform the Hamburg Wheel test.

(4) Supplying Aggregates. Provide the Engineer with approximately 40 lb. of each aggregate stockpile unless otherwise directed.

(5) Supplying Asphalt. Provide the Engineer at least 1 gal. of the asphalt material and sufficient quantities of any additives proposed for use.

(6) Ignition Oven Correction Factors. Determine the aggregate and asphalt correction factors from the ignition oven ~~using~~ in accordance with Tex-236-F. Prior to the trial batch production, provide the Engineer with split samples of the mixtures, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design, if the mixture design and ignition oven are the same as previously used unless otherwise directed. Correction factors may be waived based on past experience when approved by the Engineer.

(7) Boil Test. Perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed by the Engineer. Use this sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

(8) Trial Batch ~~Approval~~Production. Upon receiving conditional approval of JMF1 and authorization from the Engineer to produce a trial batch, provide a plant-produced trial batch, including the WMA additive or process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table

4 and Table 9. In lieu of a new trial batch, the Engineer may accept test results from recent production of the same mixture.

(9) Trial Batch Production Equipment. To produce the trial batch, use only equipment and materials proposed for use on the project. Provide documentation to verify the calibration or accuracy of the asphalt mass flow meter to measure the binder content, %, of SMAR mixtures. When required, verify that asphalt mass flow meters for A-R binder meet the requirements of 0.4 % accuracy in accordance with Item 520, "Weighing and Measuring Equipment." The Engineer may require that the accuracy of the flow mass meter be verified based on quantities used.

(10) Trial Batch Quantity. Produce enough quantity of the trial batch to ensure that the mixture ~~is representative of JMF1~~ meets the specification requirements.

(11) Number of Trial Batches. Produce trial batches as necessary to obtain a mixture that meets the specification requirements ~~in Table 9~~.

(12) Trial Batch Sampling. Obtain a representative sample of the trial batch and split it into ~~3~~ three equal portions in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

(13) Trial Batch Testing. Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the ~~verification testing requirements for gradation, asphalt content, laboratory-molded density, and VMA listed in Table 9 and is~~ mixture requirements in Table 9. The trial batch mixture must also be in compliance with the Hamburg Wheel ~~test~~ requirements in Table 8. Use a Department-approved laboratory to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

(14) Development of JMF2. After the Engineer grants full approval of JMF1 based on results from the trial batch, evaluate the trial batch test results, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt content or gradation to achieve the specified target laboratory-molded density. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements for production shown in Table 7. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 4.

(15) Mixture Production. After receiving approval for JMF2 and receiving a passing result from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch, use JMF2 to produce Lot 1 as described in Section 3XXX.4.I.3.a.(1), "Lot 1 Placement." As an option, once JMF2 is approved, proceed to Lot 1 production at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

If electing to proceed without Hamburg Wheel test results from the trial batch, notify the Engineer. Note that the Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

(16) Development of JMF3. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

(17) JMF Adjustments. If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot~~,~~;
- be numbered in sequence to the previous JMF~~,~~;
- meet the mixture requirements in Table 4;
- meet the master gradation limits shown in Table 7; and
- be within the operational tolerances of JMF2 listed in Table 9.

(18) Requesting Referee Testing. If needed, use referee testing in accordance with Section 3XXX.4.I.1, "Referee Testing," to resolve testing differences with the Engineer.

Table 9
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 7	±5.0[2,3]	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[2,3]	±3.0
% passing the #200 sieve			±2.0[2,3]	±1.6
Binder content, %	Tex-236-F[6]	±0.5	±0.3[3]	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±0.5
In-place air voids, %		N/A	N/A	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, % min		Note 4	Note 4	N/A
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	N/A	± 0.020
Drain-down	Tex-235-F	Note 5	Note 5	Note 5

1. Contractor may request referee testing only when values exceed these tolerances.
2. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
3. ~~Tolerance between JMF1 and JMF2 may exceed ±0.3%.~~ Only applies to mixture produced for Lot 1 and higher.
4. Test and verify that Table 7 requirements are met for VMA.
5. Test and verify that Table 8 requirements are met for drain-down.
6. Determine binder asphalt content from asphalt mass flow meter readouts for SMAR mixtures.

b. Engineer's Responsibilities.

(1) Gyratory Compactor. The Engineer will use a Department SGC, calibrated according to Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

(2) Conditional Approval of JMF1 and Authorizing Trial Batch. Within 2 working days of receiving the mixture design report (JMF1), ~~and~~ all required materials, Department-provided Overlay test results, and Contractor-provided Hamburg Wheel test results, the Engineer will review the Contractor's mix design report and verify conformance with all aggregates, asphalt, additives, recycled materials, and mixture specifications. ~~The Engineer may perform tests to verify the aggregates meet the requirements listed in Table 1.~~ The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test results with laboratory mixture design, a total of 10 working days is allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 ~~will be based~~ on the ~~Engineer's~~ test results on mixture from the trial batch.

The Engineer will determine the Micro-Deval abrasion loss and will estimate the magnesium sulfate soundness loss for each coarse aggregate source in accordance with Section 3XXX.2.A.1, "Coarse Aggregate." In addition to Micro-Deval testing, the Engineer may sample and test project materials at any time during the project to verify specification compliance. If the Engineer's test results are pending after 2 working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

(3) Hamburg Wheel and Overlay Testing of JMF1. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 8. The Engineer will perform the Overlay test. The Engineer will mold samples in accordance with Tex-248-F to verify compliance with the Overlay test requirements in Table 8.

~~**Authorizing Trial Batch.** After conditionally approving JMF1, which will include either Contractor- or Department-supplied Hamburg Wheel test results, the Engineer will authorize the Contractor to produce a trial batch.~~

(4) Ignition Oven Correction Factors. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for quality assurance testing during production in accordance with Tex-236-F.

(5) Testing the Trial Batch. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that ~~the gradation, asphalt content, laboratory-molded density, and VMA meet~~ the mixture meets the requirements ~~listed~~ in Table 9. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg Wheel test requirement in Table 8.

The Engineer will have the option to perform the following tests on the trial batch:

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 8~~.~~;
- Tex-461-A, to determine the need for additional magnesium sulfate soundness testing~~.~~; and
- Tex-530-C, to retain and use for comparison purposes during production.

(6) Full Approval of JMF1. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for ~~gradation, asphalt content, laboratory-molded density, and VMA confirm that~~ the trial batch meet~~s~~ the requirements in Table 9.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements ~~in Table 9~~.

(7) Approval of JMF2. The Engineer will approve JMF2 within 1 working day if ~~it~~ the mixture meets the requirements in Table 4 and the master grading limits shown in Table 7 ~~and is within the operational tolerances of JMF1 listed in Table 9~~. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 7. If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

(8) Approval of Lot 1 Production. The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF 2) as soon as a passing result is achieved from the Department's or a~~n~~ Department-approved laboratory's Hamburg Wheel test on the trial batch. ~~As an option,~~ The Contractor may proceed at their own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test ~~to~~ be removed and replaced at the Contractor's expense.

(9) Approval of JMF3 and Subsequent JMF Changes. ~~The Engineer will approve~~ JMF3 and subsequent JMF changes are approved if they meet the ~~within 1 working day if it meets~~ mixture requirements in Table 4, the master grading limits shown in Table 7, and ~~is~~ are within the operational tolerances of JMF2 listed in Table 9.

E. Production Operations. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

1. Storage and Heating of Materials. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions" or outside the manufacturer's recommended values. On a daily basis, provide the Engineer with the records of asphalt binder and hot-mix asphalt discharge temperatures (in legible

and discernable increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr unless otherwise approved.

2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F (or 275ºF for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced at more than 350°F

   When WMA is required, produce the WMA within the target temperature discharge range of 215ºF and 275ºF. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

   Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. If requested, determine the moisture content by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

F. Hauling Operations. Before use, clean all truck beds to ensure mixture is not contaminated. When a release agent is necessary, use a release agent on the approved list maintained by the Construction Division to coat the inside bed of the truck.

Use only equipment for hauling as defined in Section 3XXX.4.G.3.c, "Hauling Equipment." Other hauling equipment may be used when allowed by the Engineer.

G. Placement Operations. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed by the Engineer. When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly.

Place mixture within the compacted lift thickness shown in Table 10 unless otherwise shown on the plans or allowed. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans.

Table 10
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
SMA-C	2.25	4.00	2.00
SMA-D	1.50	3.00	1.25
SMA-F	~~1.25~~1.00	~~2.50~~2.00	1.25
SMAR-C	2.00	4.00	1.75
SMAR-F	1.50	3.00	1.25

1. **Weather Conditions.**

   a. **When Using a Pave-IR System for Specification Compliance.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 50°F; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving. Operate the Pave-IR system in accordance with Tex-244-F and demonstrate to the Engineer that no recurring severe thermal segregation exists. Provide the Engineer with the automated report described in Tex-244-F on a daily basis unless otherwise directed.

   b. **When Not Using a Pave-IR System for Specification Compliance.** Place mixture when the roadway surface temperature is 70°F or higher unless otherwise approved. Measure the roadway surface temperature with a handheld infrared thermometer. The Engineer may allow mixture placement to begin prior to the roadway surface reaching the required temperature requirements, if conditions are such that the roadway surface will reach the required temperature within 2 hours of beginning placement operations. ~~Unless otherwise shown on the plans,~~ Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.

2. **Tack Coat.** Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply the tack coat in a uniform manner such that streaks and other irregular patterns are avoided. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely prior to placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

3. **Lay-Down Operations.** ~~Use the guidelines in Table 11 to establish the temperature of mixture delivered to the paver. Record the information on Department QC/QA forms and submit the forms to the Engineer.~~

   a. **Thermal Profile.** ~~For each sublot,~~ Use an infrared thermometer or thermal camera to obtain ~~a~~ thermal profiles on each sublot in accordance with ~~using~~ Tex-244-F. ~~The Engineer may reduce the testing frequency based on a satisfactory test history. The Engineer may also obtain as many thermal profiles as deemed necessary. If the temperature differential is greater than 25°F, the area will be deemed as having thermal segregation. Evaluate areas with thermal segregation by performing a density profile in accordance with Section 344.4.I.3.c(2), "Segregation (Density Profile)." Take corrective action to eliminate areas that have thermal segregation. Unless otherwise directed, suspend operations if the maximum temperature differential exceeds 50°F. Resume operations when the Engineer determines that subsequent production will meet the specifications.~~ The Engineer will obtain a thermal profile at least once per project and may obtain as many thermal profiles as deemed necessary. Thermal profiles are not applicable in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas."

      At the completion of each lot, provide the Engineer with the thermal profile of every sublot within the lot. Report the results of each thermal profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

      (1) **Moderate Thermal Segregation.** Any areas that have a maximum temperature differential greater than 25°F but not exceeding 50°F are deemed as having moderate thermal segregation. Take immediate corrective action to eliminate the moderate thermal segregation. Evaluate areas with moderate thermal segregation by performing ~~a~~ density profiles in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile)."

      (2) **Severe Thermal Segregation.** Any areas that have a maximum temperature differential greater than 50°F are deemed as having severe thermal segregation. When the Pave-IR system is not used for specification compliance, no production or placement bonus will be paid for any sublot that contains severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Item. Evaluate areas with severe thermal segregation by performing ~~a~~ density profiles in accordance with Section 3XXX.4.I.3.c(2), "Segregation (Density Profile)." Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed. The sublot in question may receive a production and placement bonus if applicable when the defective material is successfully removed and replaced.

(3) Use of the Pave-IR System. In lieu of obtaining thermal profiles on each sublot using an infrared thermometer or thermal camera, the Contractor may use the Pave IR system (paver mounted infrared bar) to obtain a continuous thermal profile in accordance with Tex-244-F. When electing to use the Pave-IR system, notify the Engineer prior to beginning placement operations and specify if using the Pave-IR system for specification compliance or for information only. When electing to use the Pave-IR system for information only, use an infrared thermometer or thermal camera to obtain thermal profiles in accordance with Tex-244-F. When electing to use the Pave-IR system for information only, segregation density profiles are applicable.

When using the Pave-IR system for specification compliance, review the output results on a daily basis. Unless otherwise directed, provide the automated report described in Tex-244-F to the Engineer for review. Modify the paving process as necessary to eliminate any (moderate or severe) thermal segregation identified by the Pave-IR system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and are not applicable when using the Pave-IR system for specification compliance. Upon completion of use of the Pave-IR system for specification compliance or as requested by the Engineer, provide the Engineer with electronic copies of all daily data files that can be used with the Pave-IR system software to generate temperature profile plots.

b. Windrow Operations. When hot mix is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

c. Hauling Equipment. The Contractor may elect to use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with a MTD with remixing capability or when a Pave-IR system is used for specification compliance unless otherwise allowed by the Engineer.

d. Screed Heaters. If the paver stops for more than 5 minutes, turn off screed heaters to prevent overheating of the mat. If the screed heater remains on for more than 5 minutes while the paver is stopped, the Engineer may evaluate the suspect area in accordance with Section 3XXX.4.I.3.c(4),"Recovered Asphalt Dynamic Shear Rheometer (DSR)."

~~**Table 11**~~
~~**Suggested Minimum Mixture Placement Temperature**~~

~~**High-Temperature Binder Grade**~~	~~**Minimum Placement Temperature (Before Entering Paver)**~~
~~PG 76 and A-R~~	~~280°F~~
~~PG 82 or higher~~	~~290°F~~

H. Compaction. Uniformly compact the pavement to the density requirements of the specification. Use the control strip method given in Tex-207-F, Part IV, to establish the rolling pattern. Do not use pneumatic-tire rollers if excessive pickup of fines by roller tires occurs. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Where specific in-place air void requirements are waived, furnish and operate compaction equipment as approved. Monitor the paving operation and ensure that the compacted mat has between 2.7% and 8.0% in-place air voids. When the in-place air voids are outside this range, take immediate corrective action to bring the operation within these tolerances. The Engineer may suspend operations or require removal and replacement if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow paving to resume when the proposed corrective action is likely to yield acceptable results. Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

I. Acceptance Plan. ~~Sample and test the hot mix on a lot and sublot basis. If the production pay factor for 3 consecutive lots or the placement pay factor for 3 consecutive lots is below 1.000, suspend production until test results or other information indicate, to the satisfaction of the Engineer, that the next material produced or placed will meet the specified values.~~ Pay adjustments for the material will be in accordance with Article ~~346.~~6, "Payment."

Sample and test the hot mix on a lot and sublot basis. If the production pay factor given in Section 3XXX.6.A, "Production Pay Adjustment Factors," for 2 consecutive lots or the placement pay factor given in Section 3XXX.6.B, "Placement Pay Adjustment Factors," for 2 consecutive lots is below 1.000, suspend production until test results or other information indicate to the satisfaction of the Engineer that the next material produced or placed will result in pay factors of at least 1.000.

1. **Referee Testing.** The Construction Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 9 and the differences cannot be resolved. Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the samples are received at the referee laboratory for test results to be reported. The Department may require the

Contractor to reimburse the Department for referee tests if more than 3 referee tests per project are required and the Engineer's test results are closer than the Contractor's test results to the referee test results.

The Construction Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory, and the Engineer's average maximum theoretical specific gravity for the lot. With the exception of remove and replace conditions, referee test results are final and will establish pay adjustment factors for the sublot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement pay adjustment factor for any sublot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with ~~Article 344.6, "Payment."~~ Section 3XXX.6.B.2, "Placement Sublots Subject to Removal and Replacement."

2. Production Acceptance.

a. Production Lot. A production lot consists of 4 equal sublots. The default quantity for Lot 1 ~~will be~~ is1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately 3 to 4 sublots are produced each day. The lot size will be ~~at least~~ between 1,000 tons~~, but no greater than~~ and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. If the indirect tensile strength exceeds 200 psi, take corrective action to bring the mixture within specification compliance unless otherwise directed.

(1) ~~**Small Quantity**~~ **Exempt Production.** When the anticipated daily production is less than ~~500~~ 1,000 tons, ~~or~~ the total production for the project is less than 5,000 tons, or when mutually agreed between the Engineer and the Contractor, the Engineer may ~~waive~~ deem the mixture as exempt production. Production may also be exempt when shown on the plans. All quality control and quality assurance (QC/QA) sampling and testing requirements are waived for exempt production and ~~If the Engineer waives QC/QA sampling and testing~~, ~~both~~ the production and placement pay factors ~~will be~~ are 1.000. However, the Engineer will retain the right to perform random acceptance tests for production and placement and may reject objectionable materials and workmanship.

~~When the Engineer waives all QC/QA sampling and testing requirements~~ For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer;
- when not using the Pave-IR system for specification compliance, perform segregation (density profiles) and thermal profiles in accordance with the specification;
- control mixture production within ±1.0% of the target ~~to yield a~~ laboratory-molded density ~~of 96.0% ±1.0% for SMA mixtures and 97.0% ±1.0% for SMAR mixtures if~~ as tested by the Engineer; and
- compact the mixture to yield in-place air voids that are greater than or equal to 2.7% and less than or equal to 8.0% as tested by the Engineer.

(2) Incomplete Production Lots. If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 3XXX.6.A, "Production Pay Adjustment Factors." Close all lots within 5 working days, unless otherwise allowed by the Engineer.

b. Production Sampling.

(1) Mixture Sampling. Obtain hot mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into ~~3~~three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until testing by the Department is completed.

(a) Random Sample. At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. For each sublot, take ~~1~~one sample at the location randomly selected. The Engineer will perform or witness the sampling of production sublots.

(b) Blind Sample. For ~~each lot~~ 1 sublot per lot, the Engineer will ~~randomly select~~ obtain and test a "blind" sample ~~from at least 1 sublot~~ in lieu of the random sample collected by the Contractor. The Contractor may test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

~~Deliver the samples to the appropriate party's laboratory. Deliver referee samples to the Engineer. Discard unused samples after accepting pay adjustment factors for that lot.~~

(2) Informational Cantabro and Overlay Testing. During the first week of production, randomly select 1 sublot from Lot 2 or higher for Cantabro and Overlay testing. Obtain and provide the Engineer with approximately 150 lb. (70 kg) of mixture in sealed containers, boxes, or bags labeled with CSJ, mixture type, lot, and sublot number. The Engineer will ship the mixture to the Construction Division for Cantabro and Overlay testing. Results from these production tests will not be used for specification compliance; however, the laboratory mixture design must meet the Overlay test requirement in Table 8.

(3) Asphalt Binder Sampling. Obtain a 1-qt. (1-gal. for A-R binder) sample of the asphalt binder for each ~~sublot~~lot of mixture produced. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill. Take the sample in accordance with ~~the pipeline sampling procedure given in~~ Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers~~,~~ and deliver the sample to the Engineer. ~~If the Engineer chooses to obtain an independent asphalt binder sample,~~ If obtaining an independent asphalt binder sample, the Engineer will split a sample of the asphalt binder with the Contractor. The Engineer will test at least ~~1~~one asphalt binder sample per project to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

c. Production Testing. The Contractor and Engineer must perform production tests in accordance with Table 11. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in Table 9 for all sublots.

If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractors corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

At any time during production the Engineer may require the Contractor to verify the following based on quantities used:

- lime content (within ± 0.1% of JMF), when PG binder is specified;
- fiber content (within ± 0.03% of JMF), when PG binder is specified; and
- CRM content (within ± 1.5% of JMF), when A-R binder is specified

When A-R binder is specified, maintain the in-line measuring device to verify the A-R binder viscosity between 2,500 and 4,000 centipoise at 350°F unless

otherwise approved. Record A-R binder viscosity at least once an hour and provide the Engineer with a daily summary unless otherwise directed.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. ~~Unless otherwise allowed, the Engineer will require the Contractor to~~ Provide evidence that results from Tex-236-F are not reliable before requesting permission to use an alternate method unless otherwise directed. If an alternate test method is allowed, use the applicable test procedure as directed.

Table 11
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot
VMA			
Laboratory-molded bulk specific gravity			
In-place air voids			
Segregation (density profile)[5]	Tex-207-F, Part V	1 per sublot	1 per project
Longitudinal joint density	Tex-207-F, Part VII		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	1 per sublot
Drain-down	Tex-235-F	1 per sublot	1 per 12 sublots
Asphalt content	Tex-236-F		1 per lot
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Recycled Asphalt Shingles (RAS)[2]	Tex-217-F, Part III	N/A	
Thermal profile[5]	Tex-244-F	1 per sublot	
Asphalt binder sampling and testing[1]	Tex-500-C	1 per sublot (sample only)	
Boil test[3]	Tex-530-C	1 per lot	
Cantabro Test[4]	Tex-245-F	1 per project (sample only)	
Overlay Test[4]	Tex-248-F		

1. The Engineer may perform as many additional tests as deemed necessary.
2. Testing performed by the Construction Division or designated laboratory.
3. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
4. Testing performed by the Construction Division and for informational purposes only.
5. Not required when the Pave-IR system is used for specification compliance.

d. Operational Tolerances. Control the production process within the operational tolerances listed in Table 9. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

(1) Gradation. Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 7. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Unless otherwise directed, suspend production when either the Contractor's or the Engineer's test results for gradation exceed the operational tolerances for 3 consecutive sublots on the same sieve or 4 consecutive sublots on any sieve. The consecutive sublots may be from more than ~~1~~one lot.

(2) Asphalt Content. A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 9. No production or placement bonus will be paid for any ~~lot that has 2 or more sublots within a lot that are~~ sublot that is out of operational tolerance for asphalt content ~~based on either the Contractor's or the Engineer's test results~~. Suspend production and shipment of mixture if the Engineer's or the Contractor's asphalt content deviates from the current JMF by more than 0.5% for any sublot.

(3) Voids in the Mineral Aggregate (VMA). The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt content, the Engineer will use the asphalt content results from quality control testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production listed in Table 7. Suspend production and shipment of mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 7. No production or placement bonus will be paid for any sublot that does not meet the minimum VMA requirement for production listed in Table 7 based on the Engineer's VMA determination.

Suspend production and shipment of mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 7. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

(4) Fibers. Suspend production and shipment of mixture if fiber content varies from the design target value by more than 10% on 2 consecutive tests.

(5) Hamburg Wheel Test. The Engineer may perform a Hamburg Wheel test at any time during production including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any area of the roadway where rutting is observed. When the production or core samples fail the Hamburg Wheel

test criteria in Table 8, suspend production until further Hamburg Wheel tests meet the specified values. Core samples if taken will be obtained from the center of the finished mat or other areas excluding the vehicle wheel path. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department-approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request the Department confirm the results by retesting the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

e. Individual Loads of Hot Mix. The Engineer can reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 9, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load and the Engineer may require removal.

3. Placement Acceptance.

a. Placement Lot. A placement lot consists of 4 placement sublots. A placement sublot consists of the area placed during a production sublot.

(1) Lot 1 Placement. Placement bonuses for Lot 1 will be in accordance with Section 3XXX.6.B, "Placement Pay Adjustment Factors." However, no placement penalty will be assessed for any sublot placed in Lot 1, when the in-place air voids are greater than or equal to 2.7% and less than or equal to 8.0%. Remove and replace any sublot with in-place air voids less than 2.7% or greater than 8.0%.

(2) Incomplete Placement Lots. An incomplete placement lot consists of the area placed as described in Section 3XXX.4.I.2.a.(2), "Incomplete Production Lot," excluding ~~miscellaneous~~ areas ~~as~~ defined in Section 3XXX.4.I.3.a.(4), "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production sublot.

(3) Shoulders, ~~and~~ Ramps, Etc. Shoulders, ~~and~~ ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination and pay adjustments~~,~~ unless ~~otherwise shown on the plans~~ designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

(4) Miscellaneous Areas. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, ~~are not generally subject to primary traffic,~~ such as driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Intersections and temporary detours will be considered miscellaneous areas when shown on the plans. Miscellaneous areas also include level-ups and thin overlays if the layer thickness designated on the plans is less than the minimum untrimmed core height eligible for testing ~~compacted lift thickness~~ shown in Table 10. The thickness determined is based on the rate of 110 lb./sy for each inch of pavement unless otherwise shown on the plans. Miscellaneous areas are not eligible for random placement sampling locations~~, and will receive a 1.000 placement pay factor~~. Compact areas that are not subject to in-place air void determination in accordance with Section 3XXX.4.H, "Compaction."

b. Placement Sampling. At the beginning of the project, the Engineer will select random numbers for all placement sublots. The Engineer will provide the Contractor with the placement random numbers immediately after the sublot is completed. Mark the roadway location at the completion of each sublot and record the station number. Determine 1 random sample location for each placement sublot in accordance with Tex-225-F. If the randomly generated sample location is within 2 ft. of a joint or pavement edge, adjust the location by no more than necessary to achieve a 2-ft. clearance.

Shoulders, ~~and~~ ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; ~~H~~ however, if a random sample location falls on ~~a shoulder or ramp~~ one of these areas and the area ~~that~~ is designated on the plans as not subject to in-place air void ~~testing~~ determination, cores will not be taken for the sublot and a 1.000 pay factor will be assigned to that sublot.

Provide the equipment and means to obtain and trim roadway cores on-site. On-site is hereby defined as in close proximity to where the cores are taken. ~~Unless otherwise determined, the Engineer will witness the coring operation and measurement of the core thickness.~~ Obtain the cores within 1 working day of the time the placement sublot is completed unless otherwise approved. Obtain two 6-in.-diameter cores side-by-side from within 1 ft. of the random location provided for the placement sublot. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to ~~insure~~ ensure that an adequate bond will be achieved during subsequent placement operations.

Immediately after obtaining the cores from the roadway, trim the cores in accordance with Tex-207-F if the core heights meets the minimum untrimmed values listed in Table 10. Trim the cores on site in the presence of the

Engineer. Use a permanent marker or paint pen to record the lot and sublot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until testing by the Department is completed. Prior to turning the trimmed cores over to the Engineer, the Contractor may elect to wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may elect to have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use the Construction Division's protocol to provide a secure means and process that protects the integrity of the cores during transport.

If the core height before trimming is less than the minimum untrimmed value shown in Table 10, decide whether to include the pair of cores in the air void determination for that sublot. If electing to have the cores included in air void determination, trim the cores as described above before delivering to the Engineer. If electing to not have the cores included in air void determination, deliver untrimmed cores to the Engineer and inform the Engineer of the decision to not have the cores included in air void determination. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.

In lieu of the Contractor trimming the cores on-site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Trimming of the cores may be performed by either the Department or Contractor representative. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Immediately after obtaining the cores, dry the core holes and tack the sides and bottom. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

~~If the core heights exceed the minimum untrimmed values listed in Table 10, trim and deliver the cores to the Engineer within 1 working day following placement operations unless otherwise approved.~~

~~If the core height before trimming is less than the minimum untrimmed value shown in Table 10, decide whether or not to include the pair of cores in the air void determination for that sublot. If the cores are to be included in air void~~

~~determination, trim the cores before delivering to the Engineer. If the cores will not be included in air void determination, deliver untrimmed cores to the Engineer. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.~~

c. Placement Testing. Perform placement tests in accordance with Table 12. After the Engineer returns the cores, the Contractor has the option to test the cores to verify the Engineer's test results for in-place air voids. ~~Re-dry the cores to constant weight before testing.~~ The allowable differences between the Contractor's and Engineer's test results are listed in Table 9.

(1) In-Place Air Voids. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be predried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content ~~of the 2 cores to calculate a placement pay adjustment factor~~ for in-place air voids.

The Engineer will use ~~paraffin coating or~~ the vacuum method~~s~~ to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core to determine the placement pay adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

Specific in-place air void requirements are waived when the specified compacted lift thickness is less than the minimum untrimmed core height eligible for testing shown in Table 10. When specific air-void requirements are waived for any reason, the placement pay factor will be 1.000 and cores are not required for pay factor determination. However, the Engineer may require removal and replacement if the compaction requirements listed in 3XXX.4.H, "Compaction," are not met.

(2) Segregation (Density Profile). Test for segregation using density profiles in accordance with Tex-207-F, Part V. Density profiles are not required and are not applicable when using the Pave-IR system for specification compliance. ~~Provide the Engineer with the results of the density profiles as they are completed. Areas defined in Section 346.4.I.3.a(4), "Miscellaneous Areas," are not subject to density profile testing.~~ Density profiles are not applicable in areas described in Section 3XXX.4.1.3.a(4), "Miscellaneous Areas."

Unless otherwise approved, perform a density profile every time the screed stops, on areas that are identified by either the Contractor or the Engineer as having thermal segregation, and on any visibly segregated areas. If the screed does not stop, and there are no visibly segregated areas or areas that are identified as having thermal segregation, perform a

minimum of 1 profile per sublot. ~~Reduce the test frequency to a minimum of 1 profile per lot if 4 consecutive profiles are within established tolerances. Continue testing at a minimum frequency of 1 per lot unless a profile fails, at which point resume testing at a minimum frequency of 1 per sublot. The Engineer may further reduce the testing frequency based on a consistent pattern of satisfactory results.~~

At the completion of each lot, provide the Engineer with the density profile of every sublot within the lot. Report the results of each density profile in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances in Table 12. No production or placement bonus will be paid for any sublot that contains a failing density profile. When the Pave-IR system is not used for specification compliance, the Engineer will measure the density profile at least once per project and ~~may make as many independent density profile verifications as deemed necessary~~ may measure the density profile at any time, at any location, and as often as deemed necessary to verify conformance. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3XXX.4.I.3.c(5), "Irregularities." The sublot in question may receive a production and placement bonus if applicable when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if 2 consecutive density profiles fail~~,~~ unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 12
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
SMA-C & SMAR-C	8.0 pcf	5.0 pcf
SMA-D, SMA-F & SMAR-F	6.0 pcf	3.0 pcf

(3) Longitudinal Joint Density.

(a) Informational Tests. While establishing the rolling pattern, perform joint density evaluations and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern if needed to achieve the desired joint density. Perform additional joint density evaluations at least once per sublot unless otherwise directed.

(b) Record Tests. For each sublot, perform a joint density evaluation at each pavement edge that is or will become a longitudinal joint. Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results, on Department forms, to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location and the correlated joint density is less than 90.0%. The Engineer will make an independent joint density verification at least once per project and may make independent joint density verifications at the random sample locations and as often as deemed necessary to verify conformance. The Engineer's joint density test results will be used when available.

At the completion of each lot, provide the Engineer with the joint density of every sublot within the lot. Report the results of each joint density in accordance with Section 3XXX.4.B, "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if ~~2~~ two consecutive evaluations fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

(4) Recovered Asphalt Dynamic Shear Rheometer (DSR). When the Pave-IR system is not used for specification compliance, the Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Construction Division. The aging ratio is the ~~dynamic shear rheometer (~~DSR~~)~~ value of the extracted binder divided by the DSR value of the original unaged binder ~~(including RAP binder)~~. DSR values are obtained according to AASHTO T 315 at the specified high temperature PG of the asphalt. ~~The binder from RAP will be included proportionally as part of the original unaged binder.~~ The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores using Tex-211-F.

(5) Irregularities. ~~Immediately take appropriate corrective action if surface~~ Identify and correct irregularities~~,~~ including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, ~~or~~ uncoated aggregate particles ~~are detected~~ or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does

not bond to the existing pavement. If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than 1 day while the Contractor is taking appropriate corrective action.

~~The Engineer may allow placement to continue for at most 1 day of production while taking appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.~~

~~At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or has other surface irregularities identified above.~~

4. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. **Measurement.** Hot mix will be measured by the ton of composite hot mix. The composite hot mix is the asphalt, aggregate, and additives. Measure the weights on scales in accordance with Item 520, "Weighing and Measuring Equipment." Provide the Engineer with a daily summary of the asphalt mass flow meter readings for SMAR mixtures unless otherwise directed.

6. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under Article ~~346.~~5, "Measurement," will be paid for at the unit bid price for "Stone Matrix Asphalt~~,~~" of the mixture type, surface aggregate classification, and binder specified. These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.

   Pay adjustments for bonuses and penalties will be applied as determined in this Item; however, a pay adjustment factor of 1.000 will be assigned for all placement sublots for "level ups" only when "level up" is listed as part of the item bid description code.

   Applicable pay adjustment bonuses will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint density in accordance with Section 3XXX.4.B, "Reporting and Responsibilities." If the Contractor uses the Pave-IR system for specification compliance, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the Pave-IR system automated reports described in Tex-244-F are required.

   Trial batches will not be paid for unless they are included in pavement work approved by the Department.

   Pay adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

   A. **Production Pay Adjustment Factors.** The production pay adjustment factor is based on the laboratory-molded density using the Engineer's test results. A pay adjustment factor will be determined from Table 13 for each sublot using the deviation from the target laboratory-molded density defined in Table 8. The production pay adjustment

factor for completed lots will be the average of the pay adjustment factors for the 4 sublots sampled within that lot.

Table 13
Production Pay Adjustment Factors for Laboratory-Molded Density

Absolute Deviation from Target Laboratory-Molded Density	Production Pay Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.100
0.1	1.100
0.2	1.100
0.3	1.086
0.4	1.075
0.5	1.063
0.6	1.050
0.7	1.038
0.8	1.025
0.9	1.013
1.0	1.000
1.1	0.900
1.2	0.800
1.3	0.700
>1.3	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractors corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

1. **Payment for Incomplete Production Lots.** Production pay adjustments for incomplete lots, described under Section 3XXX.4.I.2.a.(2), "Incomplete Production Lots," will be calculated using the average production pay factors from all sublots sampled. A production pay factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples.

2. **Production Sublots Subject to Removal and Replacement.** If after referee testing, the laboratory-molded density for any sublot results in a "remove and replace" condition as listed in Table 13, the Engineer may require removal and replacement, or may allow the sublot to be left in place without payment. The Engineer may also elect to accept the sublot in accordance with Item 5 "Control of the Work" Article 5.3.A "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Article.

B. Placement Pay Adjustment Factors. The placement pay adjustment factor is based on in-place air voids using the Engineer's test results. A pay adjustment factor will be determined from Table 14 for each sublot that requires in-place air void measurement. A placement pay adjustment factor of 1.000 will be assigned to the entire sublot when the random sample location falls in an area designated on the plans as ~~on a ramp or shoulder~~ not subject to in-place air void ~~testing~~ determination. A placement pay adjustment factor of 1.000 will be assigned to quantities placed in ~~miscellaneous~~ areas ~~as~~ described in Section 3XXX.4.I.3.a(4), "Miscellaneous Areas." The placement pay adjustment factor for completed lots will be the average of the placement pay adjustment factors ~~for the~~ up to 4 sublots within that lot.

Table 14

Placement Pay Adjustment Factors for In-Place Air Voids

In-Place Air Voids	Placement Pay Adjustment Factor	In-Place Air Voids	Placement Pay Adjustment Factor
< 2.7	Remove and Replace	5.4	1.080 ~~1.030~~
2.7	0.710 ~~0.700~~	5.5	1.075 ~~1.025~~
2.8	0.740 ~~0.740~~	5.6	1.070 ~~1.020~~
2.9	0.770 ~~0.780~~	5.7	1.065 ~~1.015~~
3.0	0.800 ~~0.820~~	5.8	1.060 ~~1.010~~
3.1	0.830 ~~0.860~~	5.9	1.055 ~~1.005~~
3.2	0.860 ~~0.900~~	6.0	1.050 ~~1.000~~
3.3	0.890 ~~0.940~~	6.1	1.045 ~~0.985~~
3.4	0.920 ~~0.980~~	6.2	1.040 ~~0.970~~
3.5	0.950 ~~1.020~~	6.3	1.035 ~~0.955~~
3.6	0.980 ~~1.060~~	6.4	1.030 ~~0.940~~
3.7	1.010 ~~1.100~~	6.5	1.025 ~~0.925~~
3.8	1.040 ~~1.100~~	6.6	1.020 ~~0.910~~
3.9	1.070 ~~1.100~~	6.7	1.015 ~~0.895~~
4.0	1.100 ~~1.100~~	6.8	1.010 ~~0.880~~
4.1	1.100 ~~1.095~~	6.9	1.005 ~~0.865~~
4.2	1.100 ~~1.090~~	7.0	1.000 ~~0.850~~
4.3	1.100 ~~1.085~~	7.1	0.970 ~~0.835~~
4.4	1.100 ~~1.080~~	7.2	0.940 ~~0.820~~
4.5	1.100 ~~1.075~~	7.3	0.910 ~~0.805~~
4.6	1.100 ~~1.070~~	7.4	0.880 ~~0.790~~
4.7	1.100 ~~1.065~~	7.5	0.850 ~~0.775~~
4.8	1.100 ~~1.060~~	7.6	0.820 ~~0.760~~
4.9	1.100 ~~1.055~~	7.7	0.790 ~~0.745~~
5.0	1.100 ~~1.050~~	7.8	0.760 ~~0.730~~
5.1	1.095 ~~1.045~~	7.9	0.730 ~~0.715~~
5.2	1.090 ~~1.040~~	8.0	0.700 ~~0.700~~
5.3	1.085 ~~1.035~~	> 8.0	Remove and Replace

1. **Payment for Incomplete Placement Lots.** Pay adjustments for incomplete placement lots described under Section 3XXX.4.I.3.a.(2), "Incomplete Placement Lots," will be calculated using the average of the placement pay factors from all sublots sampled and sublots where the random location falls in an area designated on the plans as ~~on a ramp or shoulder~~ not eligible for ~~testing~~ in-place air void determination. A placement pay adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples.

2. **Placement Sublots Subject to Removal and Replacement.** If after referee testing, the placement pay adjustment factor for any sublot results in a "remove and replace" condition as listed in Table 14, the Engineer will choose the location of ~~2~~two cores to be taken within 3 ft. of the original failing core location. The Contractor will obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Pavements Section of the Construction Division, where they will be trimmed if necessary and tested for bulk specific gravity within 10 working days of receipt. The average bulk specific gravity of the cores will be divided by the Engineer's average maximum theoretical specific gravity for that lot to

determine the new pay adjustment factor of the sublot in question. If the new pay adjustment factor is 0.700 or greater, ~~then~~ the new pay adjustment factor will apply to that sublot. If the new pay adjustment factor is less than 0.700, no payment will be made for the sublot. Remove and replace the failing sublot, or the Engineer may allow the sublot to be left in place without payment. The Engineer may also elect to accept the sublot in accordance with Item 5 "Control of the Work" Article 5.3.A "Acceptance of Defective or Unauthorized Work." Replacement material must meet the requirements of this specification with payment made accordingly.

C. Total Adjustment Pay Calculation. Total adjustment pay (TAP) will be based on the applicable pay adjustment factors for production and placement of each lot.

$$TAP = (A + B)/2$$

where:

A = Bid price × production lot quantity × average pay adjustment factor for the production lot

B = Bid price × placement lot quantity × average pay adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous ~~quantities~~ areas × 1.000)

Production lot quantity = Quantity actually placed - quantity left in place without payment

Placement lot quantity = Quantity actually placed - quantity left in placed without payment - quantity placed in miscellaneous areas