SUPERPAVE ASPHALT CONCRETE - FUEL RESISTANT ASPHALT
(REV 6-23-21)

SECTION 334 is deleted and the following substituted for locations of fuel resistant asphalt structural course as delineated in the Plans. DEV334FRA does not apply for any other structural courses delineated in the Plans.

SECTION 334
SUPERPAVE ASPHALT CONCRETE - FUEL RESISTANT ASPHALT.

334-1 Description.

334-1.1 General: Construct a Fuel Resistant Superpave Asphalt Concrete pavement with the type of mixture specified in the Contract Documents.

Obtain Fuel Resistant Superpave Asphalt Concrete from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105. Producers must meet the requirements of Section 320 for plant and equipment and the general construction requirements of Section 330.

334-1.2 Gradation Classification: The Fuel Resistant Superpave mix is classified as fine graded and designated as Type SP-FR.

The equivalent AASHTO nominal maximum aggregate size Superpave mix is as follows:

Type SP-FR..... 9.5 mm

334-1.3 Thickness: The total thickness of the Type SP-FR asphalt layers will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

$$\text{Spread rate (lb/yd}^2\text{)} = t \times G_{mm} \times 43.3$$

Where: t = Thickness (in.) (plan thickness or individual layer thickness)

G_{mm} = Maximum specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-3.2. For target purposes only, spread rate calculations should be rounded to the nearest whole number.

Note: Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lb/yd^2-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

334-1.3.1 Layer Thicknesses: The allowable layer thickness for a Type SP-FR Asphalt Concrete mixture is 1-1/2 to 2 inches.

334-1.3.2 Additional Requirements for Type SP-FR: When construction includes the paving of adjacent shoulders (less than or equal to 5 feet wide), the layer thickness for the upper pavement layer and shoulder must be the same and paved in a single pass, unless called for differently in the Contract Documents.

Do Not Use Without CO Specs Authorization

334-2 Materials.

334-2.1 General Requirements: Meet the material requirements specified in Division III. Specific references are as follows:

Asphalt Binder, PG 88-22 (FR) .....DEV 916FRA
Coarse Aggregate.....Section 901
Fine Aggregate.....Section 902

334-2.2 Superpave Asphalt Binder: Unless specified otherwise in the Contract Documents, use a Fuel Resistant asphalt binder PG 88-22 (FR).

334-2.3 Reclaimed Asphalt Pavement (RAP) Material: Do not use RAP as a component of the SP-FR asphalt mixture.

334-2.4 Recycled Crushed Glass: Do not use recycled crushed glass as a component of the asphalt mixture.

334-3 General Composition of Mixture.

334-3.1 General: Compose the asphalt mixture using a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and asphalt binder material. Size, grade and combine the aggregate fractions to meet the grading and physical properties of the mix design. Aggregates from various sources may be combined.

334-3.2 Mix Design:

334-3.2.1 General: Design the asphalt mixture in accordance with AASHTO R 35-17, except as noted herein. Design the mixture to meet Traffic Level E (greater than or equal to $30x10^6$ EALSs) requirement, except as noted herein. Prior to the production of any asphalt mixture, submit the proposed mix design with supporting test data indicating compliance with all mix design criteria to the Engineer. Include representative samples of all component materials, including asphalt binder. Allow the Director of the Office of Materials a maximum of four weeks to either conditionally verify or reject the mix as designed.

Warm mix technologies (additives, foaming techniques, etc.) listed on the Department's website may be used in the production of the mix. For mixtures containing a PG 88-22 (FR) binder, a mixture will be considered a warm mix asphalt design if the mixing temperature is 305°F or less.

The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

334-3.2.2 Mixture Gradation Requirements: Combine the coarse and fine aggregate in proportions that will produce a 9.5 mm fine graded asphalt mixture meeting all of the requirements defined in this specification and conform to the gradation requirements at design as defined in AASHTO M 323-17, Table 4. Aggregates from various sources may be combined.

334-3.2.2.1 Mixture Gradation Classification: Plot the combined mixture gradation on an FHWA 0.45 Power Gradation Chart. Include the Control Points from AASHTO M 323-17, Table 4, as well as the Primary Control Sieve (PCS) Control Point from AASHTO M 323-17, Table 5. Fine mixes are defined as having a gradation that passes above the primary control sieve control point.

334-3.2.3 Aggregate Consensus Properties: Meet the following consensus properties at design for the aggregate blend.

Do Not Use Without CO Specs Authorization

334-3.2.3.1 Coarse Aggregate Angularity: When tested in accordance with ASTM D5821-13 (2017), meet the percentage of fractured faces requirements specified in AASHTO M 323-17, Table 6.

334-3.2.3.2 Fine Aggregate Angularity: When tested in accordance with AASHTO T 304-17 (2020), Method A, meet the uncompacted void content of fine aggregate specified in AASHTO M 323-17, Table 6.

334-3.2.3.3 Flat and Elongated Particles: When tested in accordance with ASTM D4791-19, (with the exception that the material passing the 3/8 inch sieve and retained on the No. 4 sieve shall be included), meet the requirements specified in AASHTO M 323-17, Table 6. Measure the aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (shortest dimension) of the aggregate particles.

334-3.2.3.4 Sand Equivalent: When tested in accordance with AASHTO T 176-17, meet the sand equivalent requirements specified in AASHTO M 323-17, Table 6.

334-3.2.4 Gyratory Compaction: Compact the design mixture in accordance with AASHTO T 312-19. The number of gyrations will be as follows: N_{design} = 50. Measure the inside diameter of gyratory molds in accordance with AASHTO T 312-19.

334-3.2.5 Design Criteria: Meet the requirements for nominal maximum aggregate size as defined in AASHTO M 323-17. The mixture must be designed at 2.5, plus or minus 0.2%, air voids. The minimum VMA requirement is 15.0%.

334-3.2.6 Moisture Susceptibility:

1. For all traffic levels, use a liquid anti-strip agent listed on the APL at the specified dosage rate. Hydrated lime may be used instead of the liquid anti-strip agent.

2. Provide a mixture having a retained tensile strength ratio of at least 0.80 and a minimum tensile strength (unconditioned) of 100 psi in accordance with FM 1-T 283.

334-3.2.7 Fuel Resistance: The SP-FR asphalt mixture must have a maximum weight loss of 1.5% after immersion in kerosene. Use the following procedure to determine weight loss:

1. Prepare three 4.0 inch diameter by 2.5 plus or minus 0.1 inch tall test specimens at optimum binder content and containing 2.5 plus or minus 0.7%, air voids.

2. Dry the specimens under a fan at room temperature, 68°F - 80°F for a minimum of 24 hours.

3. Totally immerse the sample in kerosene, meeting the requirements of ASTM D3699-18a, at room temperature, 68°F - 80°F, for 2 minutes plus or minus 30 seconds. (Suspending the sample with insect screen in a one-gallon paint can has been found to be satisfactory). The kerosene must meet the requirements of Federal Specification VV-K-211).

4. After submersing the specimen for 2 minutes, plus or minus 30 seconds, remove the sample and immediately surface dry it with a clean paper towel. Immediately determine the weight in air to the nearest 0.1 g. Report this as weight ‘A’.

5. Re-submerge the sample in kerosene in accordance with 334-3.2.7 for 24 hours, plus or minus 10 minutes.

6. After 24 hours, plus or minus 10 minutes, carefully remove the sample from the kerosene and place it on an absorptive cloth or paper towel. Dry the specimen under a fan at room temperature for 24 hours, plus or minus 10 minutes.

7. After drying for 24 hours, plus or minus 10 minutes, weigh the sample to the nearest 0.1 g. Report this as weight ‘B’.

Do Not Use Without CO Specs Authorization

8. The percent weight loss is calculated as (A-B)/A x 100.

334-3.2.8 Laboratory Rutting Resistance: Prepare four 150 mm diameter by 115 mm tall gyratory specimens at an air void content of 4.50 to 5.50 percent. Rut test these specimens in accordance with AASHTO T 340-10 (2015), except as noted herein. Conduct the tests at a temperature of 64ºC. The average rut depth of all four specimens shall be less than 5.00 mm and no single specimen shall rut more than 6.00 mm.

334-3.2.9 Additional Information: In addition to the requirements listed above, provide the following information with each proposed mix design submitted for verification:

1. The design traffic level and the design number of gyrations (N_{design}).
2. The source and description of the materials to be used.
3. The Department source number and the Department product code of the aggregate components furnished from a Department approved source.
4. The gradation and proportions of the raw materials as intended to be combined in the paving mixture. The gradation of the component materials shall be representative of the material at the time of use. Compensate for any change in aggregate gradation caused by handling and processing as necessary.
5. A single percentage of the combined mineral aggregate passing each specified sieve. Degradation of the aggregate due to processing (particularly material passing the No. 200 sieve) should be accounted for and identified.
6. The bulk specific gravity (G_{sb}) value for each individual aggregate and RAP component, as identified in the Department's aggregate control program.
7. A single percentage of asphalt binder by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1%.
8. A target temperature for the mixture at the plant (mixing temperature) and a target temperature for the mixture at the roadway (compaction temperature) in accordance with 320-6.3. Do not exceed a target temperature of 340°F.
9. Provide the physical properties at the optimum asphalt content, which must conform to all specified requirements.
10. The name of the Construction Training Qualification Program (CTQP) Qualified Mix Designer.
11. The ignition oven and maximum specific gravity (G_{mm}) calibration factors.
12. The warm mix technology, if used.

334-3.3 Mix Design Revisions: During production, the Contractor may request a target value revision to a mix design, subject to meeting the following requirements: the target change falls within the limits defined in Table 334-1, appropriate data exists demonstrating that the mix complies with production air voids specification criteria, and the mixture gradation meets the basic gradation requirements defined in 334-3.2.2.

Table 334-1
Limits for Potential Adjustments to Mix Design Target Values

Characteristic	Limit from Original Mix Design
No. 8 sieve and Coarser	± 5.0%
No. 16 sieve	± 4.0%
No. 30 sieve	± 4.0%
No. 50 sieve	± 3.0%

Do Not Use Without CO Specs Authorization

Table 334-1 Limits for Potential Adjustments to Mix Design Target Values	
Characteristic	Limit from Original Mix Design
No. 100 sieve	± 3.0%
No. 200 sieve	± 1.0%
Asphalt Binder Content [1]	± 0.3%
Each Component of Aggregate Blend [2]	± 5.0 %

[1] Reductions to the asphalt binder content will not be permitted if the VMA during production is lower than 1.0% below the design criteria.

Submit all requests for revisions to mix designs, along with supporting documentation, to the Engineer. In order to expedite the revision process, the request for revision or discussions on the possibility of a revision may be made verbally, but must be followed up by a written request. The verified mix design will remain in effect until the Engineer authorizes a change. In no case will the effective date of the revision be established earlier than the date of the first communication between the Contractor and the Engineer regarding the revision.

A new design mix will be required if aggregate sources change, or for any substitution of an aggregate product with a different aggregate code, unless approved by the Engineer.

334-4 Producer Process Control (PC).

Assume full responsibility for controlling all operations and processes such that the requirements of these Specifications are met at all times. Perform any tests necessary at the plant and roadway for process control purposes. Enter all PC test data into the Department's database. The Engineer will not use these test results in the acceptance payment decision.

Address in the Producer QC Plan how PC failures will be handled. When a PC failure occurs, investigate, at a minimum, the production process, testing equipment and/or sampling methods to determine the cause of the failure, and make any necessary changes to assure compliance with these Specifications. Obtain a follow up sample immediately after corrective actions are taken to assess the adequacy of the corrections. In the event the follow-up PC sample also fails to meet Specification requirements, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the QC Manager.

Test the mixture for fuel resistance in accordance with 334-3.2.7. Test the first sublot produced and every other sublot thereafter. Cease production if the percent weight loss exceeds 1.5% for any test. Resume production only after the cause of the failure has been determined and corrected and the QC Manager's approval has been obtained.

334-5 Acceptance of the Mixture.

334-5.1 General: The mixture will be accepted at the plant with respect to gradation (P_{-8} and P_{-200}), asphalt content (P_b), and volumetrics (volumetrics is defined as air voids at N_{design}). The mixture will be accepted on the roadway with respect to density of roadway cores. Acceptance will be on a LOT by LOT basis (for each mix design) based on tests of random samples obtained within each sublot taken at a frequency of one set of samples per sublot. A roadway LOT and a plant production LOT shall be the same. Acceptance of the mixture will be based on Contractor QC test results that have been verified by the Department.

334-5.1.1 Sampling and Testing Requirements: Obtain the samples in accordance with FM 1-T 168. Obtain samples at the plant of a sufficient quantity to be split into

Do Not Use Without CO Specs Authorization

three smaller samples; one for QC, one for Verification testing and one for Resolution testing. Obtain each split sample of a sufficient quantity, approximately 40 pounds, for all required testing. The split samples for Verification testing and Resolution testing shall be reduced in size and stored in three boxes each. The approximate size of each box must be 12 inches x 8 inches x 4 inches. Provide, label and safely store sample boxes in a manner agreed upon by the Engineer for future testing.

The asphalt content of the mixture will be determined in accordance with FM 5-563. The gradation of the recovered aggregate will be determined in accordance with FM 1-T 030. Volumetric testing will be in accordance with AASHTO T 312-19 and FM 1-T 209. Prior to testing volumetric samples, condition the test-sized sample for one hour, plus or minus five minutes, at the target roadway compaction temperature in a shallow, flat pan, such that the mixture temperature at the end of the one hour conditioning period is within plus or minus 20°F of the roadway compaction temperature.

If one of the QC gyratory specimens is damaged, make an additional gyratory specimen.

For situations where two properly prepared gyratory specimens do not meet single-operator precision requirements for G_{mb} as provided in FM 1-T 166:

1. Retest both gyratory specimens in accordance FM 1-T 166.
2. Following the retest, if the newly measured G_{mb} values do not meet single-operator precision requirements, QC shall prepare a third gyratory specimen in accordance with AASHTO T 312-19 and test in accordance with FM 1-T 166. All three test results shall be input into MAC. The average G_{mb} will be determined by MAC after performing an outlier check in accordance with ASTM E178-16a.

Test for roadway density in accordance with FM 1-T 166.

334-5.1.2 Acceptance Testing Exceptions: When the total combined quantity of hot mix asphalt for the project, as indicated in the Plans for Type B-12.5, Type SP and Type FC mixtures only, is less than 2000 tons, the Engineer will accept the mix on the basis of visual inspection. The Engineer may require the Contractor to run process control tests for informational purposes, as defined in 334-4, or may run independent verification tests to determine the acceptability of the material.

Density testing for acceptance will not be performed on widening strips or shoulders with a width of 5 feet or less, open-graded friction courses, variable thickness overbuild courses, leveling courses, any SP-9.5 or SP-12.5 asphalt layer placed on subgrade with a layer thickness less than or equal to 3 inches, miscellaneous asphalt pavement, shared use paths, crossovers, gore areas, raised crosswalks, speed tables, or any course with a specified thickness less than 1 inch or a specified spread rate that converts to less than 1 inch as described in 334-1.4. Density testing for acceptance will not be performed on asphalt courses placed on bridge decks or approach slabs; compact these courses in static mode only per the requirements of 330-7.7. In addition, density testing for acceptance will not be performed on the following areas when they are less than 500 feet (continuous) in length: turning lanes, acceleration lanes, deceleration lanes, shoulders, parallel parking lanes, ramps, or unsignalized side streets with less than four travel lanes and speed limits less than 35 mph. Do not perform density testing for acceptance in situations where the areas requiring density testing is less than 50 tons within a sublot.

Density testing for acceptance will not be performed in intersections. The limits of the intersection will be from stop bar to stop bar for both the mainline and side streets.

Do Not Use Without CO Specs Authorization

A random core location that occurs within the intersection shall be moved forward or backward from the intersection at the direction of the Engineer.

Where density testing for acceptance is not required, compact these courses (with the exception of open-graded friction courses) in accordance with the rolling procedure (equipment and pattern) as approved by the Engineer or with Standard Rolling Procedure as specified in 330-7.2. In the event that the rolling procedure deviates from the procedure approved by the Engineer, or the Standard Rolling Procedure, placement of the mix shall be stopped.

The density pay factor (as defined in 334-8.2) for areas not requiring density testing for acceptance will be paid at the same density pay factor as for the areas requiring density testing within the same LOT. If the entire LOT does not require density testing for acceptance, the LOT will be paid at a density pay factor of 1.00.

334-5.2 Full LOTs: Each LOT will be defined (as selected by the Contractor prior to the start of the LOT) as either (1) 2,000 tons, with each LOT subdivided into four equal sublots of 500 tons each, or (2) 4,000 tons, with each LOT subdivided into four equal sublots of 1,000 tons each. As an exception to this, the initial LOT of all new mix designs shall be defined as 2,000 tons, subdivided into four equal sublots of 500 tons each. Before the beginning of a LOT, the Engineer will develop a random sampling plan for each sublot and direct the Contractor on sample points, based on tonnage, for each sublot during construction.

334-5.3 Partial LOTs: A partial LOT is defined as a LOT size that is less than a full LOT. A partial LOT may occur due to the following:

1. The completion of a given mix type or mix design on a project.

2. Closure of the LOT due to time. LOTs will be closed 30 calendar days after the start of the LOT. Time periods other than 30 calendar days may be used if agreed to by both the Engineer and the Contractor, but under no circumstances shall the LOT be left open longer than 90 days.

3. A LOT is terminated per 334-5.4.4.

All partial LOTs will be evaluated based on the number of tests available and will not be redefined. If a LOT is closed before the first plant random sample is obtained, then the LOT will be visually accepted by the Engineer and the LOT pay factor will be 1.00.

334-5.4 QC Sampling and Testing: Obtain all samples randomly as directed by the Engineer.

Should the Engineer determine that the QC requirements are not being met or that unsatisfactory results are being obtained, or should any instances of falsification of test data occur, acceptance of the Producer's QC Plan will be suspended and production will be stopped.

334-5.4.1 Lost or Missing Verification/Resolution Samples: In the event that any of the Verification and/or Resolution asphalt mixture samples that are in the custody of the Contractor are lost, damaged, destroyed, or are otherwise unavailable for testing, the minimum possible pay factor for each quality characteristic as described in 334-8.2 will be applied to the entire LOT in question, unless called for otherwise by the Engineer. Specifically, if the LOT in question has more than two sublots, the pay factor for each quality characteristic will be 0.55. If the LOT has two or less sublots, the pay factor for each quality characteristic will be 0.80. If only the roadway cores are lost, damaged, destroyed, or are otherwise unavailable for testing, then the minimum possible pay factor for density will be applied to the entire LOT in question. In either event, the material in question will also be evaluated in accordance with 334-5.9.5.

Do Not Use Without CO Specs Authorization

If any of the Verification and/or Resolution samples that are in the custody of the Department are lost, damaged, destroyed or are otherwise unavailable for testing, the corresponding QC test result will be considered verified, and payment will be based upon the Contractor's data.

334-5.4.2 Plant Sampling and Testing Requirements: Obtain one random sample of mix per sublot in accordance with 334-5.1.1 as directed by the Engineer. Test the QC split sample for gradation, asphalt binder content and volumetrics in accordance with 334-5.1.1. Complete all QC testing within one working day from the time the samples were obtained.

334-5.4.3 Roadway Sampling and Testing Requirements: Obtain five 6 inch diameter roadway cores within 24 hours of placement at random locations as directed by the Engineer within each sublot. Test these QC samples for density (G_{mb}) in accordance with 334-5.1.1. Obtain a minimum of three cores per sublot at random locations as identified by the Engineer in situations where the sublot/LOT was closed or terminated before the random numbers were reached or where it is impractical to cut five cores per sublot. Do not obtain cores any closer than 12 inches from an unsupported edge. The Engineer may adjust randomly generated core locations for safety purposes or as the Engineer deems necessary. Do not perform density testing for acceptance in a sublot if the plant random sample for that sublot has not been obtained. Maintain traffic during the coring operation; core the roadway, patch the core holes (within three days of coring); and trim the cores to the proper thickness prior to density testing.

Density for the sublot shall be based on the average value for the cores cut from the sublot with the target density being a percentage of the maximum specific gravity (G_{mm}) of the sublot, as defined in the Contract. Once the average density of a sublot has been determined, do not retest the samples unless approved by the Engineer. Ensure proper handling and storage of all cores until the LOT in question has been accepted.

334-5.4.4 Individual Test Tolerances for QC Testing: Terminate the LOT if any of the following QC failures occur:

1. An individual test result of a sublot for air voids does not meet the requirements of Table 334-2,
2. The average sublot density does not meet the requirements of Table 334-2,
3. Two consecutive test results within the same LOT for gradation or asphalt binder content do not meet the requirements of Table 334-2,

When a LOT is terminated due to a QC failure, stop production of the mixture until the problem is resolved to the satisfaction of the QC Manager and/or Asphalt Plant Level II technician responsible for the decision to resume production after a QC failure, as identified in Section 105. In the event that it can be demonstrated that the problem can immediately be or already has been resolved, it will not be necessary to stop production. When a LOT is terminated, make all necessary changes to correct the problem. Do not resume production until appropriate corrections have been made. Prior to resuming production, inform the Engineer of the problem and corrections made to correct the problem. After resuming production, sample and test the material to verify that the changes have corrected the problem. Summarize this information and provide it to the Engineer prior to the end of the work shift when production resumes.

In the event that a QC failure is not addressed as defined above, the Engineer's approval will be required prior to resuming production after any future QC failures.

Do Not Use Without CO Specs Authorization

Address any material represented by a failing test result, as defined above in this subarticle, in accordance with 334-5.9.5. Any LOT terminated under this subarticle will be limited to a maximum Pay Factor of 1.00 (as defined in 334-8.2) for all quality characteristics and will include all material placed up to the point when the LOT was terminated.

In the event that a G_{mm} test result differs by more than 0.040 from the mix design G_{mm}, investigate the causes of the discrepancy and report the findings and proposed actions to the Engineer.

Table 334-2 Master Production Range	
Characteristic	Tolerance [1]
Asphalt Binder Content (%)	Target ±0.55
Passing No. 200 Sieve (%)	Target ±1.50
Air Voids (%)	1.00 - 4.00
Density, (minimum % G_{mm})[2]	93.50
(1) Tolerances for sample size of n = 1 from the verified mix design (2) Based on an average of three to five randomly located cores	

334-5.5 Verification Testing: In order to determine the validity of the Contractor's QC test results prior to their use in the Acceptance decision, the Engineer will run verification tests.

334-5.5.1 Plant Testing: At the completion of each LOT, the Engineer will test a minimum of one Verification split sample randomly selected from the LOT. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed. Verification samples shall be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. In lieu of the 1-1/2 hours reheating procedure, the mixture may be reheated to within plus or minus 20°F of the roadway compaction temperature using a microwave oven. Stir the mixture as necessary during the reheating process to maintain temperature uniformity. Subsequently, condition and test the mixture as described in 334-5.1.1.

The Verification test results will be compared with the QC test results based on the between-laboratory precision values shown in Table 334-3.

Table 334-3 Between-Laboratory Precision Values	
Property	Maximum Difference
G_{mm}	0.016
G_{mb} (gyratory compacted samples)	0.022
G_{mb} (roadway cores)	0.014
P_b	0.44%
P_{-200}	FM 1-T 030 (Figure 2)
P_{-8}	FM 1-T 030 (Figure 2)

If all of the specified mix characteristics compare favorably, then the LOT will be accepted, with payment based on the Contractor's QC test data for the LOT.

Do Not Use Without CO Specs Authorization

If any of the results do not compare favorably, then the Resolution samples from the LOT will be sent to the Resolution laboratory for testing, as described in 334-5.6.

334-5.5.2 Roadway Testing: At the completion of each LOT, the Engineer will determine the density (G_{mb}) of each core (previously tested by QC) as described in 334-5.1.1 from the same sublot as the plant samples. For situations where roadway density is not required for the random sublot chosen, then another sublot shall be randomly chosen for roadway density cores only. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed.

The individual Verification test results will be compared with individual QC test results by the Engineer based on the between-laboratory precision values given in Table 334-3.

If each of the core test results compare favorably, then the LOT will be accepted with respect to density, with payment based on the Contractor's QC test data for the LOT.

If any of the results do not compare favorably, then the core samples from the LOT will be sent to the Resolution laboratory for testing as specified in 334-5.6.

334-5.6 Resolution System:

334-5.6.1 Plant Samples: In the event of an unfavorable comparison between the Contractor's QC test results and the Engineer's Verification test results on any of the properties identified in Table 334-3, the Resolution laboratory will test all of the split samples from the LOT for only the property (or properties) in question. Resolution samples shall be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. In lieu of the 1-1/2 hours reheating procedure, the mixture may be reheated to within plus or minus 20°F of the roadway compaction temperature using a microwave oven. Stir the mixture as necessary during the reheating process to maintain temperature uniformity. Subsequently, condition and test the mixture as described in 334-5.1.1.

334-5.6.2 Roadway Samples: In the event of an unfavorable comparison between the Contractor's QC test data and the Engineer's Verification test data on the density results, the Resolution laboratory will test all of the cores from the LOT. Testing will be as described in 334-5.1.1.

334-5.6.3 Resolution Determination: The Resolution test results (for the property or properties in question) will be compared with the QC test results based on the between-laboratory precision values shown in Table 334-3.

If the Resolution test results compare favorably with all of the QC results, then acceptance and payment for the LOT will be based on the QC results, and the Department will bear the costs associated with Resolution testing. No additional compensation, either monetary or time, will be made for the impacts of any such testing.

If the Resolution test results do not compare favorably with all of the QC results, then acceptance and payment for the LOT will be based on the Resolution test data for the LOT, and the costs of the Resolution testing will be deducted from monthly estimates. No additional time will be granted for the impacts of any such testing.

In addition, the material failure requirements of 334-5.4.4 apply to the Resolution test data. Address any material represented by the failing test results in accordance

Do Not Use Without CO Specs Authorization

with 334-5.9.5. For this situation, the LOT will be limited to a maximum Pay Factor of 1.00 (as defined in 334-8.2) for all quality characteristics.

In the event of an unfavorable comparison between the Resolution test results and QC test results, make the necessary adjustments to assure that future comparisons are favorable.

334-5.7 Independent Verification (IV) Testing:

334-5.7.1 Plant: The Contractor shall provide sample boxes and take samples as directed by the Engineer for IV testing. Obtain enough material for three complete sets of tests (two samples for IV testing by the Engineer and one sample for testing by the Contractor). If agreed upon by both the Engineer and the Contractor, only one sample for IV testing by the Engineer may be obtained. IV samples will be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. The Contractor's split sample, if tested immediately after sampling, shall be reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. If the Contractor's sample is not tested immediately after sampling, then the sample shall be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. For the IV and Contractor's samples, in lieu of the 1-1/2 hours reheating procedure, the mixture may be reheated to within plus or minus 20°F of the roadway compaction temperature using a microwave oven. Stir the mixture as necessary during the reheating process to maintain temperature uniformity. Subsequently, condition and test the mixture as described in 334-5.1.1. The Contractor's test results shall be provided to the Engineer within one working day from the time the sample was obtained.

If any of the IV test results do not meet the requirements of Table 334-2, then a comparison of the IV test results and the Contractor's test results, if available, will be made. If a comparison of the IV test results and the Contractor's test results meets the precision values of Table 334-3 for the material properties in question, or if the Contractor's test results are not available, then the IV test results are considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

If a comparison of the IV test results and the Contractor's test results does not meet the precision values of Table 334-3 for the material properties in question, then the second IV sample shall be tested by the Engineer for the material properties in question. If a comparison between the first and second IV test results does not meet the precision values of Table 334-3 for the material properties in question, then the first IV test results are considered unverified for the material properties in question and no action shall be taken, with the following exception: if the first and second IV test results do not meet the precision values of Table 334-3 and the first IV test result and Contractor's test result do not meet the precision values of Table 334-3, yet all three test results do not meet the requirements of Table 334-2, then address any material represented by the failing test results in accordance with 334-5.9.5.

If a comparison between the first and second IV test results meets the precision values of Table 334-3 for the material properties in question, then the first IV sample is considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be

Do Not Use Without CO Specs Authorization

demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

The Engineer has the option to use the IV sample for comparison testing as specified in 334-6.

Independent Verification shall test the mixture for fuel resistance in accordance with 334-3.2.7. The testing frequency will be one test per LOT, as a minimum. Cease production if the percent weight loss exceeds 1.5% for any test. Resume production only after the cause of the failure has been determined and corrected and the Engineer's approval has been obtained.

334-5.7.1.1 Asphalt Binder and Mixture Sampling for Determination of Asphalt Binder Quality: At the Department's request, obtain an asphalt binder sample from the asphalt plant storage tank and a corresponding asphalt mixture sample using binder from the same storage tank. Samples of asphalt binder and mixture shall be sampled the same day. The asphalt binder from the storage tank and the asphalt binder recovered from the asphalt mixture will be tested by the Department for compliance with Contract Documents.

334-5.7.2 Roadway: Obtain five 6 inch diameter roadway cores within 24 hours of placement, as directed by the Engineer, for IV testing. In situations where it is impractical to cut five cores per sublot, obtain a minimum of three cores per sublot at random locations, as identified by the Engineer. These independent cores will be obtained from the same LOT and sublot as the Independent Verification Plant sample, or as directed by the Engineer. The density of these cores will be obtained as described in 334-5.1.1. If the average of the results for the sublot does not meet the requirements of Table 334-2 for density, then a comparison of the IV G_{mm} test results and the Contractor's G_{mm} test results, if available, will be made in accordance with the procedure provided in 334-5.7.1. Address any material represented by the failing test results in accordance with 334-5.9.5.

334-5.8 Surface Tolerance: The asphalt mixture will be accepted on the roadway with respect to surface tolerance in accordance with the applicable requirements of 330-9.

334-5.9 Minimum Acceptable Quality Levels:

334-5.9.1 PFs Below 0.90: In the event that an individual pay factor for any quality characteristic of a LOT falls below 0.90, take steps to correct the situation and report the actions to the Engineer. In the event that the pay factor for the same quality characteristic for two consecutive LOTs is below 0.90, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.2 CPFs Less Than 0.90 and Greater Than or Equal to 0.80: If the composite pay factor for the LOT is less than 0.90 and greater than or equal to 0.80, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.3 CPFs Less Than 0.80 and Greater Than or Equal to 0.75: If the CPF for the LOT is less than 0.80 and greater than or equal to 0.75, address the defective material in accordance with 334-5.9.5.

Do Not Use Without CO Specs Authorization

334-5.9.4 CPFs Less Than 0.75: If the CPF for the LOT is less than 0.75, remove and replace the defective LOT at no cost to the Department, or as approved by the Engineer.

334-5.9.5 Defective Material: Assume responsibility for removing and replacing all defective material placed on the project, at no cost to the Department.

As an exception to the above and upon approval of the Engineer, obtain an engineering analysis in accordance with Section 6 by an independent laboratory (as approved by the Engineer) to determine the disposition of the material. The engineering analysis must be signed and sealed by a Professional Engineer licensed in the State of Florida.

The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material.

Any material that remains in place will be accepted with a CPF as determined by 334-8, or as determined by the Engineer.

If the defective material is due to a gradation, asphalt binder content or density failure, upon the approval of the Engineer the Contractor may perform delineation tests on roadway cores in lieu of an engineering analysis to determine the limits of the defective material that may require removal and replacement. Prior to any delineation testing, all sampling locations shall be approved by the Engineer. All delineation sampling and testing shall be monitored and verified by the Engineer. For materials that are defective due to air voids, an engineering analysis is required.

When evaluating defective material by engineering analysis or delineation testing, at a minimum, evaluate all material located between passing QC, PC or IV test results. Exceptions to this requirement shall be approved by the Engineer.

334-6 Comparison Testing.

At the start of the project (unless waived by the Engineer) and at other times as determined necessary by the Engineer, provide split samples for comparison testing with the Engineer. The purpose of these tests is to verify that the testing equipment is functioning properly and that the testing procedures are being performed correctly. In the event that the Engineer determines that there is a problem with the Contractor's testing equipment and/or testing procedures, immediately correct the problem to the Engineer's satisfaction. In the event that the problem is not immediately corrected, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the Engineer.

If so agreed to by both the Contractor and the Engineer, the split sample used for comparison testing may also be used for the QC sample. The split sample used for comparison testing must also meet the requirements for IV testing described in 334-5.7.

334-7 Method of Measurement.

For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), the quantity to be paid for will be the weight of the mixture, in tons. For each pay item, excluding overbuild, the pay quantity will be based on the quantity placed on the project, limited to 105% of the adjusted plan quantity for the pay item. The adjusted plan quantity will be determined by dividing the pay item's original plan quantity (including any Engineer approved quantity revisions) by the design G_{mm} stated in 334-1.4, then multiplying it by the tonnage-weighted average G_{mm} of the mixes used for the pay item.

The bid price for the asphalt mix will include the cost of the liquid asphalt and the tack coat application as directed in 300-8. There will be no separate payment or unit price adjustment

Do Not Use Without CO Specs Authorization

for the asphalt binder material in the asphalt mix. For the calculation of unit price adjustments of bituminous material, the average asphalt content will be based on the percentage specified in 9-2.1.2. The weight will be determined as provided in 320-3.2 (including the provisions for the automatic recordation system).

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

334-8 Basis of Payment.

334-8.1 General: Price and payment will be full compensation for all the work specified under this Section (including the applicable requirements of Sections 320 and 330).

For materials accepted in accordance with 334-5, based upon the quality of the material, a pay adjustment will be applied to the bid price of the material as determined on a LOT by LOT basis. The pay adjustment will be assessed by calculating a Pay Factor for the following individual quality characteristics: pavement density, air voids, asphalt binder content, and the percentage passing the No. 200 and No. 8 sieves. The pay adjustment will be computed by multiplying a Composite Pay Factor (CPF) for the LOT by the bid price per ton.

334-8.2 Pay Factors:

334-8.2.1 Partial LOTs: For Partial LOTs where no random sample is obtained due to insufficient tonnage, a CPF of 1.00 shall be applied.

334-8.2.2 Two or Less Sublot Test Results: In the event that two or less sublot test results are available for a LOT, Pay Factors will be determined based on Table 334-4, using the average of the accumulated deviations from the target value. (Except for density, deviations are absolute values with no plus or minus signs.) Use the 1-Test column when there is only one sublot test result and use the 2-Tests column when there are two sublots.

Table 334-4
Small Quantity Pay Table

Pay Factor	1 Sublot Test Deviation	2 Sublot Test Average Deviation
Asphalt Binder Content, percent		
1.05	0.00-0.23	0.00-0.16
1.00	0.24-0.45	0.17-0.32
0.90	0.46-0.55	0.33-0.39
0.80	>0.55	>0.39
No. 8 Sieve, percent passing		
1.05	0.00-2.25	0.00-1.59
1.00	2.26-4.50	1.60-3.18
0.90	4.51-5.50	3.19-3.89
0.80	>5.50	>3.89
No. 200 Sieve, percent passing		
1.05	0.00-0.55	0.00-0.39
1.00	0.56-1.10	0.40-0.78
0.90	1.11-1.50	0.79-1.06
0.80	>1.50	>1.06
Air Voids, percent		
1.05	0.00-0.50	0.00-0.35
1.00	0.51-1.00	0.36-0.71

Do Not Use Without CO Specs Authorization

Table 334-4 Small Quantity Pay Table		
Pay Factor	1 Sublot Test Deviation	2 Sublot Test Average Deviation
0.90	1.01-1.70	0.72-1.20
0.80	1.71-2.00	1.21-1.41
0.70	2.01-2.50	1.42-1.77
0.55	>2.50	>1.77
Density (1) Target = 96.50 percent of G_{mm}		
1.05	+ (0.00-3.50), - (0.00-0.50)	+ (0.00-3.25), - (0.00-0.35)
1.00	+ (3.51-4.50), - (0.51-1.00)	+ (3.26-4.25), - (0.36-0.71)
0.95	+ (4.51-5.00), - (1.01-2.00)	+ (4.26-4.75), - (0.72-1.41)
0.90	+ (5.01-5.50), - (2.01-3.00)	+ (4.76-5.25) – (1.42-2.12)
0.80	+ (>5.50), - (>3.00)	+ (>5.25), - (>2.12)
Density (1) Target = 95.50 percent of G_{mm}		
1.05	+ (0.00-4.50), - (0.00-0.50)	+ (0.00-4.25), - (0.00-0.35)
1.00	+ (4.51-5.50), - (0.51-1.00)	+ (4.26-5.25), - (0.36-0.71)
0.95	+ (5.51-6.00), - (1.01-1.50)	+ (5.26-5.75), - (0.72-1.41)
0.90	+ (6.01-6.50), - (1.51-2.00)	+ (5.76-6.25) – (1.42-2.12)
0.80	+ (>6.50), - (>2.00)	+ (>6.25), - (>2.12)

(1). Each density test result is the average of three to five randomly located cores. The target density is 96.50 percent of G_{mm} (95.50 percent when compaction is limited to the static mode or for layers specified to be one inch thick). When compaction is limited to the static mode, no vibratory mode in the vertical direction will be allowed. Other vibratory modes will be allowed, if approved by the Engineer. In this case, the target density is 95.50 percent of G_{mm}.

334-8.2.3 Three or More Sublot Test Results: When three or more sublot test results are available for a LOT, the variability-unknown, standard deviation method will be used to determine the estimated percentage of the LOT that is within the specification limits. The number of significant figures used in the calculations will be in accordance with requirements of AASHTO R 11-06/ASTM E29-13 (2019) Absolute Method.

334-8.2.3.1 Percent Within Limits: The percent within limits (PWL) and Pay Factors for the LOT will be calculated as described below. Variables used in the calculations are as follows:

x = individual test value (sublot)
n = number of tests (sublots)
s = sample standard deviation
$\Sigma(x^2)$ = summation of squares of individual test values
$(\Sigma x)^2$ = summation of individual test values squared
Q_U = upper quality index
USL = upper specification limit (target value plus upper specification limit from Table 334-5)
Q_L = lower quality index
LSL = lower specification limit (target value minus lower specification limit from Table 334-5)
P_U = estimated percentage below the USL
P_L = estimated percentage above the LSL

Do Not Use Without CO Specs Authorization

1. Calculate the arithmetic mean $(\overline{X})$ of the test values:

$$\overline{X} = \frac{\sum x}{n}$$

2. Calculate the sample standard deviation (s):

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

3. Calculate the upper quality index (Q_U):

$$Q_U = \frac{\text{USL} - \overline{\text{X}}}{\text{s}}$$

4. Calculate the lower quality index (Q_L):

$$Q_L = \frac{\overline{X} - LSL}{s}$$

5. From Table 334-6, determine the percentage of work below the USL (P_U).

6. From Table 334-6, determine percentage of work above the LSL (P_L) Note: If USL or LSL is not specified, percentages within (USL or LSL) will be 100.

7. If Q_U or Q_L is a negative number, then calculate the percent within limits for Q_U or Q_L as follows: enter Table 334-6 with the positive value of Q_U or Q_L and obtain the corresponding percent within limits for the proper sample size. Subtract this number from 100.00. The resulting number is the value to be used in the next step (Step 8) for the calculation of quality level.

8. Calculate the percent within limits (PWL) = (P_U + P_L) - 100

9. Calculate the Pay Factor (PF) for each quality characteristic using the equation given in 334-8.2.3.2.

Table 334-5
Specification Limits

Quality Characteristic	Specification Limits
Passing No. 8 sieve (percent)	Target ± 3.1
Passing No. 200 sieve (percent)	Target ± 1.0
Asphalt Content (percent)	Target ± 0.40
Air Voids (percent)	2.50 ± 1.20
Density, static mode (percent of G_{mm}):	95.50 + 4.00, - 1.20(1)
Density, vibratory mode (percent of G_{mm}):	96.50 + 3.00, - 1.20

(1): No vibratory mode in the vertical direction will be allowed. Other vibratory modes will be allowed, if approved by the Engineer.

Do Not Use Without CO Specs Authorization

Table 334-6 Percent Within Limits		
Quality Index	Percent within Limits for Selected Sample Size	
	n = 3	n = 4
0.00	50.00	50.00
0.05	51.38	51.67
0.10	52.76	53.33
0.15	54.15	55.00
0.20	55.54	56.67
0.25	56.95	58.33
0.30	58.37	60.00
0.35	59.80	61.67
0.40	61.26	63.33
0.45	62.74	65.00
0.50	64.25	66.67
0.55	65.80	68.33
0.60	67.39	70.00
0.65	69.03	71.67
0.70	70.73	73.33
0.75	72.50	75.00
0.80	74.36	76.67
0.85	76.33	78.33
0.90	78.45	80.00
0.95	80.75	81.67
1.00	83.33	83.33
1.05	86.34	85.00
1.10	90.16	86.67
1.15	97.13	88.33
1.20	100.00	90.00
1.25	100.00	91.67
1.30	100.00	93.33
1.35	100.00	95.00
1.40	100.00	96.67
1.45	100.00	98.33
1.50	100.00	100.00
1.55	100.00	100.00
1.60	100.00	100.00
1.65	100.00	100.00
1.70	100.00	100.00
1.75	100.00	100.00
1.80	100.00	100.00
1.85	100.00	100.00
1.90	100.00	100.00

Do Not Use Without CO Specs Authorization

Table 334-6 Percent Within Limits		
Quality Index	Percent within Limits for Selected Sample Size	
	n = 3	n = 4
1.95	100.00	100.00
2.00	100.00	100.00
2.05	100.00	100.00
2.10	100.00	100.00
2.15	100.00	100.00
2.20	100.00	100.00
2.25	100.00	100.00
2.30	100.00	100.00
2.35	100.00	100.00
2.40	100.00	100.00
2.45	100.00	100.00
2.50	100.00	100.00
2.55	100.00	100.00
2.60	100.00	100.00
2.65	100.00	100.00

334-8.2.3.2 Pay Factors (PF): Pay Factors will be calculated by using the following equation:

Pay Factor = (55 + 0.5 x PWL) / 100

The PWL is determined from Step (8) of 334-8.2.3.1.

334-8.3 Composite Pay Factor (CPF): A CPF for the LOT will be calculated based on the individual PFs with the following weighting applied: 40% Density (D), 25% Air Voids (V_a), 20% asphalt binder content (P_b), 10% Passing No. 200 (P_{-200}) and 5% Passing No. 8 (P_{-8}). Calculate the CPF by using the following formula:

CPF = [(0.400 x PF D) + (0.250 x PF V_a) + (0.200 x PF P_b) + (0.100 x PF P_{-200}) + (0.050 x PF P_{-8})]

Where the PF for each quality characteristic is determined in either 334-8.2.2 or 334-8.2.3, depending on the number of sublot tests. Note that the number after each multiplication will be rounded to the nearest 0.01.

The pay adjustment shall be computed by multiplying the CPF for the LOT by the bid price per ton.

334-8.4 Payment: Payment will be made under:

Item No. 914-334- Fuel Resistant Superpave Asphaltic Concrete - per ton.

Do Not Use Without CO Specs Authorization

ASPHALT CONCRETE FRICTION COURSES - FUEL RESISTANT ASPHALT (REV 6-23-21)

SECTION 337 is deleted and the following substituted for locations of fuel resistant asphalt friction course as delineated in the Plans. DEV337FRA does not apply for any other friction courses delineated in the Plans:

SECTION 337
ASPHALT CONCRETE FRICTION COURSES - FUEL RESISTANT ASPHALT

337-1 Description.

Construct a Fuel Resistant asphalt concrete friction course pavement with the type of mixture specified in the Contract Documents.

Obtain Fuel Resistant asphalt concrete friction course from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105. Producers must meet the plant and equipment requirements of Section 320, as modified herein. Meet the general construction requirements of Section 330, as modified herein.

337-2 Materials.

337-2.1 General Requirements: Meet the requirements specified in Division III as modified herein. The Engineer will base continuing approval of material sources on field performance. Warm mix technologies (additives, foaming techniques, etc.) listed on the Department's website may be used in the production of the mix.

337-2.2 Asphalt Binder: Use a PG 88-22 (FR) binder meeting the requirements of Section 916.

337-2.3 Coarse Aggregate: Meet the requirements of Section 901, and any additional requirements or modifications specified herein for the various mixtures.

337-2.4 Fine Aggregate: Meet the requirements of Section 902, and any additional requirements or modifications specified herein for the various mixtures.

337-2.5 Hydrated Lime: Meet the requirements of AASHTO M 303-89 (2010), Type 1. Provide certified test results for each shipment of hydrated lime indicating compliance with the specifications.

337-2.6 Liquid Anti-strip Additive: Meet the requirements of 916-4 and be listed on the Department's Approved Product List (APL).

337-3 General Composition of Mixes.

337-3.1 General: Use a bituminous mixture composed of aggregate (coarse, fine, or a mixture thereof), asphalt binder, and if necessary, hydrated lime or a liquid anti-strip additive. Size, uniformly grade and combine the aggregate fractions in such proportions that the resulting mix meets the requirements of this Section.

337-3.2 Specific Component Requirements by Mix: Use an aggregate blend of approved friction course aggregates that consists of crushed granite, crushed granitic gneiss, crushed limestone, crushed shell rock, or a combination of the above. As an exception, mixes that contain a minimum of 60% of approved friction course aggregates of crushed granite and/or crushed granitic gneiss may either contain: up to 40% fine aggregate from other sources of

Do Not Use Without CO Specs Authorization

aggregate not approved for friction courses. Mixtures utilizing PG 88-22 (FR) binder are not allowed to contain RAP.

A list of aggregates approved for use in friction course may be available on the Department's website. The URL for obtaining this information, if available, is: https://mac.fdot.gov/.

337-3.3 Grading Requirements: Meet the design gradation requirements for a Type SP-Fuel Resistant Superpave fine mixture, as defined in 334-3.2.2.

337-4 Mix Design.

Provide a mix design conforming to the requirements of 334-3.2 unless otherwise designated in the plans. All mix design revisions must meet the requirements of 334-3.3.

337-5 Contractor's Process Control.

Provide the necessary process control of the friction course mix and construction in accordance with the applicable provisions of 320-2, 330-2 and 334-4.

The Engineer will monitor the spread rate periodically to ensure uniform thickness. Perform quality control procedures for daily monitoring and control of spread rate variability. If the spread rate varies by more than 5% of the spread rate set by the Engineer in accordance with 337-8, immediately make all corrections necessary to bring the spread rate into the acceptable range.

337-6 Acceptance of the Mixture.

Meet the requirements of 334-5.

337-7 Special Construction Requirements.

337-7.1 Temperature Requirements:

337-7.1.1 Air Temperature at Laydown: Meet the requirements of Table 330-1.

337-7.1.2 Temperature of the Mix: Heat and combine the asphalt binder and aggregate in a manner to produce a mix having a temperature, when discharged from the plant, meeting the requirements of 320-6.3. Meet all requirements of 330-6.1.3 at the roadway.

337-7.2 Prevention of Adhesion: To minimize adhesion to the drum during the rolling operations, the Contractor may add a small amount of liquid detergent to the water in the roller.

At intersections and in other areas where the pavement may be subjected to cross-traffic before it has cooled, spray the approaches with water to wet the tires of the approaching vehicles before they cross the pavement.

337-7.3 Transportation Requirements of Friction Course Mixtures: Cover all loads of friction course mixtures with a tarpaulin, or waterproof cover, meeting requirements of 320-7.

337-8 Thickness of Friction Courses.

The thickness of the friction course layer will be the plan thickness as shown in the Contract Documents. For construction purposes, the plan thickness will be converted to spread rate as defined in 334-1.3.

Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lbs/yd^2-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

Do Not Use Without CO Specs Authorization

337-9 Failing Material.

Meet the requirements of 334-5.9.

337-10 Method of Measurement.

For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), the quantity to be paid for will be the weight of the mixture, in tons. The pay quantity will be based on the quantity placed on the project, limited to 105% of the adjusted plan quantity for the pay item. The adjusted plan quantity will be determined by dividing the pay item's original plan quantity (including any Engineer approved quantity revisions) by the design G_{mm} stated in 334-1.3, then multiplying it by the tonnage-weighted average G_{mm} of the mixes used for the pay item.

The bid price for the asphalt mix will include the cost of the asphalt binder (asphalt cement, anti-stripping agent, additives, blending and handling) and the tack coat application as directed in 300-8. There will be no separate payment or unit price adjustment for the asphalt binder material in the asphalt mix. The weight will be determined as provided in 320-3.2 (including the provisions for the automatic recordation system).

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

337-11 Basis of Payment.

337-11.1 General: Price and payment will be full compensation for all the work specified under this Section (including the applicable requirements of Sections 320 and 330).

Meet the requirements of 334-8.

Based upon the quality of the material, a pay adjustment will be applied to the bid price of the material as determined on a LOT by LOT basis. The pay adjustment will be assessed by calculating a Pay Factor for individual quality characteristics. The pay adjustment will be computed by multiplying a Composite Pay Factor for the LOT by the bid price per ton.

337-11.2 Payment: Payment will be made under:

Item No. 914-337 - Fuel Resistant Asphalt Concrete Friction Course - per ton.

Do Not Use Without CO Specs Authorization

BITUMINOUS MATERIALS – FUEL RESISTANT ASPHALT
(REV 6-23-21)

SECTION 916 is deleted and the following substituted for locations of fuel resistant asphalt structural and/or friction course as delineated in the Plans. DEV916FRA does not apply for any other structural or friction courses delineated in the Plans.

SECTION 916
BITUMINOUS MATERIALS – FUEL RESISTANT ASPHALT

916-1 General.

All products supplied under this Specification shall be one of the products included on the Approved Product List (APL). Producers seeking evaluation of a product for inclusion on the APL shall submit an application in accordance with Section 6. Fuel Resistant (FR) binder, PG 88-22 (FR), will not need to be included on the APL, however, a sample of the binder must be tested and approved by the State Materials Office prior to use on the project.

Any marked variation from the original test values for a material below the established limits or evidence of inadequate quality control or field performance of a material will be considered sufficient evidence that the properties of the material have changed, and the material will be removed from the APL.

916-2 Superpave PG Asphalt Binder:

916-2.1 Requirements: Superpave Performance Graded (PG) asphalt binders, identified as PG 52-28, PG 58-22, PG 67-22, polymer modified asphalt (PMA) binders, PG 76-22 (PMA) and High Polymer, Fuel Resistant (FR) binder, PG 88-22 (FR), and asphalt rubber binders (ARB), PG 76-22 (ARB), shall meet the requirements of 916-2 and AASHTO M 332-20. When the Contract Documents specify either a PG 76-22 (PMA), PG 76-22 (ARB), or PG 76-22 binder, either binder can be used interchangeably at no additional cost to the Department. All PG asphalt binders shall meet the following additional requirements:

1. The intermediate test temperature at 10 rad/sec. for the Dynamic Shear Rheometer (DSR) test (AASHTO T 315-20 shall be 26.5ºC for PG grades PG 67 and higher.

2. An additional high temperature grade of PG 67 is added for which the high test temperature at 10 rad/sec for the DSR test (AASHTO T 315-120shall be 67ºC.

3. All PG asphalt binders having a high temperature designation of PG 67 or lower shall be prepared without modification.

4. All PMA and FR binders having a high temperature designation higher than PG 67 shall only be produced with a styrene-butadiene-styrene (SBS) or styrene-butadiene (SB) elastomeric polymer modifier and the resultant binder shall meet all requirements of this Section.

5. Polyphosphoric acid may be used as a modifier not exceeding 0.75% by weight of asphalt binder for PG 76-22 (PMA) and PG 76-22 (ARB) binders. Polyphosphoric acid may not be used in High Polymer binder or PG 88-22 (FR) binder.

6. PG 76-22 (ARB) shall meet the additional requirements of 916-2.1.1.

7. All PG asphalt binders having a high temperature designation of PG 67 or lower shall not have a high temperature true grade more than 5.9°C higher than the specified PG grade, (for example, if a PG 58-22 is specified, do not supply a PG 64-22 or higher).

8. The use of waste oil is prohibited in the modification of any PG binder grade. Waste oil shall be defined as recycled oil products that have not been processed through a

Do Not Use Without CO Specs Authorization

vacuum tower and have an initial boiling point of 385°C (725°F) or lower when tested in accordance with ASTM D6352-19.

9. Re-refined engine oil bottoms (REOB)/vacuum tower asphalt extenders (VTAE) may be used as a modifier not exceeding 8.0% by weight of asphalt binder. REOB/VTAE are materials as defined in Asphalt Institute document IS-235.

10. Additional polymer modifiers may be used in the PG 88-22 (FR) binder.

For all PG binder used in all hot mix asphalt, silicone may be added to the PG binder at the rate of 25 cubic centimeters of silicone mixed to each 5,000 gallons of PG binder. If a disbursing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cubic centimeters of silicone shall be added in accordance with the manufacturer's recommendation. The blending of the silicone with the PG binder shall be done by the supplier prior to the shipment. When the asphalt binder will be used with a foaming warm mix technology, refer to the technology supplier's guidance on the addition of silicone.

Where an anti-strip additive is required, the anti-strip additive shall meet the requirements of 916-4. The anti-strip additive shall be introduced into the PG binder by the supplier during loading.

916-2.1.1 Additional Requirements for PG 76-22 (ARB): The following additional requirements apply only to PG 76-22 (ARB):

1. The asphalt binder shall contain a minimum of 7.0% ground tire rubber (GTR) by weight of asphalt binder.
2. The GTR shall meet the requirements of Section 919.
3. Polymer modification is optional for PG 76-22 (ARB).

916-2.1.2 High Polymer Binder Blending: Existing high polymer binder may be blended in an asphalt producer's storage tank to make a PG 76-22 binder provided the following requirements are met:

1. Notify the State Materials Office (SMO) and the local District Materials Office prior to blending.
2. Follow the blending instructions of the high polymer binder supplier.
3. Submit a sample of the blended binder to a SMO approved laboratory for testing. Provide test results to the SMO.
4. Use the newly blended binder only after approval from the SMO.

916-2.2 Compliance with Materials Manual: Producers of Superpave PG binders shall meet the requirements of Section 3.5, Volume II of the Department's Material Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section35V2.shtm.

916-2.3 Reporting: Specification compliance testing results shall be reported for the tests in Table 916-1 below, unless noted otherwise. Quality control (QC) testing results shall be reported for original binder DSR (G/sin δ and phase angle, as applicable).

Do Not Use Without CO Specs Authorization

Table 916-1		
SUPERPAVE PG ASPHALT BINDER		
Test and Method	Conditions	Specification Minimum/Maximum Value
Superpave PG Asphalt Binder Grade		Report
APL Number		Report
Modifier (name and type)	Polymer, Ground Tire Rubber with Approved Product List (APL) number, Sulfur, PPA, REOB, and any Rejuvenating Agents	Report
Original Binder		
Solubility, AASHTO T 44-14 (2018)	in Trichloroethylene	Minimum 99.0% (Not applicable for PG 76-22 (ARB))
Flash Point, AASHTO T 48-18	Cleveland Open Cup	Minimum 450ºF
Rotational Viscosity, AASHTO T 316-19	275ºF	Maximum 3 Pa·s[(a)]
Dynamic Shear Rheometer [(b)], AASHTO T 315-20	$G^*/\sin\delta$	Minimum 1.00 kPa
	Phase Angle, δ[(c)] PG 76-22 (PMA) and PG 76-22 (ARB)[(d)] PG 88-22 (FR)	Maximum 75 degrees Maximum 70 degrees
Separation Test, ASTM D7173-20 and Softening Point, AASHTO T 53-09 (2018)	163±5°C 48 hours	Maximum 15°F (PG 76-22 (ARB) only) Maximum 7.2°F (PG 88-22 (FR) only)
Rolling Thin Film Oven Test Residue (AASHTO T 240-13 (2017))		
Rolling Thin Film Oven, AASHTO T 240-13 (2017)	Mass Change %	Maximum 1.00
Multiple Stress Creep Recovery, $J_{nr,\ 3.2}$ AASHTO T 350-19	Grade Temperature (Unmodified binders only)	"S" = 4.50 kPa^{-1} max
Multiple Stress Creep Recovery, $J_{nr,\ 3.2}$ [(d, e, f)] AASHTO T 350-19	67°C (Modified binders only) 76°C (High Polymer binder only)	"V" = 1.00 kPa^{-1} max Maximum $J_{nr,diff}$ = 75% 0.10 kPa^{-1} max
Multiple Stress Creep Recovery, %Recovery [(d, e)] AASHTO T 350-19	67°C (Modified binders only) 76°C (High Polymer binder only)	$\%R_{3.2} \geq 29.371\ (J_{nr,\ 3.2})^{-0.2633}$ $\%R_{3.2} \geq 90.0$

Do Not Use Without CO Specs Authorization

Table 916-1		
SUPERPAVE PG ASPHALT BINDER		
Elastic Recovery ASTM D6084-18	25ºC	Minimum 85.0% (PG 88-22 (FR) only)
Pressure Aging Vessel Residue (AASHTO R 28-12 (2016))		
Dynamic Shear Rheometer, AASHTO T 315-20	$G^*\sin\delta$, 10 rad/sec.	Maximum 6,000 kPa (g, h)
Creep Stiffness, AASHTO T 313-20	S (Stiffness), @ 60 sec. m-value, @ 60 sec.	Maximum 300 MPa Minimum 0.300
ΔTc, ASTM D7643-16	20 hours PAV aging S (Stiffness), @ 60 sec. m-value, @ 60 sec.	ΔTc ≥ -5.0°C

(a) Binders with values higher than 3 Pa·s should be used with caution and only after consulting with the supplier as to any special handling procedures, including pumping capabilities.
(b) Dynamic Shear Rheometer (AASHTO T 315-20) shall be performed on original binders for the purposes of QC testing only. The original binder G*/sin δ shall be performed at grade temperature. Grade temperature for High Polymer binder is 76°C.
(c) The original binder phase angle (AASHTO T 315-20) shall be performed at grade temperature.
(d) AASHTO T 315-20 and AASHTO T 350-20 will be performed at a 2-mm gap for PG 76-22 (ARB).
(e) All binders with a high temperature designation >67 will be tested at 67°C. PG 76-22 (PMA) and PG 76-22 (ARB) shall pass a "V" grade and PG 88-22 (FR) shall pass an "E" grade per AASHTO M 332-20.
(f) A maximum Jnr diff = 75% does not apply for any Jnr value ≤ 0.50 kPa-1.
(g) For 5000 kPa ≤ G*sin δ ≤ 6000 kPa, the phase angle, δ, shall be a minimum of 42°.
(h) For PG 67 or higher grades, perform the PAV residue testing at 26.5°C.

916-3 Asphalt Emulsions.

916-3.1 Compliance with Materials Manual: Producers of asphalt emulsions shall meet the requirements of Section 3.4, Volume II of the Department's Material Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section34V2.shtm.

916-3.2 Requirements: Use a prime coat meeting the requirements of AASHTO M 140-20 for anionic emulsions, AASHTO M 208-18 or AASHTO M 316-19 for cationic emulsions, or as specified in the Producer's QC Plan. For anionic emulsions, the cement mixing test will be waived. For tack products, the minimum testing requirements shall include percent residue, naphtha content (as needed), one-day storage stability, sieve test, Saybolt Furol viscosity, original DSR, and solubility (on an annual basis). Residue testing shall be performed on residue obtained from distillation, AASHTO T 59-16 or low- temperature evaporation, AASHTO R 78-16 (2020).

At the direction of the Engineer, sample tack from the distributor used on the project at a minimum frequency of once per project per product. The sample shall be tested by the Department for the following specified material properties: percent residue, contaminants, and the residue property G*/sin δ. Should any of the test results fail the specification requirements, the tack material will be considered defective and shall not to be used on Department projects unless waived by the Engineer. The Engineer may require the Contractor to obtain roadway cores for bond strength testing (FM 5-599).

916-4 Liquid Anti-strip Agents.

916-4.1 Requirements: Liquid anti-strip agents shall be tested by the Department in accordance with FM 1-T 283. A minimum tensile strength ratio of 0.80 must be obtained when

Do Not Use Without CO Specs Authorization

testing the liquid anti-strip with various aggregate sources and two nominal maximum aggregate size mixtures for approval to be placed on the APL.

916-4.2 Mix Design Verification: Particular aggregate sources may require moisture susceptibility testing per FM 1-T 283 for each mix design. Results from this testing may meet the Department's requirement of minimum tensile strength ratio of 0.80 or may indicate the need for a larger dosage rate of anti-strip agent (up to 0.75% maximum) or may require a different anti-strip agent to meet the specification requirements.

Do Not Use Without CO Specs Authorization