

## **SECTION 904 — PERFORMANCE GRADED ASPHALT BINDERS AND HOT MIX ASPHALT**

**904.01 CERTIFICATION.** The manufacturer and hauler shall furnish certifications as specified in TC-1.02 and the following:

The manufacturer shall also certify:

- (a) Date and time of loading.
- (b) Tank or blending system.
- (c) Identification of hauling unit.
- (d) Binder grade, temperature, and quantity of materials.
- (e) Complete certified analysis.
- (f) Lot number, if applicable.
- (g) Mixing and compaction temperatures when the binder is polymer modified.

The hauler shall also certify:

- (a) Identification of hauling unit.
- (b) Binder grade and source of last delivery.
- (c) The date of the last delivery using this hauling tank and volume of material remaining in the tank at the time of current loading.

### **904.02 PERFORMANCE GRADED ASPHALT BINDERS.**

Performance graded asphalt binders for mixes containing all virgin materials, recycled asphalt pavement materials, or roofing shingles from manufacturing waste shall conform to AASHTO MP1, Table 1, for the specified performance grade. The asphalt binder recovered from the final plant mixed material will be considered Rolling Thin Film Oven (RTFO) material and shall conform to AASHTO MP1, Table 1 for the specified performance grade.

The performance graded binder shall be preapproved by the Administration. The Contractor shall submit a certificate of analysis showing conformance with the Performance Graded Binder Specification AASHTO MP1 and the critical cracking temperature as described in the Binder ETG Draft, Standard Practice for Determination of Low-

Temperature Performance Grade (PG) of Asphalt Binder, for the binders specified in the Contract Documents.

The PG binder for HMA mixes shall be achieved by the use of Neat Asphalt with elastomer polymer modifications when needed.

**904.03 EMULSIFIED ASPHALTS.** Emulsified asphalts shall conform to M 140 or M 208 with the following exceptions:

- (a) Cement mixing tests are waived.
- (b) Grade SS-1 viscosity shall be 50 to 400 seconds at 77 F.
- (c) Maximum of 3.0 percent by volume of oil distillate.
- (d) The sieve test requirement for field samples shall be a maximum of 0.4 percent.

**904.04 HOT MIX ASPHALT (HMA).** Mixes shall be produced in a plant as specified in Section 915.

**904.04.01 Aggregates.** Aggregates shall conform to Section 901, and AASHTO MP2 with the exception that the aggregate retained on the 4.75 mm sieve shall be tested for flat and elongated particles in conformance with D 4791. When recycled asphalt pavement is used in an HMA mix as defined in MSMT 412, it shall be considered an aggregate source.

**904.04.02 Mix Design.** The Contractor shall develop a Superpave mix design in conformance with AASHTO PP 28. HMA Superpave mixes shall conform to the specification for Superpave Volumetric Mix Design, AASHTO MP 2, and shall be designed for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

The Contractor may elect to use crushed, recycled asphalt pavement (RAP) material or a maximum of 5 percent roofing shingles from manufacturing waste. The allowable percentage and its suitability for use shall be determined in conformance with MSMT 412. When using 15 percent or less of RAP, binder viscosity adjustments are not required.

The use of RAP may be considered for applications where higher polish value aggregates are required. Approval for use will be on an individual project basis. Documentation of RAP stockpile quality and traceability shall be submitted to the Engineer for approval prior to use.

Crushed glass shall not be used in surface mixes. RAP and roofing shingles from manufacturing waste shall not be used in gap-graded mixes,

surface mixes requiring high polish aggregate, or mixes requiring elastomer type polymer binder.

**904.04.03 Mix Design Approval.** Documents containing the data from the Contractor's laboratory study shall be submitted to the Engineer for tentative approval at least two weeks prior to paving operations using Administration approved AASHTO software, and shall include the following:

- (a) Mix designation.
- (b) Source and percentage of aggregate.
- (c) Source, percentage, and grade of performance graded asphalt binder.
- (d) Anticipated gradation and proportion of each component aggregate.
- (e) Combined cold feed grading, extracted grading, or ignited grading.
- (f) Plant where the HMA mix will be produced.
- (g) Plant target mixing temperature based on viscosity of 0.22 Pa·s.
- (h) Percent passing No. 200 sieve removed by dust collecting system.
- (i) Ratio of dust to binder material on effective asphalt.
- (j) Maximum specific gravity at the target binder content.
- (k) Mix design grading plotted on 0.45 power gradation chart.
- (l) Tensile strength ratio and worksheets.
- (m) The gyratory compaction curve for  $N_{max}$ .
- (n) The bulk specific gravity at  $N_{design}$  gyrations.
- (o) The air void content (percent  $V_a$ ) at  $N_{initial}$ ,  $N_{design}$ , and  $N_{max}$  gyrations.
- (p) The voids in the mineral aggregate (percent VMA) and the voids filled with asphalt (percent VFA) at  $N_{design}$  gyrations (TP4).
- (q) The slope of the gyratory compaction curve.

- (r) All consensus and source properties.
  - (1) Coarse aggregate angularity.
  - (2) Flat and elongated.
  - (3) Sand equivalent.
  - (4) Uncompacted void content of fine aggregate.
  - (5) Bulk and apparent specific gravity of coarse and fine aggregate.
  - (6) Absorption of coarse and fine aggregate.

Mix designs submitted to the Regional Engineer for approval shall be accompanied by a quantity of job mix formula aggregate and appropriate amount of required PG binder for ignition oven calibration.

If previous construction or performance experience has shown the proposed mix design to be unsatisfactory, the Regional Engineer may require the Contractor to submit a more suitable design.

If the Contractor proposes to change the source of aggregate used in the mix, a revised mix design shall be submitted with the information required above and in 904.04.02. The conditions set forth above relative to initial submission shall apply. If a change in the Performance Grade binder source becomes necessary, a stripping test shall be conducted in conformance with MSMT 410, prior to approval. The Administration may require an antistripping additive test in conformance with D 4867 before giving the final approval.

**Field Verification of Mix Design.** After receiving the tentative approval for the mix design from the Regional Engineer, the Contractor shall conduct a field verification of the mix at the beginning of production in each plant. Field verification shall be performed by the certified personnel as specified in 504.03. The verification samples shall be prepared as specified in PP28. The Contractor shall notify the Engineer at least two working days in advance of the scheduled verification.

**Verification Evaluation.**

- (a) Initial verification shall consist of four samples tested for the parameters listed in MSMT 730, Table 3. These samples shall be randomly drawn from the first day's production. If the first day of production is less than 1000 tons, the Contractor may choose to spread verification testing over the number of days needed to

accumulate 1000 tons. The verification testing shall be completed on the day when production has reached the 1000 tons. The Contractor shall evaluate the verification tests results as specified in MSMT 730. All tonnage up to and including the final day of verification will not be subject to a price adjustment if individual test data is within the allowable control limits specified in Table 904 A.

- (b) If the mix produced by the plant conforms to the parameters listed in MSMT 730, Table 3 with the Percent Within Specification Limit (PWSL) a minimum of 85, production may proceed without any changes. If the Contractor has submitted mixes with identical aggregate combinations and differing asphalt contents associated with changes in ESAL loads, verification will be limited to volumetric analysis at the Engineer’s discretion.
- (c) If the mix produced by the plant does not conform to the parameters listed in MSMT 730, Table 3 with PWSL a minimum of 85, then an adjustment to the asphalt content or gradation may be made to bring the mix design requirements within acceptable levels.

Permissible adjustment limitations between the approved Mix Design and Adjusted Mix Design are as follows:

TEST PROPERTY	PERMISSIBLE ADJUSTMENT % (*)
Larger than 1/2 in. (12.5 mm) sieve	± 5
1/2 in. (12.5 mm) thru No. 4 (4.75 mm) sieves	± 4
No. 8 (2.36 mm) thru No. 100 (1.50 μm) sieves	± 3
No. 200 (75 μm) sieve	± 1.0
Binder Content	± 0.20

\* The permissible adjustment for all mixes shall establish a job mix formula having targets outside the restricted zone. Additionally, Superpave mixes shall be within control points.

When an adjustment is made to the mix design, a second verification shall be performed to ensure that the modified mix conforms to all design requirements. The time and tonnage limitations shall be as specified in (a) above. Material produced during this verification will be subject to a price adjustment if it does not conform to Specifications.

If the adjusted mix conforms to the PWSL, production may proceed. If the mix does not conform to these requirements, production for the mix shall be suspended and a new mix design shall be submitted to the Engineer for approval. The new mix shall be designed as specified in MSMT 412 or AASHTO PP28.

- (d) Subsequent designs submitted due to nonconformance will be subjected to the price adjustment during the required field verifications. If the mix does not conform to (b) above during the initial verification, production for the mix shall be suspended until corrective action is taken as approved by the Engineer.

**904.04.04 Antistripping Additives.** HMA shall have a minimum Tensile Strength Ratio (TSR) of 0.85 when tested in conformance with D 4867. The freeze-thaw conditioning cycle is required. HMA mixes not conforming to the minimum TSR requirement shall include an antistripping additive.

When an antistripping additive is needed, the exact quantity shall be determined by the producer in conformance with D 4867 based on a minimum TSR of 0.85.

When a heat stable antistripping additive is used, the minimum dosage rate shall be 0.20 percent of the total weight of asphalt. The additive shall be introduced at the plant by line blending, metering, or otherwise measuring to ensure accurate proportioning and thorough mixing.

When hydrated lime is used, it shall be added in slurry form at the rate of 1.0 to 1.5 percent by weight of total aggregate. The hydrated lime shall conform to C 1097. Lime slurry shall be sprayed uniformly on the damp, cold aggregate on the feed belt prior to entry into the HMA plant dryer.

Plant control and acceptance of the mix shall be based on MSMT 410 with respect to its stripping potential.

**904.04.05 Plant Control.** The following tolerances shall apply:

**TABLE 904 A – MIX TOLERANCES**

PHYSICAL PROPERTY	TOLERANCE (b)
Passing No. 4 (4.75 mm) sieve and larger, %	± 7
Passing No. 8 (2.36 mm) thru No. 100 (150 µm) sieve, %	± 4
Passing No. 200 (75 µm) sieve, %	± 2
Asphalt content, %	± 0.4
Ratio of dust to binder material	0.6 to 1.6 (a)
Mix temperature leaving plant versus mix design temperature, F	± 25
Deviation of maximum specific gravity per lot versus design maximum specific gravity	± 0.030
Voids, total mix, (VTM), %	4 ± 1.2
Voids, total mix, 4.75mm mix (VTM), %	3 ± 2
Voids in mineral aggregate, (VMA), %	± 1.2 from design target
Voids filled asphalt (VFA), %	Within spec
Bulk specific gravity, $G_{mb}$ , %	± 0.022
$G_{mb}$ at $N_{max}$ , %	+ 0.5

- (a) Not applicable to 4.75 mm.
- (b) For mixes other than Gap Graded HMA.

PWSL computations shall be performed for maximum specific gravity, voids in the total mix, voids in the mineral aggregate, and voids filled with asphalt. This computation shall be performed as specified in 504.04.02 using the moving average of the last three consecutive test values for each parameter. If the PWSL for the three test values fall below 85, corrective action shall be taken to bring the PWSL to at least 85. If the PWSL drops below 68, production shall be suspended until corrective action is taken as approved by the Engineer.

**904.05 GAP GRADED HOT MIX ASPHALT (GGHMA).**

**904.05.01 Aggregates.** Refer to 904.04.01.

**904.05.02 Mix Design.** Refer to 904.04.02 and the following table:

**MIX TOLERANCES**

PHYSICAL PROPERTIES	MIX DESIGN	PLANT CONTROL
VCA* Mix, %	Less than VCA <sub>drc</sub>	Less than VCA <sub>drc</sub>
VMA, %	18.0 min.	17.0 min.
VTM, %	4.0	± 1.2
N <sub>design</sub> Gyration	100	—
AC% by volume	6.5 min.	± 0.4
Draindown, % max	0.3	—
Stabilizer, by weight of total mix, %	0.2 – 0.4	± 0.1

\*VCA – voids in coarse aggregate.

**904.05.03 Mix Design Approval.** Refer to 904.04.03.

**904.05.04 Performance Graded Binder.** As specified in the Contract Documents, 904.02, and the following table:

TABLE BASED ON MINIMUM ASPHALT BINDER CONTENT OF 6.5 BY VOLUME		
Combined Aggregate Bulk Specific Gravity	Minimum Asphalt Content, %	Rounded Minimum Asphalt Content, %
2.40	7.38	7.4
2.45	7.24	7.2
2.50	7.11	7.1
2.55	6.98	7.0
2.60	6.85	6.8
2.65	6.73	6.7
2.70	6.61	6.6
2.75	6.50	6.5
2.80	6.39	6.4
2.85	6.29	6.3
2.90	6.19	6.2
2.95	6.09	6.1
3.00	5.99	6.0

Note: The above table shall be used to establish minimum asphalt binder content requirements based on the combined aggregate bulk specific gravity.

$$\text{Minimum Asphalt Content} = 16.13 / (0.1613 + 0.8434 G_{sb})$$

$G_{sb}$  = bulk specific gravity of combined aggregate

**904.05.05 Stabilizer.** GGHMA shall incorporate a stabilizer selected from a source previously approved by the Administration.

**904.05.06 Stabilizer Supply System.** A separate system for feeding shall be used to proportion the required amount into the mixture so that uniform distribution is obtained.

When a batch plant is used, the stabilizer shall be added to the aggregate in the weigh hopper and both dry and wet mixing times shall be increased. The stabilizer shall be uniformly distributed prior to the addition of asphalt cement into the mixture. The plant shall be interlocked so that asphalt can not be added until the stabilizer has been introduced into the mix.

When a drum plant is used, the stabilizer shall be added to the mixture in a manner that prevents the stabilizer from becoming entangled in the exhaust system.

The stabilizer supply system shall include low level and no-flow indicators, and a printout of the status of feed rate in lb/minute and shall have a 60 second plant shut down function for no-flow occurrences.

The stabilizer supply line shall include a section of transparent pipe for observing consistency of flow or feed.

All stabilizer addition systems shall be as approved by the Engineer.

**904.05.07 Antistripping Additives.** Refer to 904.04.04.