

**Hot-Mix Asphalt Mixture Design Verification Procedure
Appendix B.9**

Effective Date: January 1, 2002

Revised: February 28, 2019

1.1 GENERAL

Contractors shall provide all hot-mix asphalt (HMA) mix designs for use on Department contracts. All mix designs must provide mixture meeting Department mix criteria. The Department will provide current aggregate bulk specific gravity. The Engineer reserves the right to be present for the sampling of all aggregates for mix designs.

2.1 PURPOSE

Establish a verification procedure to evaluate Contractor mix designs for use on Department contracts. This procedure also allows for comparison of the test accuracy and precision between laboratories.

3.1 REQUIRED DESIGN DATA/MATERIAL SAMPLES

3.2 The Contractor shall provide a mix design prepared by a Hot-Mix Asphalt Level III Technician in accordance with the Department's "Hot-Mix Asphalt Design Procedure" in the current *Hot-Mix Asphalt Level III Technician Course* manual. All testing shall be performed by Hot-Mix Asphalt Level I Technicians or higher. The mix design shall be submitted with the following design data:

- A. The material name, material code number, source name, source Producer/Supplier Number, and source location shall be provided for all materials used in the mix design.
- B. The Contractor shall provide the average mix plant stockpile gradations and aggregate blend percentages used to design the mix. Each of the individual aggregate gradations used in the Contractor design shall be an average of a minimum of 5 (five) stockpile gradations from existing stockpiles at the plant. Adjusted average aggregate source gradations (stockpile gradations preferred) may be substituted if aggregate has not been shipped to the mix plant. The adjustment shall be based on the amount of aggregate degradation during shipment to, and handling at, the mix plant. A design using gradation information not comparing to mix plant or aggregate source gradations shall be considered unacceptable.

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C. The Contractor shall provide a summary of design test data and optimum design data utilizing a design package with the same output format as [the QC/QA Package](#).

- (1) Design sheet. The design shall contain a minimum of four design points, two of which shall bracket the optimum design asphalt binder (AB) content by at least $\pm 0.5\%$. Under remarks include: short-term aging time, dust correction factor, compaction temperature, and mixing temperature.
- (2) Design summary data sheet (in [the QC/QA Package](#) format).
- (3) Actual graph paper from the stability machine and actual G_{mm} lab worksheets (original copy unless otherwise specified).
- (4) Batching worksheet.
- (5) Dust correction worksheet (include an example packet, such as the one from the Level III manual).
- (6) Batching sources sheet.
- (7) Mix design graphs (full page).
 - (a) Gradation (45 power curve).
 - (b) Asphalt Binder Content vs. G_{mb}/G_{mm} .
 - (c) Asphalt Binder Content vs. VMA.
 - (d) Asphalt Binder Content vs. Air Voids.
 - (e) Asphalt Binder Content vs. Voids Filled with Asphalt (VFA).
- (8) Recalculations and/or retested points (e.g., recalculated G_{mm} 's using average G_{se}).
- (9) TSR worksheet.

The forms used shall be the Department's computer spreadsheet from [the QC/QA Package](#), or other forms having the same format as [the QC/QA Package](#).

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3.3 The Contractor shall provide samples of blended aggregate, asphalt binder, additives, and compacted gyratory bricks, at the optimum asphalt content according to Section 3.3.D as specified herein, which represent the materials in the mix design. The representative samples shall be identified and submitted as follows:

- A. Aggregate (including mineral filler/collected dust) -- Dried, split into the individual sizes specified for the Batching Worksheet as stated in the current *Hot-Mix Asphalt Level III Technician Course* manual, and then blended to the chosen gradation. The amount submitted shall be two (2) 10,000-gram samples of dry aggregate, with an additional 2,000 grams for gradation testing if requested by the District. All material shall be bagged in plastic bags or other airtight containers. Each container shall be identified with the source names, source locations, source Producer/Supplier Numbers, material codes, sample location, and sample date.
- B. Asphalt Binder -- A minimum of 4 qts (4,000 mL). Identified with source name, source location, source Producer/Supplier Number, material code, sample location, and sample date.
- C. Additive(s) -- The same additive(s) as used in the Contractor's design, identified by the additive source name, source location, brand name or number, material code, sample location, sample date, additive MSDS, the manufacturer's recommended dosage rate, and the rate used in the design if different than the manufacturer's recommended dosage rate. **NOTE:** Prior to submitting the additive(s), the Contractor shall contact the District Materials Engineer for the required sample size.
- D. **Compacted Gyratory Bricks** – The Contractor shall provide compacted 150 mm diameter gyratory bricks yielding test specimens with $7.0 \pm 1.0\%$ air voids. The number of gyratory bricks and the height of the gyratory bricks per test is specified in the following table.

	TSR	Hamburg Wheel	I-FIT	I-FIT Long-Term Aging
No. of Gyratory Bricks*	6	2/4	1/2	1/2
Height of Gyratory Bricks (mm)*	95	160/115	160/115	160/115
*If a Contractor does not possess the equipment to prepare the 160 mm tall bricks, twice the number of 115 mm tall bricks per test will be acceptable.				

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- 3.4 All design data and material samples shall be submitted to the Department a minimum of 30 calendar days prior to production.
- 3.5 The Contractor shall certify in writing that all materials submitted for mix design verification meet Department requirements and represent the materials to be used during mix production.

4.1 DEPARTMENT VERIFICATION

- 4.2 At the option of the Department, mix designs may be verified using Method A or Method B listed below. Mix designs adjusted per Section 5.3.A will be verified using Method A or Method B. Mix designs adjusted per Sections 5.3.B, 5.3.C, 5.3.D, or Section 5.4 will be verified using Method C.

Method A (Contractor Four Point Mix Design). Department verification for mix designs will include review of all mix design data (including all aggregate field gradations) submitted by the Contractor, mixing the component materials submitted by the Contractor, and verification testing of the asphalt mixture. The verification testing will include volumetric, TSR, Hamburg Wheel, and I-FIT. A mixture made from the individual materials will be tested for volumetric properties. The Contractor shall provide compacted gyratory bricks for TSR, Hamburg Wheel and I-FIT as per Section 3.3.D herein. The mixture at the optimum design asphalt binder content shall meet the mix design criteria for the following: VMA, VFA, G_{mb} , G_{mm} , Pa (voids), Tensile Strengths, TSR values, Hamburg Wheel, and I-FIT.

Method B (Contractor Four Point Mix Design). Department verification for mix designs will be based on 1) a review of all mix design data (including all aggregate field gradations) submitted by the Contractor and 2) Department verification testing for TSR, Hamburg Wheel, and I-FIT. The Contractor shall provide compacted gyratory bricks for TSR, Hamburg Wheel and I-FIT as per Section 3.3.D herein. The mixture at the optimum design asphalt binder content shall meet the mix design criteria for the following: VMA, VFA, G_{mb} , G_{mm} , Pa (voids), Tensile Strengths, TSR values, Hamburg Wheel, and I-FIT.

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Method C (Contractor One Point Mix Design). Department verification for mix designs will include review of all mix design data (including all aggregate field gradations) submitted by the Contractor, mixing the component materials submitted by the Contractor, and verification testing of the asphalt mixture. The verification testing will include volumetric, TSR, Hamburg Wheel, and I-FIT. A mixture made from the individual materials will be tested for volumetric properties. The Contractor shall provide compacted gyratory bricks for TSR, Hamburg Wheel and I-FIT as per Section 3.3.D herein. The mixture at the optimum design asphalt binder content shall meet the mix design criteria for the following: VMA, VFA, G_{mb} , G_{mm} , Pa (voids), Tensile Strengths, TSR values, Hamburg Wheel, and I-FIT.

- 4.3 The Contractor mix design data and Department verification testing shall meet the mix design criteria in the Standard Specifications, any Special Provision in the Contract, and the following tolerances (where applicable):

Volumetric Testing	Tolerance
G_{se} (effective SG of combined aggregates)	± 0.014
G_{mb}	± 0.020
G_{mm}	± 0.014
Air Voids	± 0.5 %

Gradation	Tolerance
12.5 mm (1/2 in)	± 3.0
4.75 mm (No. 4)	± 2.0
2.36 mm (No. 8)	± 2.0
600 µm (No. 30)	± 1.0
75 µm (No. 200)	± 0.5
Pb (Asphalt Binder Content)	± 0.15

All aggregate field gradations submitted by the Contractor will be compared to previous mix plant and/or Aggregate Gradation Control System gradations for validity.

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4.4 The Department will notify the Contractor in writing within 30 calendar days of receiving the design data/materials as to the acceptability of the submitted Contractor mix design. If the verification fails, the 30-calendar-day time for the Department to notify the Contractor starts over. Acceptable designs may be used in Department contracts, provided the design is reproducible in the mix plant.

5.1 MIX DESIGN APPROVAL STATUS

5.2 All mix designs verified as specified herein are approved indefinitely provided that the current contract documents have been met and the current aggregate bulk specific gravities have been adjusted per Section 5.3 herein.

5.3 The aggregate bulk specific gravities used in a mix design shall be updated annually when published by the Department and prior to the next construction season. The resulting combined aggregate bulk specific gravity will be used for volumetric calculations during production that year.

- A. If the combined aggregate bulk specific gravity of the mix changes by more than ± 0.020 from the original mix design, the mix design shall be resubmitted for verification as per Section 4.2 herein.
- B. If the aggregate producer changes ledges prior to the construction season, the Department will require Method C verification as per Section 4.2 herein.
- C. If the aggregate producer changes ledges during the construction season, the Department will require the Contractor to submit compacted gyratory bricks of plant-produced mix as per Section 3.3.D herein to verify Tensile Strengths, TSR values, Hamburg Wheel, and I-FIT criteria. The Department will require Method C verification as per Section 4.2 herein after the current construction season is completed.
- D. If the aggregate producer changes production practices (including, but not limited to changing crushers, stockpiling practices, or production rate), the Contractor may submit material for Method C verification as per Section 4.2 herein.
- E. The Contractor may at any time resubmit the mix design for verification as per Section 4.1 herein.

5.4 If a mix design adjustment is needed to meet current contract requirements and is outside of the adjustment limits stated in the Standard Specifications Art. 1030.06, the Department will require Method C verification as per Section 4.2 herein.