Illinois Department of Transportation

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

Effective Date: January 1, 2002
Revised Date: May 13, 2022

1.1 GENERAL

Contractors shall provide all hot-mix asphalt (HMA) mix designs for use on Department contracts. Mix designs must result in mixtures meeting Department criteria. The Department will provide current aggregate bulk specific gravities.

Note. The values stated in SI units are to be regarded as the standard. The English units are shown in parentheses and may not be exact equivalents.

2.1 PURPOSE

To establish a verification procedure to evaluate Contractor mix designs for use on Department contracts. This procedure also allows for comparison of 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, II, or III Technicians . An approved mix design that will be used as WMA through the use of foaming technology alone (without WMA additives) will not require a new submittal. Mix designs shall be submitted with the following design data:

A. 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 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 anticipated 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.

B. The Contractor shall provide the following information utilizing a design package with the same output format as the Department's Quality Management Program (QMP) Package software.

(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 QMP Package format).

(3) G_{mm} lab worksheets.

(4) Batching worksheet.

(5) Dust correction worksheet (example shown in the *Hot-Mix Asphalt Technician Course Level III* manual).

(6) Batching sources sheet.

(7) Mix design graphs (full page).

(a) Gradation (0.45 power curve).

(b) Asphalt Binder Content vs. G_{mb}/G_{mm}.

(c) Asphalt Binder Content vs. VMA.

(d) Asphalt Binder Content vs. Air Voids.

(8) Recalculations and/or retested points (e.g., recalculated G_{mm}'s using average G_{se}).

(9) TSR worksheet including the mixture unconditioned tensile strength, conditioned tensile strength, TSR and, if anti-strip additive is used, the conditioned tensile strength of the mixture without the anti-strip additive.

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3.3 The Contractor shall submit the following to the Department a minimum of 30 calendar days prior to production: samples of blended aggregate, asphalt binder, additives, and compacted gyratory cylinders, at the optimum asphalt content according to Section 3.3.D as specified herein, which represent the materials in the mix design. These representative samples shall be identified and submitted as follows:

A. Aggregate (including the mineral filler or 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 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 four individual one quart cans with friction lids. Each container shall be identified with source name, source location, source Producer/Supplier Number, material code, sample location, and sample date.

C. Additive(s) (including anti-strip, WMA and fibers) -- Each container shall be identified with the source name, source location, brand name or number, material code, sample location, sample date, Safety Data Sheet (SDS), the manufacturer's recommended dosage rate, and the dosage rate used in the design. NOTE: Prior to submitting the additive(s), the Contractor shall contact the District Materials Engineer for the required sample size.

D. Compacted Gyratory Cylinders – The Contractor shall provide compacted 150 mm (5.91 in.) diameter gyratory cylinders meeting the air void requirements of the respective tests shown in the following table. The number of gyratory cylinders and the height of the gyratory cylinders per test is also specified in the following table.

	TSR	**Hamburg Wheel**	**I-FIT**	**I-FIT Long-Term Aging**
IL Modified AASHTO Procedure	T 283	T 324	T 393	T 393
No. of Gyratory Cylinders*	6	2/4	1/2	1/2
Height of Gyratory Cylinders mm (in.)*	95 (3.74)	160/115 (6.30/4.53)	160/115 (6.30/4.53)	160/115 (6.30/4.53)
* If a Contractor does not possess the equipment to prepare 160 mm (6.30 in.) tall gyratory cylinders, twice the number of 115 mm (4.53 in.) tall gyratory cylinders per test will be acceptable.				

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 By submitting a mix design and the constituent materials for verification, the Contractor certifies that they 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, new mix designs will be verified using Method A or Method B listed below. Previously approved mix designs adjusted per Section 5.2.A will be verified using Method A or Method B. Mix designs adjusted per Sections 5.2.B, 5.2.C, 5.2.D, or Section 5.3 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; which includes volumetric (VMA, VFA, G_{mb}, G_{mm}, air voids), tensile strength, TSR, Hamburg Wheel, and I-FIT; shall meet the mix design criteria at the optimum asphalt content. A mixture made from the individual materials will be tested for volumetric properties. The Contractor shall provide compacted gyratory cylinders as per Section 3.3.D herein.

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 tensile strength, TSR, Hamburg Wheel, and I-FIT. The Contractor shall provide compacted gyratory cylinders 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}, air voids, tensile strength, TSR values, Hamburg Wheel, and I-FIT.

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; which includes volumetric (VMA, VFA, G_{mb}, G_{mm}, air voids), tensile strength, TSR, Hamburg Wheel, and I-FIT; shall meet the mix design criteria at the optimum asphalt content. A mixture made from the individual materials will be tested for volumetric properties. The Contractor shall provide compacted gyratory cylinders as per Section 3.3.D herein.

Verification Method	Department Tests/Calculations Performed on[1/]:									
	Mixture Prepared by the Department					Gyratory Cylinders Prepared by Contractor				
	VMA	VFA	G_{mb}	G_{mm}	Air Voids	Unconditioned Tensile strength	Conditioned Tensile strength	Tensile strength Ratio	Hamburg Wheel	I-FIT
A[2/]	X	X	X	X	X	X	X	X	X	X
B[2/]						X	X	X	X	X
C[3/]	X	X	X	X	X	X	X	X	X	X

1/ At the optimum asphalt binder content using materials provided by the Contractor.

2/ Contractor Four Point Mix Design.

3/ Contractor One Point Mix Design at Optimum Asphalt Content.

In all cases the Department will review test data, including aggregate field gradations, provided by the Contractor for compliance with the specifications. All mixtures shall meet specifications at the optimum asphalt content for approval.

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.

4.4 If a mix fails any of the Department's volumetric or verification tests, the Contractor shall make necessary changes to the mix and provide passing tensile strength, TSR, Hamburg Wheel, and I-FIT test results, as required, from a private lab before resubmittal. The Department will verify the passing results.

4.5 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 mixture volumetrics or verification tests fail, the 30-calendar-day time for the Department to notify the Contractor starts over.

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, no changes are made to mixture ingredients and the aggregate bulk specific gravities are updated annually using the current Department published values. The resulting combined aggregate bulk specific gravity shall be used for volumetric calculations during production that year. The following actions will occur to maintain verified mix designs due to changes at Aggregate Producers.

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.
B. If the aggregate producer changes ledges prior to the construction season, the Department will require Method C verification of a previously approved mix design as per Section 4.2.
C. If the aggregate producer changes ledges during the construction season, the Department will require the Contractor to submit compacted gyratory cylinders of plant-produced mix as per Section 3.3.D herein to verify tensile strength, TSR values, Hamburg Wheel, and I-FIT criteria. The Department will require Method C verification as per Section 4.2 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 shall submit material for Method C verification as per Section 4.2.
E. The Contractor may at any time resubmit a mix design for verification as per Section 4.1.

5.3 If a mix design adjustment is needed to meet current contract requirements and is outside of the adjustment limits stated in Article 1030.10, the Department will require Method C verification as per Section 4.2.

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