Standard procedure to verify that plant produced hot mix asphalt will meet mix design requirements.

Scope: Mix Verification consists of validating that the stock-pile materials at the production facility and the production process used by the contractor will produce the desired JMF and design volumetric properties of the hot mix asphalt (HMA) on the first full day of production. This verification is done using the actual plant facilities and the actual project materials.

1.2 *This practice may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2 Referenced Documents

2.1 AASHTO Standards

MP2 Standard Specification for Performance-Graded Binder
T312 Standard Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the SHRP Gyratory Compactor
PP28 Standard Practice for Designing SUPERPAVE**J** HMA
T166 Bulk Specific Gravity of Compacted Bituminous Mixtures (Method A)
T209 Maximum Specific Gravity of Bituminous Paving Mixtures
T308 Determination of Asphalt Binder Content and Gradation using the Ignition Furnace

3. Definitions:

LTMF - Laboratory Trial Mix Formula is defined as the single point target value for percent passing designated sieve sizes and volumetric properties established from trial produced in the design laboratory before the start of production.

JMF - Job Mix Formula is defined as the single point target value for percent passing designated sieve sizes and volumetric properties established from the mix verification process to be used by the contractor for production quality control.

4. Summary of method

4.1 Mix verification includes several steps to assure the plant produced mix will meet the Superpave design requirements. Prior to the beginning of production, aggregate stockpile samples shall be taken and a three point LTMF design check is preformed. This is to establish the design target values for the production mix. This is done using the same equipment that will be used for mix verification and quality control testing. This design check is done in accordance with AASHTO T 312 and PP 28. If the mix properties from the LTMF design check do not meet the requirements of MP 2, adjustments shall be

made to the gradation and, or binder content to bring the design into accordance.

4.2 The first day of production shall be used for the mix verification process. The first day of production shall be divided into 4 sub-lots. The sub-lots shall be 250 to 500 tons based on the days expected production. For each sub-lot, hot mix asphalt is randomly sampled in a large enough quantity to produce 3 gyratory specimens, 2 rice test specimens, and asphalt binder content and gradation. The mix sample will be approximately 25kg in mass. The Contractor shall perform a Percent within limits statistical analysis to verify that the plant-produced HMA is within the SUPERPAVE LTMF design check tolerances specified.

4.3 If deemed necessary, the Contractor shall adjust the HMA plant operations to bring all characteristics of the SUPERPAVE HMA mix into compliance with the LTMF established tolerances.

4.4 The Contractor shall employ test data obtained for the plant produced HMA in compliance with the LTMF to establish initial control charts for the HMA production process.

4.5 During Field Verification production of the HMA, the Contractor shall place and compact at least 500 Mg of HMA produced in compliance with the LTMF tolerances in order to establish compaction patterns and verify that the equipment and the processes planned for laydown and compaction are satisfactory.

4.6 The HMA shall be placed in a trial area (Control Strip) at the thickness required by the pavement cross-section design. The Contractor shall employ a nuclear density gauge or other approved method of test to establish a compaction pattern that meets the specification criteria for in-place density. The nuclear gauge shall be calibrated using cores from the Control Strip.

5. Procedure

5.1 Prior to the beginning of production, aggregate stockpile samples shall be taken in accordance with AASHTO T 2, for each stock-pile used to produce the LTMF. For each stock-pile to be used for HMA production, washed gradation and specific gravity is determined in accordance with AASHTO T 11, T 27, T 84, and T 85.

5.2 From the aggregate stock-pile samples a three point LTMF design check is preformed. This is to establish the design target values for the production mix. This is done using the same equipment that will be used for mix verification and quality control testing. This design check is done in accordance with AASHTO T 312 and PP 28. If the mix properties from the LTMF design check do not meet the requirements of MP 2, adjustments shall be made to the gradation and, or binder content to bring the design into accordance and a new LTMF established.

5.3 The first day of production shall be used for the mix verification process. The first day of production shall be divided into 4 sub-lots. The sub-lots shall be 250 to 500 tons based on the days expected production. For each sub-lot, hot mix asphalt will be randomly sampled in a large enough

quantity to produce 3 gyratory specimens for T 312, 2 rice test specimens for T 209, and asphalt binder content and gradation for T 308. The mix sample will be approximately 25kg in mass. The Contractor shall verify that the plant-produced HMA is within the HMA LTMF design check tolerances shown in Table 1.

5.4 Each sample shall be used to prepare a set of specimens to be tested for determination of the properties listed below. Subsequent to completion of the tests, the test values will be used to determine the arithmetic means and standard deviations of the properties for each stratified random sample and for the initial days production.

5.5 Field Verification Tests:

5.5.1 Determine the gradation of the cold-feed aggregate samples in accordance with AASHTO T 27 and T11

5.5.2 Determine the asphalt content and combined aggregate gradation of the HMA samples in accordance with AASHTO T 164 or T 308 and AASHTO T 30 respectively.

5.5.3 Determine the maximum specific gravity and maximum density of the HMA samples in accordance with AASHTO T 209.

5.5.4 Determine the bulk specific gravity of the HMA samples in accordance with AASHTO T 166, SSD Method, at N_{design} gyrations derived in accordance with T 312.

5.5.5 Determine the air void content (% V_a), of the HMA samples in accordance with PP 28 at N_{init} and N_{design} gyrations derived in accordance with T 312.

5.5.6 Determine the voids in the mineral aggregate (% VMA) and the voids filled with asphalt (% VFA) of the HMA samples in accordance with PP 28 at N_{design} gyrations derived in accordance with T 312.

5.6 The HMA sample shall be brought back to the field lab and split down into the proper size for each type of test specimen. The time for splitting of mix should be kept to a minimum to avoid excessive loss of heat from the sample.

5.7 HMA for gyratory specimens should be placed into molds preheated to the mix compaction temperature. Once the mix is placed in the mold it shall be immediately place into a forced draft oven set at the mix compaction temperature. Once the mix has reached the compaction temperature, it shall be taken from the oven, placed into the gyratory compacter and compacted to the design number of gyrations as specified in AASHTO T 312. The mix should not be left in the oven for more than two hours during the reheating process. Excessive time in the oven may cause additional aging of the binder. After compaction, the samples should be extracted from mold, allowed to cool to room temperature, and the bulk specific gravity of the sample determined according to AASHTO T 166.

5.8 HMA for the determination of Maximum Specific Gravity, (rice test), AASHTO T 209 shall be split down to the proper test sample size for the aggregate size being used. The Rice test is run on the same mix as sampled for gyratory compacted specimens, the binder content, and gradation. Additionally a 1000g sample is used to determine the moisture content of the mix by drying to a constant weight in 110°C oven. Constant weigh is defined as a mass loss of less than 0.1g in 15 minutes.

Note 1: For some aggregates, typically those with water absorption greater than 2%, laboratory aging is require for field rice tests. The aging should simulate the time it takes to transport the mix from the plant to the paver. This aging should be done in a gyratory mold to simulate storage in a truck. Aging of the loose mix in a pan may excessively age the mix.

5.9 HMA for determination of asphalt binder content and gradation shall be quartered down to the proper test sample size for the aggregate size being tested and placed in the ignition furnace according to AASTHO T 308. When using the ignition furnace, the sample should be weighed before and after placement in the oven. After the binder content is determined, the remaining aggregate is used to determine the washed gradation of the mix sample according to AASHTO T30.

5.10 The Va, VMA, VF, Pb, F/A ratio, and gradation are determined for each hot mix sample following AASHTO T 312 and PP 28. These results are compared against the LTMF field check and mix design requirements.

Note 2: During volumetric calculations the aggregate effective specific gravity (Gse) should be calculated. The Gse is compared to the Gsb and the Gsa. As long as the Gse is in between the bulk and apparent gravities of the mix aggregate the bulk gravity used for calculations should be ok. If the Gse falls outside the aggregate bulk and apparent gravities the aggregate gravities should be retested.

Note 3: For field verification as long as Pb and P200 are within specification, the F/A ratio is not used for control of the mix.

Table 1 - SUPERPAVE LTMF Tolerances for HMA Plant Trial Mix

Mix Composition Property	Tolerance Limit
Asphalt Binder Content (P_b)	± 0.40
Gradation Passing 4.75mm and Larger Sieves	± 4
Gradation Passing 2.36mm to 150? m Sieve	±4
Gradation Passing 75? m Sieve	± 2

Mix Composition Property	Tolerance Limit
Air Voids (V_a)	± 1.5
Voids in Mineral Aggregate (VMA)	± 1

6. Data Analysis

6.1 The test results from section 5 shall be statistically evaluated using percent within limits based on the tolerances in table 1, and the targets established in the LTMF field check. Based on the results from the PWL for gradation, P 0.075mm, Va, VMA, and Pb, one of the following actions can be taken:

1. "GO AS IS"
   no changes to mix or documentation.

2. "GO WITH CHANGES"
   minor LTMF adjustments or administrative changes to adjust production targets.

3. "REDESIGN"
   Non compliance with the LTMF requiring new mix design

4. "RECALIBRATE PLANT"
   Binder content and gradation are outside of acceptable limits and the plant requires recalibration to bring it within limits.

6.2 "GO AS IS" means the mix as produced by the plant met approved targets for the LTMF and void properties with a Percent Within Limits greater than 85%. Production should start with JMF targets based on the average results from the verification tests for gradation and void properties

6.3 "GO WITH CHANGES" indicates the mix as produced by the plant varies to a certain degree from the LTMF for gradation and void properties targets, less than 85% within limits for void properties. Typically there are two different cases that initiate the "GO WITH CHANGES" recommendation.

6.3.1 In one case the test results may indicate the plant produced mix matched the LTMF targets for gradation, but not for void targets. However, the mix did meet the Superpave design void requirements. In this case the change would be to establish new void property targets using the average results from the mix verification.

6.3.2 In the second case, the test results indicate one or more of the void properties were outside MP2 mix design void requirements. However, the test results also indicate a minor adjustment to the gradation and or asphalt content could bring these properties back into design requirements. When this

type adjustment is made to the mix, a second mix verification is required to assure that the modified mix will meet all design requirements.

6.4 "REDESIGN" indicates the void properties of the mix as produced by the plant are dramatically outside the Superpave design requirements. When this happens a complete redesign of the mix is required. Production should be stopped until a new mix design is completed and verified.

6.5 "RECALIBRATE PLANT" indicates the production gradation and or binder content are outside acceptable tolerance limits, (less than 70 % within limits) and therefore requires the plant to be recalibrated to bring it within tolerance. The mix verification is performed again after the plant is within calibration.

6.6 The Contractor shall employ test data obtained for the HMA produced in compliance with the LTMF to establish initial control charts for the HMA production process. These charts shall be used to determine if variability has occurred which is due to assignable causes which must be remedied. Control charts shall be refined with test results obtained during the first week of routine HMA mix production in accordance with the SUPERPAVE mix design.

7. Establishment of Compaction Rolling Pattern (Control Strip)

7.1 During Field Verification production of the SUPERPAVE HMA mix, the Contractor shall place and compact at least 500 Mg of HMA produced in compliance with the LTMF tolerances in order to establish compaction patterns and verify that the equipment and the processes planned for laydown and compaction are satisfactory.

7.2 The HMA shall be placed in a trial area (Control Strip) at the thickness required by the pavement cross-section design. The Contractor shall employ a nuclear density gauge or other approved method of test to establish a compaction pattern that meets the specification criteria for in-place density. The nuclear gauge shall be calibrated using cores from the Control Strip.

8. Reporting

8.1 HMA verification shall be reported on the form shown in table 2.

8.2 Individual test reports will be recorded as specified in the individual test procedures.

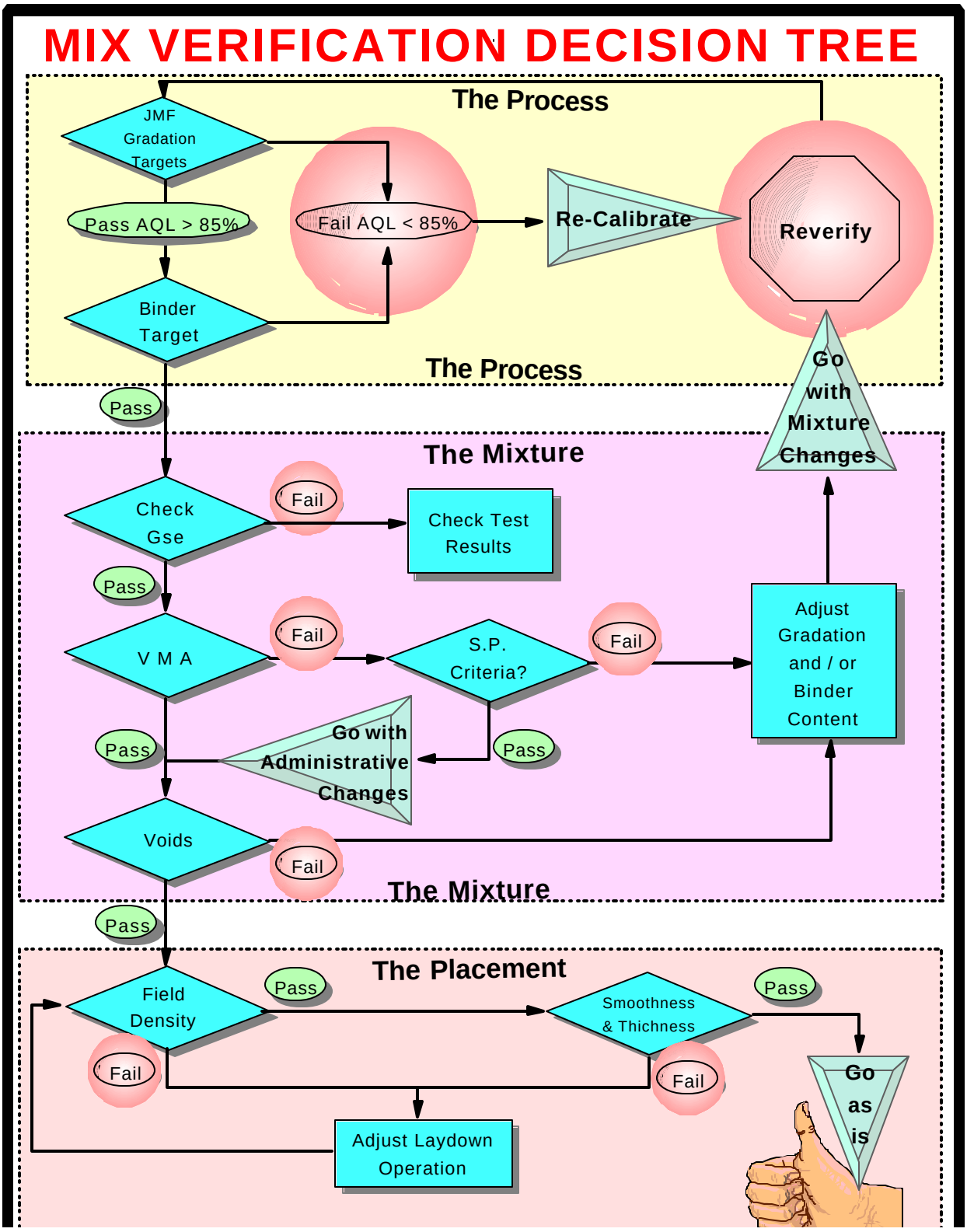
MIX VERIFICATION DECISION TREE
The Process
JMF Gradation Targets
Pass AQL > 85%
Binder Target
Fail AQL < 85%
Re-Calibrate
Reverify
The Process
Go with Mixture Changes
Pass
The Mixture
Check Gse
Fail
Check Test Results
Pass
V M A
Fail
S.P. Criteria?
Fail
Adjust Gradation and / or Binder Content
Pass
Go with Administrative Changes
Pass
Voids
Fail
The Mixture
Pass
The Placement
Field Density
Pass
Smoothness & Thichness
Pass
Fail
Fail
Go as is
Adjust Laydown Operation

Table 2. Mix verification Report Form

Design Parameter	Superpave Criteria	LTMF	Avg. Mix Verification
Binder Sp. Gr. (PGXX-YY)			
Stockpile Percentages 1. 2.	 n/a n/a		
Blend Agg. Gravities Bulk, G_{sb} Apparent, G_{sa} % Absorption, H_2O	 n/a n/a n/a		
Consensus Properties Coarse Agg Angularity Fine Agg Angularity Flat & Elongated Sand Equivalent	 --- / --- min --- % min --- % max --- % min		
Optimum Asphalt, P_b	n/a	%	%
Mix Properties Air Voids, V_a VMA at N_{des} VFA at N_{des} $\%G_{mm}$ at N_{ini} = -- $\%G_{mm}$ at N_{des} = -- $\%G_{mm}$ at N_{max} = -- Fines : P_{be} Rice, G_{mm} Effective, G_{se}	 4.0 % --- % --/-- % -- % max 96 % 98 % max --- to --- n/a n/a		
Moisture Sensitivity	80% min	----	
Mixing Temperature Range * Compaction Temp. Range *	150 - 190 cSt 250 - 310 cSt	℃ ℃	℃ ℃

* Or temperature ranges recommended by the supplier.