Colorado Procedure – Laboratory 5117-15

Standard Method of Test for

Superpave Design for Hot Mix Asphalt

1. SCOPE

This procedure is used to determine or verify the optimum binder content of an asphalt paving mix.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

T 11 Materials Finer than the No. 200 Sieve in Mineral Aggregates by Washing

T 27 Sieve Analysis of Fine and Coarse Aggregates

T 40 Sampling Bituminous Materials

T 90 Determining the Plastic Limit and Plasticity Index of Soils

T 96 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

T 218 Sampling Hydrated Lime

T 304 Uncompacted Void Content of Fine Aggregate

2.2 Colorado Procedures:

CP 30 Sampling of Aggregates

CP 31 Sieve Analysis of Aggregates

CP 37 Plastic Fines in Graded Aggregates and Soils by Sand Equivalent Test

CP 44 Bulk Specific Gravity and Percent Relative Compaction of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

CP 45 Determining Percent of Particles with Two or More Fractured Faces

CP 51 Determining the Maximum Specific Gravity of HMA

CP 52 Contractor Mix Design Approval Procedures

CP-L 4211 Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

CP-L 5106 Resistance to Deformation of Bituminous Mixtures by Means of Hveem Apparatus

CP-L 5109 Resistance of Compacted Bituminous Mixture to Moisture Induced Damage

CP-L 5115 Preparing and Determining the Density of Bituminous Mixture Test Specimens Compacted by the Superpave Gyratory Compactor

3. SIGNIFICANCE AND USE

3.1 This procedure may be used to select and evaluate materials for Superpave mix designs.

4. SUMMARY OF METHOD

4.1 Aggregate samples are blended in the proportions recommended by the Contractor. Specimens are set up and mixed with the binder to be used on the project and various criteria, such as voids, are determined and examined. If the criteria are met, the optimum binder content is either chosen or verified and other properties of the mix are examined for compliance with specifications.

5. APPARATUS

5.1 Ovens capable of maintaining the following temperatures:

Temperature	Tolerance
60° C	3° C
110° C	5° C
163° C	2.8° C

6. SAMPLING

6.1 Sample aggregates in accordance with CP 30.

6.2 Binder samples will be taken in accordance with AASHTO T 40.

6.3 Hydrated lime samples will be taken in accordance with AASHTO T 218.

7. AGGREGATE TESTING

7.1 Aggregates shall be tested for the following:

7.1.1 Gradations per CP 31.

7.1.2 Sand Equivalence using CP 37.

7.1.3 Plastic Index using AASHTO T 90.

7.1.4 LA Abrasion using AASHTO T 96.

7.1.5 Micro-Deval Abrasion using CP-L 4211.

7.1.6 Fractured Faces using CP 45.

7.1.7 Fine Aggregate Angularity using AASHTO T 304.

7.2 If only one blend is to be run, portions of each source may be combined as per the Contractor's recipe before separating the rock fractions from the -#8. The rock fractions shall be separated on the #8, #4, 3/8", ½", ¾", 1" and 1½" screens.

7.3 Theoretical Rejection of Baghouse Fines:
If the mix design is for a job that will have theoretical rejection of baghouse fines, the aggregates shall be separated on the 1 ½", 1", ¾", ½", 3/8", #4, #8, #16, #30, #50, #100, and #200 screens.

8. SAMPLE PREPARATION

8.1 Using the gradations obtained in Section 7 and the proportions from the Contractor's proposed Mix Design, calculate the weight of each portion needed for two specimens for Maximum Specific Gravity, four Bituminous Mixture Test Specimens for Voids, six Lottman specimens and, if desired, three Ignition Furnace Correction Factors.

8.1.1 If the mix design is for a job that will have Theoretical Rejection of Baghouse Fines, the aggregates are put together from the Contractor's proposed Mix Design, including the calculated effect of the material that will be rejected by the Contractor's equipment.

8.1.2 The presence of adherent fines may produce a gradation that is finer than is intended. Therefore, the gradation is washed to determine how closely the sample matches the Contractor's target.

8.1.3 Through trial and error, the batch weights for individual sieves sizes are modified and washed to achieve conformance to the target gradation according to the following recommendation: % passing #200 ± 0.5%, and all other sieves ± 1%.

8.2 Using weights from Subsection 8.1 or 8.1.3, set up specimens as mentioned there. It may be desirable to set up the Maximum Specific Gravity specimens first and run CP 51 before setting up the voids specimens. This way, the maximum specific gravity can be multiplied by the multiplier from Table 1 for 100 mm specimens (or multiplied by 1670 for 150 mm) to obtain specimen weights that will compact to the proper height. Likewise, the voids specimens can be compacted before setting up the Lottman specimens. The heights and specific gravities of the voids specimens can be used to calculate the desired Lottman heights. It is important that the -#8 fragments do not become segregated during this process.

8.3 Heat the Maximum Specific Gravity specimens and the desired binder to the appropriate mixing temperature as per CP-L 5115. The binder must not be overheated to where its properties are damaged.

8.4 Weigh the preheated, buttered mixing bowl. Place the specimen in the mixing bowl, being careful to clean all the fines from the sample pan into the mixing bowl. Determine the specimen weight and calculate the weight of binder needed [specimen weight * percent binder / (100-percent binder)]. Add the calculated amount of binder and mix the aggregate with the binder thoroughly, until there are no thin spots on the aggregate. After mixing is complete, place the mixture in a pan for aging. Be sure to scrape the mixing bowl until it reaches the original weight and be sure to clean all of the mix and binder from the mixing paddle and utensils into the pan.

8.5 Repeat Subsection 8.4 for the other maximum specific gravity specimens and age them for 2 – 3 hours per CP-L 5115.

8.6 After removing the maximum specific gravity specimens from the oven, spread them out and allow them to cool to room temperature. Determine the Maximum Specific Gravity per CP 51.

8.7 Multiply the average maximum specific gravity by the multiplier from Table 1 for 100 mm specimens (use a multiplier of1670 for 150 mm) to obtain the total mix weight for the voids specimens.

Table 1

Number of Gyrations	Multiplier
50	470
75	474
100	478
125	482
SMA	470

8.8 Set up, mix, and age voids specimens at the anticipated optimum binder content, at optimum plus 0.5 percent binder, at optimum minus 0.5 percent binder and optimum minus 1.0 percent binder as per Subsections 8.4 and 8.5.

8.9 Compact the voids specimens to the desired number of gyrations according to CP-L 5115.

8.10 After the voids specimens have cooled to room temperature; determine the bulk specific gravities of them per CP 44. Place the voids specimens in the 60℃ oven and determine the stabilities per CP-L 5106. After determining the percent voids, the VMA, the VFA, and the stabilities, create graphs or otherwise plot the data versus binder content. Determine the binder content where the voids are at 4% (unless some other value is desired). Inspect the other criteria to see if the mix passes everything at the optimum binder content. If it does, proceed with running the Lottman test as per CP-L 5109.

9. REPORT

9.1 Report test results on CDOT Form #429 per CP 52.

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