

Colorado Procedure 52-13

Standard Practice for

Contractor Asphalt Mix Design Approval Procedures

1. SCOPE

1.1 This practice describes the procedures for asphalt mix design approval, the time required to perform the required tests, and the cost of the testing.

2. REFERENCED DOCUMENTS

- 2.1 *AASHTO Standards:*
- T 84 Specific Gravity & Absorption of Fine Aggregate
 - T 85 Specific Gravity & Absorption of Coarse Aggregate
 - T 90 Determining the Plastic Limit & Plasticity Index of Soils
 - T 96 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- 2.2 *Colorado Procedures:*
- CP 10 Qualification of Testing Personnel and Laboratories
 - CP 30 Sampling of Aggregates
 - CP 51 Determining the Maximum Specific Gravity of HMA
- 2.3 *Colorado Procedures – Laboratories:*
- 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 & Determining the Density of Bituminous Mixture Test Specimens Compacted by the Superpave Gyrotory Compactor
 - CP-L 5145 Contractor Asphalt Mix Design Approval Procedures Utilizing RAP Millings from the Same Project

3. APPROVAL OF MIX DESIGNS

3.1 Asphalt mix designs shall be performed in conformance with CP-L 5115, CP-L 5106, and CP-L 5109 as well as other specified Colorado, AASHTO, and ASTM procedures. Mix designs for S and SX mixes will be done using 4-inch molds. Mix designs for SG mixes will be done using 6-inch molds. A complete mix design will be required for all mixtures placed on the project.

3.2 The Contractor must submit to the Engineer three copies of the asphalt mix design on CDOT Form #429, which contains all the information detailed in Subsection 4.2, and the aggregate samples, a minimum of 4 weeks prior to the anticipated paving start date. All asphalt mix designs shall be stamped by a registered Professional Engineer in the State of Colorado pursuant to Section 12-25-117 of the Colorado Revised Statutes. Mix designs shall have an original manual ink signature. Copied or faxed mix designs will not be accepted. As a minimum, the cover letter describing the asphalt mix design shall be stamped by a registered Professional Engineer in the State of Colorado. If the supporting documentation listed in Subsection 4.2 is not covered by the Engineer of Record, each supporting page shall be stamped by a registered Professional Engineer in the State of Colorado. The Region Materials Engineer (RME) must approve the Contractor's proposed asphalt mix design before paving may proceed. The Engineer may reject a mix design that appears to have errors. The Contractor shall use the latest version of the CDOT Form # 429 which may be obtained through the RME or through the Flexible Pavement Unit of the Central Laboratory. Additionally, each mix design submitted for approval must be accompanied by a Microsoft® Excel® electronic version of the CDOT Form #429 specific to each mix.

3.2.1 To verify the asphalt mix design, the aggregates to be used shall be sampled in accordance with CP 30, in the presence of the Engineer, and will be tested by the Concrete/Physical Properties Unit of the CDOT

Central Laboratory. The aggregates shall be tested for: Aggregate Specific Gravity and Absorption, (AASHTO T 84 & T 85) and Plastic Index (AASHTO T 90). The Engineer will coordinate with the Region Materials Engineer to determine the need to run the Micro-Deval (CP-L 4211) and/or the Los Angeles Abrasion (AASHTO T 96).

NOTE 1: If the combined aggregate specific gravity of the contractor's asphalt mix design is not within 0.020 of the results from the CDOT Central Laboratory testing for the combined aggregates, the Contractor and CDOT Central Laboratory shall both recheck calculations, retest, and/or resample/retest as needed until the resulting mix combined aggregate specific gravities agree to within 0.020. The contractor's aggregate specific gravity values will then be used to calculate the HMA mixture volumetric properties. After the Contractor develops the mix design he may use the aggregate test results from the CDOT Central Laboratory as listed in Subsection 3.2.1 for mix development.

3.3 The asphalt mix design cannot be approved when the laboratory trial, binder data, or aggregate data possess results are from tests performed more than one year in the past.

3.4 If all tests conform to the specifications, a CDOT Form #43 (Job Mix Formula) will be executed.

3.5 All mix design properties must satisfy Table 403-1 from the Project Special Provisions. The CDOT Form #43 will establish construction targets for Asphalt Content and all mix properties at Air Voids up to 1.0% below the mix design optimum.

3.6 After an asphalt mix design is approved for use, binder changes shall be handled as follows:

3.6.1 If the Supplier remains the same, but the binder used changes, such that future binder supply to a project will come from a different refinery, different terminal, or be a different formulation that could potentially affect mix properties, a one point check at the Form #43 target AC content shall be done by the Contractor to verify that asphalt mix design properties are still valid. The one point check verification shall be reviewed and stamped by a registered Professional Engineer in the State of Colorado and shall be submitted to the Engineer. Production

shall not commence until one point verification is completed and is approved by the RME. A new mix design shall be required if the one point check is not accepted by the RME. If the supplier is changing terminal location and both locations utilize the same formulation, the one point check may be waived with concurrence from the RME.

3.6.2 If the Supplier or grade changes, a new asphalt mix design shall be submitted for approval.

4. MIX DESIGN REQUIREMENTS

4.1 Labs and personnel providing asphalt mix designs shall comply with the requirements listed in CP 10.

4.2 It is recommended that a complete mix design consisting of test results from three trial blends (in accordance with Superpave Mix Design SP-2) be conducted when the materials sources used in the mix design have not been verified on past CDOT projects. A complete mix design must contain all of the following:

(1) For each aggregate stockpile:

- A. Aggregate source
- B. Target gradation along with gradation results from at least the 10 most current samples. These samples shall have been sampled and tested within two months of submitting the mix design.
- C. Coarse Aggregate Bulk specific gravity and fine aggregate bulk specific gravity if applicable.
- D. Atterberg limits.
- E. Los Angeles Abrasion.
- F. Statistical data for the Apparent Specific Gravity and Bulk Specific Gravity.

(2) Reclaimed asphalt pavement (RAP) if used shall include the source and following statistical data from at least 10 samples tested within two months of mix design submittal:

- A. Percent RAP Binder Content - AASHTO T-164, Method A or B, or CP-L 5120 if correction established per Revision of 401 – Reclaimed Asphalt Pavement.
- B. RAP Aggregate Gradation – CP 31.
- C. Effective Specific Gravity (in lieu of the RAP aggregate specific gravity).

- D. Uniformity Calculations for the Processed RAP, to include Binder Content and Aggregate Gradation.
- (3) Reclaimed asphalt shingles (RAS) if used, shall include the source and following statistical data from at least 10 samples tested within two months of mix design submittal:
- A. Percent Asphalt – AASHTO T-164, Method A or B, or CP-L 5120 if correction established per Revision of 401 – Reclaimed Asphalt Shingles.
 - B. RAS Aggregate Gradation – AASHTO PP 53.
 - C. Effective Specific Gravity (in lieu of the RAS aggregate specific gravity – AASHTO PP 53).
 - D. Uniformity Calculations for the RAS to include gradation (on the processed RAS material), Asphalt Binder Content, and Percent Passing #200 Sieve (on the extracted RAS aggregate).
 - E. A copy of the RAS QC Plan from the contractor or RAS supplier per Section 401.
- (4) Combined Aggregate Properties:
- A. Percentage of each aggregate used,
 - B. Combined Aggregate Gradation and Virgin Aggregate Gradation.
 - C. Sand Equivalent.
 - D. Fine Aggregate Bulk Specific Gravity and Coarse Aggregate Bulk Specific Gravity on the virgin portion of the mix aggregates.
 - E. Fine Aggregate Angularity.
 - F. Combined Aggregate, Apparent and Bulk Specific Gravity.
 - G. Fractured Faces.
 - H. Micro-Deval according to CP-L 4211.
 - I. Effective Specific Gravity.
- (5) Source and grade of asphalt cement from a CDOT Certified Binder Supplier. Use the actual specific gravity of the asphalt cement in calculations.
- (6) Name and percentage of each additive.
- (7) For each asphalt content tested:
- A. Voids in Mineral Aggregate (VMA) @ N_{des} .
 - B. Dust to Asphalt ratio.
 - C. Percent Voids Filled with Asphalt (VFA) @ N_{des} .
 - D. Hveem Stability (@ N_{des}) for Grading S and Grading SX mixes only.
 - E. Maximum Theoretical Specific Gravity,
 - F. Bulk specific gravity @ N_{des} .
 - G. Air voids, Voids in Total Mix (VTM) @ N_{des} .
- (8) Graphs of stability, Air Voids, VMA, VFA and virgin effective AC content (for RAP/RAS mixtures) vs. total Asphalt content.
- (9) Lottman and wet/dry tensile strength at optimum asphalt content.
- (10) A 0.45 power plot of the proposed combined aggregate gradation, with maximum density line and control points included.
- (11) For SMA, submit the following additional aggregate information:
- A. Bulk Specific Gravity of the coarse-aggregate fraction.
 - B. Unit weight of the coarse aggregate fraction in the dry-rodded condition.
 - C. Draindown test results (at production temperature).
 - D. Mineral filler gradation (for limestone dust); or, plasticity index, hydrometer analysis, gradation, calcium oxide content, and modified Rigden Voids (if alternate mineral fillers are used).
- (12) For Warm Mix Asphalt, submit the following additional information.
- A. Contractor WMA Design Considerations:
 - i. A brief summary of mix design practices with WMA technology if different from HMA procedures.
 - ii. WMA deviations from CDOT design and acceptance criteria. All mix will be tested for acceptance in accordance with existing HMA procedures. Significant deviation from these criteria will require an experimental feature in accordance with PD 1401.1.
 - B. WMA Production Considerations:
 - i. Summary of equipment and plant requirements to control WMA production.
 - ii. For WMA mixtures provide data

illustrating differences between mix design properties and the anticipated WMA production properties. WMA volumetric targets may be adjusted as approved by the RME. See CP-59 for details on the required data to be submitted.

- iii. If the WMA produced on the project fails mixture verification, goes in to condition red, or if the asphalt plant fails to satisfy the WMA production controls outlined in the submittal for WMA approval, WMA production shall cease, written explanation shall be provided for the failures, and production may be required to revert to conventional HMA. WMA mix design submittals shall include a summary of contractor production plans should this occur during production.

C. WMA Contacts:

- i. WMA product manufacturer representative name, email, and phone number.
- ii. Name, email, and phone number of WMA product manufacturer representative who will be available during construction.

5. CONTRACTOR CHECKS

5.1 If a contractor wishes to check a test result with CDOT, they should make arrangements with the Flexible Pavement Unit or Physical Properties Unit of the CDOT Staff Materials Laboratory, depending upon the properties (mix or aggregate) that are to be tested. The Unit will work one-on-one with the contractor, as time permits, to improve inter-lab agreement. The testing will not be a part of the mix design process.

6. COST OF MIX AGGREGATE TESTING

6.1 CDOT Staff Materials Laboratory will conduct one complete set of mix aggregate tests at no cost to the Contractor upon receipt of a completed asphalt mix design submittal from the Contractor. (See Subsection 3.2.1) The Contractor must pay \$500 per aggregate for each subsequent set of mix aggregate tests performed by the CDOT Central Laboratory. The Project Engineer will document the additional tests

performed and the appropriate charges will be passed through to the Contractor.

7. TIME REQUIRED FOR AGGREGATE TESTS

7.1 Reference the Laboratory Test Time table located in the Appendix of the Field Materials Manual.

8. RECORD

8.1 CDOT Form # 429 is used. It is available electronically from the Central Lab at 303-398-6576 or from the Region Materials Engineers. See Chapter 400 for an example and instructions on the use of this form.

8.2 All requests for mix design information shall be made under the Colorado Open Records Act and shall follow CDOT Procedural Directives 25.2, 51.2, and 51.3.