

## Colorado Procedure 52-05

*Standard Practice for*

### Contractor Mix Design Approval Procedures

#### 1. SCOPE

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

#### 2. APPROVAL OF MIX DESIGNS

2.1 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. One-point mix design verification will not be accepted.

2.2 The Contractor must submit to the Engineer three copies of the mix design on CDOT Form #429, which contains all the information detailed in Section 3.2, and the aggregate samples, a minimum of 4 weeks prior to the anticipated paving start date. Pursuant to Section 12-25-102(10) of the Colorado Revised Statutes all mix designs shall be sealed by a registered Professional Engineer in the State of Colorado. The Engineer must approve the Contractor's proposed mix design before paving may proceed. (In Region 6, the Contractor must submit the mix design to the Region Materials Engineer for approval.) Form # 429 may be obtained through the RME or through the Flexible Pavement Unit of the Central Lab.

2.2.1 To verify the mix design, the aggregates to be used shall be sampled in accordance with CP 30, in the presence of the Engineer. The Engineer will immediately take possession of the sample and transport it to the Concrete/Physical Properties Unit of the CDOT Central Laboratory for testing. The aggregates shall be tested for: Aggregate Specific Gravity and Absorption, (AASHTO T 84 & T 85), Aggregate Gradation (CP 31A and CP 31B), Plastic Index (AASHTO T 90), **and if requested by the Region Materials Engineer,**

**the Micro Deval (CP-L 4211) and/or the Los Angeles Abrasion (AASHTO T 96).**

**NOTE:** If the aggregate specific gravity of the contractor's mix design is not within 0.020 of the results from the CDOT Central Laboratory testing **for the ~~for both individual and combined aggregates~~**, the Contractor and CDOT Central Laboratory shall both recheck calculations, retest, and/or resample as needed until the resulting mix 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 Section 2.2.1 for mix development.

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

2.4 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 1.0% below the mix design optimum.

2.5 The Form # 43 shall be verified according to Section 106, (see Section 105 & 106 (Quality of Hot Mix Asphalt) in the Project Standard Special Provisions, part 8(d) Mix Verification testing.)

#### 3. MIX DESIGN REQUIREMENTS

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

3.2 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 sources,
  - B. Gradation,
  - C. Atterberg limits,
  - D. Apparent Specific Gravity, Bulk Specific Gravity,
  - E. Los Angeles Abrasion,
  - ~~E. Micro-Deval according to CP-L 4214~~
  - ~~F.E.~~ Recycled asphalt pavement (RAP)
    - (1) Percent asphalt
    - (2) Aggregate Gradation
    - (3) Effective Specific Gravity (in lieu of the RAP aggregate specific gravity).
- (2) Combined Aggregate Properties:
  - A. Percentage of each aggregate used,
  - B. Combined Aggregate Gradation (See #8 below), both before and after RAP use,
  - C. Sand Equivalent,
  - D. Fine Aggregate Bulk Specific Gravity, Coarse Aggregate Bulk Specific Gravity,
  - F. Fine Aggregate Angularity,
  - G. Combined Aggregate Bulk Specific Gravity,
  - H. Fractured Faces,
  - ~~I. Los Angeles Abrasion,~~
  - J. Micro-Deval according to CP-L 4211,
  - K. Effective Specific Gravity.
- (3) Source and grade of asphalt cement from a CDOT Certified Binder Supplier. Use the actual specific gravity of the asphalt cement in calculations.
- (4) Name and percentage of each additive.
- (5) For each asphalt content tested:
  - A. Voids in Mineral Aggregate (VMA) @  $N_{ini}$ , and  $N_{des}$ ,
  - B. Dust to Asphalt ratio,
  - C. Percent Voids Filled with Asphalt (VFA) @  $N_{des}$ ,
  - D. Hveem Stability (@ $N_{des}$ ),
  - E. Maximum Theoretical Specific Gravity,
  - F. Bulk specific gravity @  $N_{ini}$ , and  $N_{des}$ ,
  - G. Air voids, Voids in Total Mix (VTM) @  $N_{ini}$ , and  $N_{des}$ .

(6) Graphs of stability and air voids vs. asphalt content and VMA-VFA, Voids Filled with Asphalt, vs. Asphalt content.

(7) Lottman and wet/dry tensile strength at optimum asphalt content.

(8) A 0.45 power plot of the proposed combined aggregate gradation, with maximum density line, restricted zone and control points included.

#### 4. CONTRACTOR CHECKS

4.1 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.

#### 5. COST OF MIX AGGREGATE TESTING

5.1 CDOT Staff Materials Laboratory will conduct one complete set of mix aggregate tests at no cost to the Contractor upon receipt of a completed mix design submittal from the Contractor. (See Section 2.2.1) The Contractor must pay \$500 per aggregate for each subsequent set of mix aggregate tests performed by the CDOT Staff Materials Laboratory. The Project Engineer will document the additional tests performed and the appropriate charges will be passed through to the Contractor.

#### 6. TIME REQUIRED FOR AGGREGATE TESTS

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

#### 7. RECORD

7.1 CDOT Form # 429 is used. It is available electronically from the Central Lab at 303-757-9724 or from the Region Materials Engineers. See Chapter 400 for an example and instructions on the use of this form.