Colorado Procedure – Laboratory 5120-20

Standard Method of Test for

Determination of the Asphalt Binder Content of Bituminous Mixtures by the Ignition Method

1. SCOPE

1.1 This method of test determines the asphalt binder content of bituminous mixtures by heating the mixture until the asphalt binder fraction of the mix ignites and is burned away. The gradation of the remaining aggregate is then determined using CP 31. This procedure includes infrared heat source ignition furnaces. This procedure shall not be used for determining the asphalt binder content of cores or otherwise obtained samples from existing bituminous pavements.

1.2 This standard 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 standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 Colorado Procedures:

CP 30 Sampling of Aggregates
CP 31 Sieve Analysis of Aggregates
CP 41 Sampling Bituminous Paving Mixtures
CP 55 Reducing Field Samples of Hot Mix Asphalt to Testing Size
CP 85 Binder and Asphalt Cement Content of Asphalt Mixtures by the Nuclear Method

3. SUMMARY OF TEST METHODS

3.1 A specimen of bituminous mixture is heated in a furnace at a high enough temperature to ignite the asphalt binder fraction, which burns away. The asphalt binder content is calculated by dividing the mass loss of the specimen after ignition by the mass of the bituminous mixture before ignition. A correction factor is determined for each bituminous mixture and then applied to the measured asphalt binder content of field produced bituminous mixtures.

4. SIGNIFICANCE AND USE

4.1 This method can be used for quantitative determinations of asphalt binder content and gradation in HMA mixtures and pavement samples for quality control, specification acceptance, and mixture evaluation studies. This method does not require the use of solvents. Residual aggregate obtained by this test method may be used for gradation analysis according to CP 31.

5. REDUCING PRODUCTION SAMPLES TO TEST SIZE

Note 1: The word *specimen* represents a test portion of bituminous mixture sample. When the specimen's mass exceeds the capacity of test equipment, it shall be divided into multiple units, tested, and the results averaged.

Note 2: The word *sample* represents a quantity of bituminous mixture gathered from a stockpile or roadway in accordance with CP 41.

5.1 If the bituminous mixture is not sufficiently soft to separate with a spatula or trowel, place it in a pan and warm it in an oven at the binder compaction temperature until it can be separated.

5.1.1 Sampling of HMA shall be done according to CP 41. One specimen conforming to the appropriate column of Table 1 shall be selected from each bituminous mixture production sample in accordance with CP 55. Extreme care must be taken to obtain representative specimens.

5.2 The specimens shall conform to the mass requirements shown in the appropriate column of Table 1.

6. CORRECTION FACTOR

6.1 Virgin Aggregates

6.1.1 This method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, a correction factor will be established with the testing of a set of correction factor samples for each mix type. This procedure must be performed before any acceptance testing is completed.

6.1.2 The correction factor process should be repeated each time there is a change in the mix ingredients or design.

6.1.3 According to the requirements of Section 5 and using the Calculation in Subsection 9.1, prepare two correction factor samples at the design asphalt content. Mixing temperatures have been determined for many different binder grades and are summarized in CP-L 5115 Table 2. Aggregate used for the correction factor specimens shall be sampled from stockpiled material produced in the current construction season and designated for use on the candidate project. Any method may be used to combine the aggregates, lime, fibers, additives, RAP and other components of the mix design; however, an additional “blank” specimen shall be batched and tested for aggregate gradation according to CP 31. The washed gradation shall fall within the mix design tolerances.

Note 3: Mixing equipment, including bowls, wire whips, spoons, and spatulas should be buttered prior to the correction factor. If necessary, prior to mixing, prepare a butter mix at the design asphalt content. The purpose of the butter mix is to condition the mixing bowl by providing a coating of asphalt and fines in the bowl. Mix and discard the butter mix prior to mixing any of the correction factor specimens to ensure an accurate asphalt content.

6.1.4 If they are going to be burned immediately, the freshly mixed specimens may be placed directly in the sample baskets. If allowed to cool, the samples shall be heated at the binder compaction temperature for 30 minutes. Do not preheat the sample baskets.

6.1.5 Test specimens in accordance with Sections 7, 8 and 9.

6.1.6 Determine the measured asphalt contents for each sample by calculation.

6.1.7 Perform a gradation analysis on the residual aggregate as indicated in Section 12. Compare this gradation to the gradation of the unburned, “blank”, specimen to evaluate the amount of aggregate breakdown

6.1.8 If the difference between the measured asphalt contents of the two samples exceeds 0.15 percent, the results should be discarded, new samples obtained, and the measured asphalt contents of the material retested. Retest as needed until the measured asphalt contents agree to within 0.15 percent. Determine the correction factor from the two results that are within 0.15 percent. Calculate the difference between the actual and measured asphalt contents for each sample. The correction factor is the average of the differences expressed in percent by weight of the asphalt mixture.

Note 4: Each ignition furnace will have its own unique asphalt binder correction factor determined in the location where testing will be performed.

6.2 **Aggregates with Reclaimed Asphalt Pavement (RAP)**

6.2.1 This Method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, a correction factor will be established with the testing of a set of correction factor samples for each mix type. This procedure must be performed before any acceptance testing is completed.

6.2.2 The correction factor process should be repeated each time there is a change in the mix ingredients or design.

6.2.3 Determine the bitumen content of RAP per Section 7, 8, and 9 or use the bitumen content submitted with the mix design.

6.2.4 Sampling of RAP will be conducted using CP 30. Reduce to proper test sample size using CP 55. Two individual samples will be used to determine the average bitumen content using Section 7, 8, and 9.

Table 1: Size of Specimen

Nominal Maximum Aggregate Size (mm)	Sieve Size	Specimen Weight Range (g)
4.75	No. 4	1200 - 1300
9.5	3/8 in.	1200 - 1300
12.5	½ in.	1800 - 1900
19.0	¾ in.	2200 - 2300
25.0	1 in.	3000 – 3100*
37.5	1 ½ in.	4000 – 4100*

* Specimens shall either be divided in half or thirds, each individual part Will be tested, and then the results averaged.

6.2.5 Sample size will be determined by using Table 1.

6.2.6 According to the requirements of Section 5 and using the Calculations in Section 9, prepare two correction factor samples at the design asphalt content. Mixing temperatures have been determined for many different binder grades and are summarized in CP-L 5115 Table 2. Aggregate used for the correction factor specimens shall be sampled from stockpiled material produced in the current construction season and designated for use on the candidate project. Any acceptable method may be used to combine the aggregates; however, an additional "blank" specimen shall be batched and tested for aggregate gradation according to CP 31. The washed gradation shall fall within the mix design tolerances.

6.2.7 If they are going to be burned immediately, the freshly mixed specimens may be placed directly in the sample baskets. If allowed to cool, the samples shall be heated at the binder compaction temperature for 30 minutes. Do not preheat the sample baskets.

6.2.8 Test specimens in accordance with Sections 7, 8 and 9.

6.2.9 Determine the measured asphalt contents for each sample by calculation.

6.2.10 Perform a gradation analysis on the residual aggregate as indicated in Section 12. Compare this gradation to the gradation of the unburned, “blank”, specimen to evaluate the amount of aggregate breakdown.

6.2.11 If the difference between the measured asphalt contents of the two samples exceeds 0.15 percent, the results should be discarded, new samples obtained, and the measured asphalt contents of the material retested. Retest as needed until the measured asphalt contents agree to within 0.15 percent. Determine the correction factor from the two results that are within 0.15 percent. Calculate the difference between the actual and measured asphalt contents for each sample. The correction factor is the average of the differences expressed in percent by weight of the asphalt mixture.

Note 5: Each ignition furnace will have its own unique asphalt binder correction factor determined in the location where testing will be performed.

7. APPARATUS

7.1 *Ignition furnace* - A forced air ignition furnace that heats the samples by convection method or direct irradiation method that is capable of maintaining the required temperature. There must be an internal balance thermally isolated from the furnace chamber that is readable to 0.1 g. The balance shall be capable of weighing a minimum 3000 gram sample in addition to the sample baskets. A data collection system will be included so that the weight can be automatically determined and displayed during the test. The furnace shall have a built in computer program to calculate change in mass of the sample baskets and provide for the input of a correction factor for aggregate loss. The furnace shall provide a printed ticket with the initial specimen mass, specimen mass loss, temperature compensation, correction factor, corrected asphalt content (percent), test time, and test temperature. The furnace chamber dimensions shall be adequate to accommodate a sample size of at least 3000 grams. The furnace shall provide an audible alarm and indicator light when the sample mass loss does not exceed 0.01 percent of the total sample mass for three consecutive minutes. The furnace door shall be equipped so that the door cannot be opened during the test. A method for reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside and shall have no noticeable odors escaping into the laboratory. The furnace shall have a fan to pull air through the furnace to expedite the test and to reduce the escape of smoke into the laboratory.

Note 6: The furnace shall also allow the operator to adjust the change in ending mass loss percentage to 0.02 percent.

7.2 *Sample basket(s)* - of appropriate size that allows the samples to be thinly spread and allows air to flow up through and around the sample particles. Sets with two or more baskets shall be nested. The sample shall be completely enclosed with screen mesh, perforated stainless steel plate, or other suitable material.

Note 7: Screen mesh or other suitable material with maximum and minimum opening of 2.36 mm (No. 8) and 600 microns (No. 30) respectively has been found to perform well.

7.3 *Catch Pan* - of sufficient size to hold the sample basket(s) so that aggregate particles and melting asphalt binder falling through the screen mesh are caught.

7.4 *Oven* - capable of maintaining specified compaction temperature ± 5°C (± 9°F) throughout the oven chamber.

7.5 *Balance* - of sufficient capacity and conforming to the requirements of AASHTO M 231 Class G2 for weighing specimen in basket(s).

7.6 *Safety Equipment* - safety glasses or face shield, high temperature gloves, long sleeve jacket, a heat resistant surface capable of withstanding 650°C (1202°F) and a protective cage capable of surrounding the sample baskets during the cooling period.

7.7 *Miscellaneous Equipment* - a pan larger than the sample basket(s) for transferring the sample after ignition, as well as spatulas, bowls, and wire brushes.

8. TEST PROCEDURE

8.1 All production specimens shall have a moisture correction determined in accordance with CP 43. Alternatively, the ignition sample specimen obtained per Section 5 above may be dried to 0.00% moisture prior to placement in the furnace. The specimen is considered to be at 0.00% moisture per the process and tolerance in CP 43, method B, section 13.2.

8.2 Preheat the ignition furnace to 538°C (1000°F) or per manufacturer's directions. Manually record the furnace temperature (set point) prior to the initiation of the test if the furnace does not record automatically.

8.3 Weigh and record the mass of the sample basket(s) and catch pan (with guards in place).

8.4 Prepare the sample as described in Section 5. Evenly distribute the sample in the sample basket(s) that have been placed in the catch pan, taking care to keep the material away from the edges of the basket. Use a spatula or trowel to level the specimen.

8.5 Weigh and record the total mass of the sample, basket(s), catch pan, and basket guards. Calculate and record the initial mass of the specimen (total mass minus the mass of the specimen basket assembly).

8.6 Input the initial mass of the specimen in whole grams into the ignition furnace controller. Verify that the correct mass has been entered.

8.7 Open the chamber door, and place the sample baskets in the furnace. Close the chamber door, and verify that the sample mass (including the basket(s)) displayed on the furnace scale equals the total mass recorded in Subsection 8.5 within ± 5 g. Differences greater than 5g or failure of the furnace scale to stabilize may indicate that the sample basket(s) are contacting the furnace wall. Initiate the test by pressing the start/stop button. This will lock the sample chamber and start the combustion blower.

Note 8: The furnace temperature will drop below the set point when the door is opened, but will recover with the door closed and when ignition occurs. Sample ignition typically increases the temperature well above the set point, depending on sample size and asphalt content.

8.8 Allow the test to continue until the stable light and audible stable indicator indicates the test is complete (the change in mass does not exceed 0.01 percent for three consecutive minutes). Press the start/stop button. This will unlock the sample chamber.

Note 9: A change in ending mass loss percentage of 0.02 may be substituted when aggregate that exhibits an excessive amount of loss during ignition testing is used. The precision and bias statement was developed using 0.01 percent. Both precision and accuracy may be adversely affected by using 0.02.

8.9 Remove the specimen basket assembly after ignition and allow it to cool at room temperature for 40 +/- 5 minutes. Weigh the basket assembly containing the residual aggregate and record the weight. The amount of time elapsed between removal from the furnace and weighing on the external scale should be the same for correction factors and plant produced material, within 5 minutes.

8.10 Determine the uncorrected asphalt binder content for the external scale.

8.11 Determine the corrected asphalt binder content for the external scale.

8.12 See Section 12 to perform gradation on burn-off sample.

9. CALCULATIONS

9.1 **Laboratory Mixed Specimen**.
This section includes one method of determining the correction factor.

9.1.1 Calculate the weight of aggregate needed for each specimen as follows:

$$Ws = \frac{Wm(100 - Pb)}{100}$$

Where:
Ws = Weight of aggregate in specimen,
Wm = Total mix weight of specimen,
Pb =Target percent of binder in mix.

Calculate the weight of binder to be added to the aggregate:

$$W_b = \frac{P_b W_s}{100 - P_b}$$

Where:
W_b = Weight of binder to be added to the aggregate specimen,
Pb = Target percent of binder in mix,
Ws = Weight of aggregate in specimen.

9.1.2 The uncorrected asphalt binder content of a specimen is determined using an external scale as follows:

$$P_{b(uncorr)} = \frac{W_{m(initial)} - W_{m(final)}}{W_{m(initial)}} \times 100$$

Where:
$P_{b(uncorr)}$ = Percent uncorrected asphalt binder determined by the mass loss measured on an external scale,
$W_{m(initial)}$ = External scale weight of the hot mix specimen before ignition
$W_{m(final)}$ = External scale weight of the hot mix specimen after ignition.

9.1.3 The asphalt binder correction factor is the percent of binder in the laboratory-mixed specimen minus the uncorrected percent binder in the same specimen after ignition:

$$C_f = P_b - P_{b\,(uncorr)}$$

Where:
Cf = Asphalt binder correction factor,
Pb = Target percent of binder in mix,
$P_{b(uncorr)}$ = Percent uncorrected asphalt binder determined by the mass loss measured on an external scale.

9.1.4 The corrected asphalt binder content for field-produced specimens is:

$$P_{b(corr)} = P_{b(uncorr)} + C_f - P_w$$

Where:
$P_{b(corr)}$ = Corrected percent asphalt binder in field-produced specimens,
$P_{b(uncorr)}$ = Percent uncorrected asphalt binder determined by the mass loss measured on an external scale,
Cf = Asphalt binder correction factor,
P_w = Percent moisture determined in accordance with CP 85, Section 10.

9.2 **Laboratory-Mixed Specimen Using RAP.**

9.2.1 Calculate the weight of aggregate and RAP needed for each specimen as follows:

$$W_{st} = \frac{W_{mt}(100 - P_b)}{100}$$

Where:
Wst = Weight of aggregate and RAP,
Wmt = Target mix weight of specimen,
Pb = Target percent of binder in mix.

The weight of virgin aggregate required in a specimen containing RAP is:

$$Wsv = \frac{Wst(100-Pr)}{100}$$

Where:
Wsv = Weight of virgin aggregate needed,
Wst = Weight of aggregate and RAP,
Pr = Percent RAP in mix.

9.2.2 The weight of RAP required in the specimen is:

$$Wr = \frac{Wst \times Pr}{100}$$

Where:
Wr = Weight of RAP needed in the specimen,
Wst = Weight of aggregate and RAP,
Pr = Percent RAP in mix.

9.2.3 The weight of binder in the RAP is:

$$Wbr = \frac{Wr \times Pbr}{100}$$

Where:
Wbr = Weight of binder in the RAP portion of the specimen,
Wr = Weight of RAP needed in the specimen,
P_{br} = Percent binder in the RAP.

9.2.4 The weight of binder to be added to the aggregate and RAP specimen is:

$$Wba = (Wsv + Wr - Wbr) \times (Pb/(100-Pb)) - Wbr$$

Where:
Wba = Weight of binder to be added to the aggregate and RAP specimen,
Wsv = Weight of virgin aggregate needed,
Wr = Weight of RAP needed in the specimen,
Wbr = Weight of binder in the RAP portion of the specimen,
Pb = Target percent of binder in mix.

9.2.5 The weight of the mixed specimen is:

$$Wma = Wsv + Wr + Wba$$

Where:
Wma = Actual total mix weight of specimen,
Wsv = Weight of virgin aggregate needed,
Wsr = Weight of RAP needed in the specimen,
Wba = Weight of binder to be added to the aggregate and RAP specimen.

9.2.6 The actual percent binder in the mixed specimen is:

$$Pbm = \frac{100 \times (Wba + Wbr)}{Wma}$$

Where:
Pbm = percent binder in the mixed specimen,
Wba = Weight of binder to be added to the aggregate and RAP specimen,
Wbr = Weight of binder in the RAP portion of the specimen,
Wma = Actual total mix weight of specimen.

9.3 **Laboratory-Mixed Specimen Using Two or More RAP Stockpiles.**

9.3.1 The example below is for two RAP stockpiles. More than two RAP stockpiles may be calculated in a similar fashion.

9.3.1.1 Spreadsheet may be obtained through the Flexible Pavement Unit of the Central Laboratory (303) 398-6533.

9.3.2 Calculate the weight of aggregate and RAP needed for each specimen as follows:

$$Wst = Wmt\,(100 - Pb)\,/100$$

Where:
Wst = Weight of aggregate and RAP,
Wmt = Target mix weight of specimen,
Pb = Target percent of binder in mix.

The weight of virgin aggregate required in a specimen containing RAP is:

$$Wsv = Wst(100-Pr)/100$$

Where:
Wsv = Weight of virgin aggregate needed,
Wst = Weight of aggregate and RAP,
Pr = Percent RAP in mix.

9.3.3 The weight of RAP required in the specimen is:

$$Wr1 = Wst \times Pr1/100$$
$$Wr2 = Wst \times Pr2/100$$

Where:
Wr1 = Weight of RAP1 needed in the specimen,
Wr2 = Weight of RAP2 needed in the specimen,
Wst = Weight of aggregate and RAP,
Pr1 = Percent RAP1 in mix,
Pr2 = Percent RAP 2 in mix.

9.3.4 The weight of binder in the RAP is:

$$\mathbf{Wbr1 = Wr1 \times Pbr1/100}$$
$$\mathbf{Wbr2 = Wr2 \times Pbr2/100}$$
$$\mathbf{WbrTotal = Wbr1 + Wbr2}$$

Where:
Wbr1 = Weight of binder in the RAP1 portion of the specimen,
Wbr2 = Weight of binder in the RAP2 portion of the specimen,
Wbr Total = Total weight of binder in the RAP portion of the specimen,
Wr1 = Weight of RAP1 needed in the specimen,
Wr2 = Weight of RAP2 needed in the specimen,
Pbr1 = Percent binder in the RAP1,
Pbr2 = Percent binder in the RAP2.

9.3.5 The weight of binder to be added to the aggregate and RAP specimen is:

$$\mathbf{Wba = (Wsv + Wr1 + Wr2 - WbrTotal) \times (Pb/(100-Pb))-WbrTotal}$$

Where:
Wba = Weight of binder to be added to the aggregate and RAP specimen,
Wsv = Weight of virgin aggregate needed,
Wr1 = Weight of RAP1 needed in the specimen,
Wr2 = Weight of RAP2 needed in the specimen,
WbrTotal = Total weight of binder in the RAP portion of the specimen,
Pb = Target percent of binder in mix.

9.3.6 The weight of the mixed specimen is:

$$\mathbf{Wma = Wsv + Wr1 + Wr2 + Wba}$$

Where:
Wma = Actual total mix weight of specimen,
Wsv = Weight of virgin aggregate needed,
Wr1 = Weight of RAP1 needed in the specimen,
Wr2 = Weight of RAP2 needed in the specimen,
Wba = Weight of binder to be added to the aggregate and RAP specimen.

9.3.7 The actual percent binder in the mixed specimen is:

$$\mathbf{Pbm = 100 \times (Wba + WbrTotal)/ Wma}$$

Where:
Pbm = Percent binder in the mixed specimen,
Wba = Weight of binder to be added to the aggregate and RAP specimen,
WbrTotal = Total weight of binder in the RAP portion of the specimen,
Wma = Actual total mix weight of specimen

9.4 **Glossary.**

Cf = Asphalt binder correction factor

Pb = Target percent of binder in mix

Pb(uncorr) = Percent uncorrected asphalt binder determined using an external scale

Pbr = Percent binder in the RAP

Pbm = Percent binder in the mixed specimen

Pr = Percent RAP in the mix

Pr1 = Percent RAP1 in mix

Pr2 = Percent RAP 2 in mix.

Pw = Percent moisture determined by CP 85, Section 10

RAP = (Reclaimed Asphalt Pavement) which includes the aggregate and binder

Wb = Weight of binder to be added to aggregate *not* containing RAP

Wba = Weight of binder to be added to the aggregate and RAP specimen

Wbr = Weight of binder in the RAP portion of the specimen

WbrTotal = Total weight of binder in the RAP portion of the specimen,

Wm = Total mix weight of specimen

Wma = Actual total mix weight of specimen

Wmt = Target mix weight of specimen

Wm(final) = External scale weight of the hot mix specimen after ignition

Wm(initial) = External scale weight of the hot mix specimen before ignition

Ws = Weight of aggregate in specimen

Wr = Weight of RAP needed in specimen

Wr1 = the weight of RAP1 needed in the Specimen

Wr2 = the weight of RAP2 needed in the specimen

Wst = Weight of aggregate and RAP in specimen

Wsv = Weight of virgin aggregate needed in specimen having RAP.

10. Section 10 (Deleted)

11. Section 11 (Deleted)

12. GRADATION

12.1 Empty the residual aggregate from the baskets into a flat pan. Use a small wire brush to ensure that any residual fines are removed from the baskets. Weigh the residual aggregate on an external scale and record the weight.

Note 10: If the potential presence of lime in asphalt paving mixture needs to be determined, introduce water over the residual aggregate and add 2-4 drops of phenolphthalein alcohol indicator into the sample. Let it rest for 10 seconds and look for the indicator to show the potential presence of lime.

12.2 Perform a gradation analysis in accordance with CP 31.

12.3 If aggregate degradation is suspected, or if the test results will be used for project acceptance, Subsections 12.3.1 to 12.3.6 may be used to verify whether aggregates have a tendency to degrade.

12.3.1 Obtain a sample of the final aggregate blend in question from a conveyor belt discharge or a stopped conveyor belt according to CP 30.

12.3.2 Using a sample splitter, split a sample weighing at least four times the sample size specified in Table 1 into four specimens having approximately equal mass. Set two specimens aside.

12.3.3 Mix two of the aggregate specimens with asphalt cement to yield specimens having an asphalt binder content within 0.5 percent of the mix in question.

12.3.4 Test the two mixed specimens as specified in Section 7.

12.3.5 Using CP 31, determine the gradation of the two specimens, which were mixed with asphalt binder and ignited. Determine the gradation of the two specimens, which were set-aside in Subsection 12.3.2.

12.3.6 Calculate the average percent passing each sieve size for the two sets of two specimens. For a RAP mix, test the virgin aggregate gradation without RAP. Mathematically add the RAP gradation results from the mix design to the virgin gradation at the percent used in the mix design for the unburned sample. Mix the virgin aggregate with RAP at the mix design percentages and burn. Compare the differences between the unburned and the burned sample.

Compare the average gradation at each sieve size for the two sets of specimens. If the difference for any single sieve exceeds the allowable difference for that sieve as listed in Table 2, then aggregate gradation correction factors (equal to the resultant average differences) for **all** sieves shall be applied to all acceptance gradation test results determined by CP 31, prior to final rounding and reporting. If the 0.075-mm (No. 200) sieve is the only sieve outside the limits in Table 2, apply the aggregate correction factor to only the 0.075-mm (No. 200) sieve.

The aggregate correction factor calculation shall be calculated to the nearest 0.1% for all sieves except the #200 sieve. The #200 sieve shall be calculated to the nearest 0.01%. Those corrections are applied to the non-rounded percent passing. The final reported percent passing is rounded to the whole percentage for all sieves except the reported #200 sieve. The reported #200 sieve is rounded to the nearest 0.1%.

Table 2 - Permitted Sieving Difference

Sieve	Allowable Difference
Sizes larger than or equal to 2.36 mm (No.8)	+/- 5.0 percent
Sizes larger than 0.075 mm (No. 200) and smaller than 2.36 mm (No. 8)	+/- 3.0 percent
Sizes 0.075 mm (No. 200) and smaller	+/- 0.5 percent

13. REPORT

13.1 There is no designated CDOT Form used for recording / reporting information for this CP-L.

13.1.1 The report shall include the following information:

13.1.2 Date of correction factor determination.

13.1.3 Identification of aggregate and mix type.

13.1.4 Correction factor.

13.1.5 Corrected asphalt content (nearest 0.01%).

13.1.6 Aggregate gradation, if performed.

14. PRECISION AND BIAS

14.1 The precision for this test method is as follows:

Standard Deviation

Type Index	Virgin Mixes, %	RAP Mixes, %
Single-laboratory	0.15	0.20
Multi-laboratory	0.30	0.40

14.2 A bias for this test method will be determined at a later date, and included in future re*visions*.

APPENDIX

Laboratory Mixed Specimen

Input Values	Examples
Total Mix Weight of Specimen (Wm)	7600.0
Target Percent of Binder in Mix (Pb)	5.00

Calculated Values	Examples	Calculations
Weight of Aggregate in Specimen (Ws)	7220.0	Ws = Wm * (100 - Pb) / 100
Weight of Binder to be added to the Aggregate Specimen (Wb)	**380.0**	Wb = (Pb * Ws) / (100 - Pb)

Laboratory - Mixed Specimen Using RAP

Input Values	Examples
Target Mix Weight of Specimen (Wmt)	1850.0
Target Percent of Binder in Mix (Pb)	5.30
Percent RAP in Mix (Pr)	20.00
Percent Binder in the RAP (Pbr)	4.64

Calculated Values	Examples	Calculations
Weight of Aggregate and RAP (Wst)	1752.0	Wst = Wmt * (100 - Pb) / 100
Weight of Virgin Aggregate needed (Wsv)	1401.6	Wsv = Wst * (100 - Pr) / 100
Weight of RAP needed in the Specimen (Wr)	350.4	Wr = Wst * Pr / 100
Weight of Binder in the RAP portion of the Specimen (Wbr)	16.3	Wbr = Wr * Pbr / 100
Weight of Binder to be added to the Aggregate and RAP Specimen (Wba)	**80.9**	Wba = (Wsv + Wr - Wbr) * (Pb / (100 - Pb)) - Wbr
Actual Total Mix Weight of Specimen (Wma)	1832.8	Wma = Wsv + Wr + Wba
Percent Binder in the Mixed Specimen (Pbm)	5.3	Pbm = 100 * (Wba + Wbr) / Wma

Laboratory - Mixed Specimen Using Two RAP Stockpiles

Input Values	Examples
Target Mix Weight of Specimen (Wmt)	2050.0
Target Percent of Binder in Mix (Pb)	5.20
Percent RAP1 in Mix (Pr1)	15.00
Percent RAP2 in Mix (Pr2)	3.00
Percent Binder in the RAP1 (Pbr1)	5.80
Percent Binder in the RAP2 (Pbr2)	18.50

Calculated Values	Examples	Calculations
Weight of Aggregate and RAP (Wst)	1943.4	Wst = Wmt * (100 - Pb) / 100
Percent RAP in Mix (Pr)	18.0	Pr = Pr1 + Pr2
Weight of Virgin Aggregate needed (Wsv)	1593.6	Wsv = Wst * (100 - Pr) / 100
Weight of RAP1 needed in the Specimen (Wr1)	291.5	Wr1 = Wst * Pr1 / 100
Weight of RAP2 needed in the Specimen (Wr2)	58.3	Wr2 = Wst * Pr2 / 100
Weight of Binder in the RAP1 portion of the Specimen (Wbr1)	16.9	Wbr1 = Wr1 * Pbr1 / 100
Weight of Binder in the RAP2 portion of the Specimen (Wbr2)	10.8	Wbr2 = Wr2 * Pbr2 / 100
Total Weight of Binder in the RAP portion of the Specimen (WbrTotal)	27.7	WbrTotal = Wbr1 + Wbr2
Weight of Binder to be added to the Aggregate and RAP Specimen (Wba)	**77.4**	Wba = (Wsv + Wr1 + Wr2 - WbrTotal) * (Pb/(100-Pb))-WbrTotal
Actual Total Mix Weight of Specimen (Wma)	2020.8	Wma = Wsv + Wr1 + Wr2 + Wba
Percent Binder in the Mixed Specimen (Pbm)	5.2	Pbm = 100 * (Wba + WbrTotal) / Wma

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