ASPHALT BINDER CONTENT OF ASPHALTIC CONCRETE MIXTURES CONTAINING RECLAIMED ASPHALT PAVEMENT (RAP) BY THE IGNITION FURNACE METHOD

(A Modification of AASHTO T 308)

1. SCOPE

1.1 This procedure describes the method for determining the percent asphalt binder content of asphaltic concrete mixtures containing reclaimed asphalt pavement (RAP), by use of an ignition furnace. The aggregate remaining after ignition can be used for sieve analysis, as indicated in Section 6.

1.1.1 The gradation, moisture content, and binder content of the RAP material are determined as described in Appendix A of this test method. The determination of the RAP aggregate gradation is also discussed in Appendix A. The procedure for determining the RAP binder content correction factor is described in Appendix B.

1.1.2 This procedure addresses the use of reclaimed asphalt pavement (RAP) in asphaltic concrete mixtures. **See Arizona Test Method 427 when testing is to be performed on asphaltic concrete mixtures which do not contain RAP.**

1.2 This test method involves hazardous material, operations, and equipment. This test method does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.3 See Appendix A1 of the Materials Testing Manual for information regarding the procedure to be used for rounding numbers to the required degree of accuracy.

1.4 A listing of subsequent Sections and Figures in this procedure is given below:

2. APPARATUS

2.1 Requirements for the frequency of equipment calibration and verification are found in Appendix A3 of the Materials Testing Manual. Apparatus for this test procedure shall consist of the following:

2.1.1 Ignition Furnace - a forced-air ignition furnace that heats the sample by the convection method. The furnace must be capable of heating to temperatures up to 538 °C (1000 °F), and able to maintain a given temperature at ± 5 °C (± 9 °F). The furnace shall have an internal weighing system thermally isolated from the furnace chamber and accurate to 0.1 gram. The balance shall be capable of weighing a 3500 gram sample in addition to the sample baskets. A data collection system shall also be included so that the sample mass loss can be automatically determined to an accuracy of 0.1 gram and displayed during a test. The furnace shall provide a printout that includes, as a minimum, the initial sample mass, sample mass loss, test time, and test temperature. 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 one minute intervals. A filter capable of reducing

emissions to an acceptable level shall also be incorporated into the furnace. The furnace shall be vented into a hood or to the outside and be set up properly so that there are no noticeable odors escaping into the laboratory. The furnace shall have a fan with the capability to pull air through the furnace to expedite the test and to reduce escape of smoke into the laboratory. The furnace shall be equipped so that the door cannot be opened until testing is complete.

2.1.2 Stainless Steel Perforated Baskets - the baskets shall be an appropriate size that allow the samples to be a thickness which allows air to flow up through and around the sample particles. The sample shall be completely enclosed with screen mesh, perforated stainless steel plate, or other suitable material. Screen mesh or other suitable material with openings of No. 8 has been found to perform well.

2.1.3 Stainless Steel Catch Pan - of sufficient size to hold the sample baskets so that aggregate particles and melting asphalt binder falling through the screen mesh are caught.

2.1.4 Oven(s) - capable of heating to temperatures up to 350 °F, and able to maintain a given temperature at the tolerances specified herein.

2.1.5 Scale(s) or balance(s) - capable of measuring the maximum mass to be determined and conforming to the requirements of AASHTO M 231, except the readability and sensitivity of any balance or scale utilized shall be at least 0.1 gram.

2.1.6 Safety Equipment - safety glasses or face shield, high temperature gloves, and long sleeve jacket. Additionally, a heat resistant surface capable of withstanding 1200 °F and a protective cage capable of surrounding the sample baskets shall be provided.

2.1.7 Miscellaneous Equipment - a pan larger than the sample basket(s) for transferring samples after ignition, spatulas, bowls, spoons, and wire brushes.

2.1.8 Mixing apparatus - Mechanical mixing is recommended; 20 quart capacity mixer is required. (Hand mixing may be performed if desired.)

2.1.9 Thermometer - with a temperature range of 50 to 500 °F.

2.1.10 Hot plate - capable of heating to temperatures up to 350 °F, and able to maintain a given temperature at ± 5 °F.

2.1.11 For performing sieve analysis, apparatus as specified in Arizona Test Method 201.

3. SAMPLING

3.1 For preparing calibration samples, obtain representative samples of virgin aggregate and RAP material in accordance with Arizona Test Method 105. Samples of virgin aggregate and RAP material shall be sufficiently large to provide enough material for calibration testing.

3.2 For testing field samples of asphaltic concrete, obtain a representive sample of the freshly produced mix in accordance with Arizona Test Method 104. Obtain representative test samples, in accordance with the appropriate sections of Arizona Test Method 416, for the determination of moisture content (if required) and asphalt binder content.

3.2.1 The size of the asphalt binder content test sample shall be within $\pm$ 150 grams of the sample size used for calibration and must also conform to the mass requirement shown in Table 1. When the mass of the test sample exceeds the capacity of the equipment used, the test sample shall be divided into suitable increments, tested, and the results appropriately combined.

4. CALIBRATION

4.1 Asphalt binder content results may be affected by the type of aggregate and binder in the mixture. A calibration factor for the asphalt binder content must be established for each mix design. Certain aggregate types may result in an unusually high calibration factor and erroneous gradation results due to aggregate breakdown. Such mixes should be calibrated and tested at a lower temperature as described in Subsection 4.13.

TABLE 1

Size of Test Sample

Nominal Maximum Aggregate Size (See Note)	Mass of Sample, grams
1-1/2 in.	4000 – 4500
1 in.	3000 – 3500
3/4 in.	2000 – 2500
1/2 in.	1500 – 2000
3/8 in.	1200 – 1700
No. 4	1200 – 1700

Note: The smallest sieve opening through which the entire amount of material, by specification, is permitted to pass.

4.2 Spread the RAP material from each individual RAP stockpile to be used for the calibration in separate pans at 1 to 1-1/2 inches in depth and dry overnight at 140 ± 10 °F, and continue drying until the mass, after successive one-half hour periods of drying, indicates no change in mass. Allow the material to cool. Screen the RAP material from the individual stockpiles and separate into individual sizes for No. 8 and larger sieves, and minus No. 8 material. The RAP material shall be screened for 5 minutes ± 15 seconds per Arizona Test Method 240 to prevent excessive breakdown of the RAP agglomerations.

4.3 Dry the individual virgin aggregate stockpile samples to constant mass at 290 ± 10 °F. Allow the material to cool. Screen the virgin aggregate from the individual stockpiles and separate into individual sizes for No. 8 and larger sieves, and minus No. 8 material.

Note: In lieu of drying and screening the virgin aggregate samples for each individual stockpile, a bulk-batched sample may be used as described in Subsection 4.3.1.

4.3.1 Using the adjusted stockpile percentages shown in Mix Design Composite #2 (Virgin Aggregate Composite), the material from the individual stockpiles may be bulk-batched into a single sample of an adequate amount of material necessary to prepare the required calibration samples. Dry the bulk-batched sample to constant mass at 290 ± 10 °F. Allow the material to cool. Screen the bulk-batched material and separate into individual sizes for No. 8 and larger sieves, and minus No. 8 material.

4.4 The RAP aggregate [extracted aggregate (AASHTO T 164 - Method A) from the RAP material] shall be dried to constant mass at 290 ± 10 °F. Allow the material to cool. Screen the RAP aggregate material from the individual stockpiles and separate into individual sizes for No. 8 and larger sieves, and minus No. 8 material.

Note: The batching of samples described below in Subsection 4.5 and Subsection 4.6 is based on the mix design weigh-up information, as shown in the example in Figure 1.

4.5 A gradation check sample is batched using:

- The virgin mineral aggregate component (individual stockpile material or bulk-batched material), which has been screened into individual sizes for No. 8 and larger sieves, and minus No. 8 material.

- The RAP aggregate component, which has been screened into individual sizes for No. 8 and larger sieves, and minus No. 8 material.

- Mineral admixture.

4.5.1 Batch the virgin aggregate portion to Mix Design Composite #2 (Virgin Aggregate Composite). If the individual virgin aggregate stockpiles were screened, batch to the individual accumulative weights required for each individual stockpile, as shown in the example in Figure 2. If bulk-batched virgin aggregate material is used, batch to the accumulative weights required for the total batch weight as shown in the example in Figure 2.

4.5.1.1 The weight of the virgin aggregate portion is determined as follows:

$$W_{va} = \left(\frac{100 - T_{pra}}{100} \right) \text{ x } (W_{ta})$$

Where:

W_{va} = Weight of virgin aggregate
T_{pra} = Total percent of RAP aggregate in mix design
W_{ta} = Weight of total aggregate desired (combined virgin aggregate and RAP aggregate)

Example:

$$W_{va} = \left(\frac{100 - (15 + 10)}{100} \right) \text{ x } (2200) = 1650 \text{ grams}$$

4.5.2 Batch the RAP aggregate portion to Mix Design Composite #1 (Virgin Aggregate and RAP Aggregate Composite), utilizing the accumulative weights required for each individual RAP aggregate material, as shown in the example in Figure 2.

4.5.2.1 The weight of RAP aggregate portion required for each RAP stockpile is determined as follows:

$$W_{ra} = \left(\frac{P_{ra}}{100} \right) \text{ x } (W_{ta})$$

Where:

W_{ra} = Weight of RAP aggregate for each RAP stockpile
P_{ra} = Percent of RAP aggregate used in mix design
W_{ta} = Weight of total aggregate desired (combined virgin aggregate and RAP aggregate)

Example (for fine RAP aggregate):

$$W_{ra} = \left(\frac{15}{100} \right) \text{ x } (2200) = 330.0 \text{ grams}$$

Example (for coarse RAP aggregate):

$$W_{ra} = \left(\frac{10}{100} \right) \text{ x } (2200) = 220.0 \text{ grams}$$

4.5.3 Add the required type and amount of mineral admixture to the virgin aggregate and RAP aggregate and blend thoroughly.

4.5.3.1 The weight of mineral admixture is determined as follows:

$$W_{ad} = \left(\frac{P_{ad}}{100} \right) \text{ x } (W_{ta})$$

Where:

W_{ad} = Weight of mineral admixture
P_{ad} = Percent mineral admixture
W_{ta} = Weight of total aggregate desired (combined virgin aggregate and RAP aggregate)

Example:

$$W_{ad} = \left(\frac{1.0}{100} \right) \text{ x } (2200) = 22 \text{ grams}$$

4.5.4 The weight of the combined virgin aggregate, RAP aggregate, and mineral admixture for the gradation check sample shall conform to the requirements of Table 1.

4.5.5 Perform a gradation analysis on the gradation check sample in accordance with Section 6 to determine the actual gradation.

4.6 Two calibration (burn) samples and also a “butter mix” sample are batched using:

- The virgin mineral aggregate component (individual stockpile material or bulk-batched material), which has been screened into individual sizes for No. 8 and larger sieves, and minus No. 8 material.
- The RAP material (dry screened RAP) component, which has been screened into individual sizes for No. 8 and larger sieves, and minus No. 8 material.
- Mineral admixture.

4.6.1 Batch the virgin aggregate portion to Mix Design Composite #2 (Virgin Aggregate Composite). If the individual virgin aggregate stockpiles were screened, batch to the individual accumulative weights required for each individual stockpile, as shown in the example in Figure 3. If bulk-batched virgin aggregate material is used, batch to the accumulative weights required for the total batch weight as shown in as shown in the example in Figure 3.

4.6.1.1 The weight of the virgin aggregate portion is detemined as shown in Subsection 4.5.1.1.

4.6.2 Add the required type and amount of mineral admixture to each of the batched virgin aggregate samples and blend thoroughly.

4.6.2.1 The weight of the mineral admixture is detemined as shown in Subsection 4.5.3.1.

4.6.3 Form a shallow crater in the center of each of the blended virgin aggregate/mineral admixture samples.

4.6.4 Batch the dry screened RAP portion to Mix Design Composite #3 (Virgin Aggregate and Dry Screened RAP Composite), utilizing the accumulative weights required for each individual dry screened RAP material, as shown in the example in Figure 3.

4.6.4.1 The weight of the dry screened RAP portion from each RAP stockpile is determined as follows:

$$W_{rap} = \left(\frac{W_{ra}}{1 - \frac{P_{br}}{100}} \right)$$

Where:

W_{rap} = Weight of dry screened RAP from each RAP stockpile
W_{ra} = Weight of RAP aggregate for each RAP stockpile
P_{br} = Percent binder content of each RAP stockpile

Example (for fine RAP stockpile):

$$W_{rap} = \left(\frac{330.0}{1 - \frac{5.82}{100}} \right) = 350.4 \text{ grams}$$

Example (for coarse RAP stockpile):

$$W_{rap} = \left(\frac{220.0}{1 - \frac{3.43}{100}} \right) = 227.8 \text{ grams}$$

4.6.5 Place the dry screened RAP material in the crater formed in each of the blended virgin aggregate/mineral admixture samples.

4.6.6 The weight of the combined virgin aggregate, dry screened RAP, and mineral admixture for each calibration sample and the “butter mix” sample shall be such that when the required amount of virgin asphalt binder is added, they conform to the requirements of Table 1.

Note: It is recommended that an initial calibration sample be prepared and tested in accordance with the requirements of Subsection 4.6.7 prior to the preparation of additional samples. Doing so may help avoid the waste of the limited amount of dry screened RAP material.

4.6.7 Prior to the addition of the virgin binder, record the weight of the combined virgin aggregate, dry screened RAP, and mineral admixture for each calibration sample to the nearest 0.1 gram as the “Weight of Initial Charge Before Drying”. Dry each charge to constant mass at 290 ± 10 °F, allow to cool, and record the weight to the nearest 0.1 gram as the “Weight of Initial Charge After Drying”. If the loss from drying is greater than

25 grams, discard the charge and prepare a new charge using the same procedure, except the dry screened RAP shall be initially dried overnight at 160° ± 3 °F, and drying continued at 160° ± 3 °F until the mass, after successive one-half hour periods of drying, indicates no change in mass. Do not add make-up material to account for any loss from drying, as doing so will change the gradation of the samples.

Note: The extended drying at the increased temperature (from 140 ± 10 °F to 160° ± 3 °F) specified above is to ensure that all moisture is removed from the dry screened RAP material.

4.6.8 Two calibration samples and the butter mix are prepared as described below at the design total asphalt binder content. The asphalt binder grade and type shall be the same as will be used in the asphalt concrete mixture to be tested during production. The percent total asphalt binder content is based on the mass of the total mix. For each sample, the weight of virgin asphalt binder to be added is determined using the calculations in Subsections 4.5.1.1, 4.5.3.1, and 4.5.6.1 in conjunction with Subsections 4.6.8.1, 4.6.8.2, and 4.6.8.3.

4.6.8.1 The weight of binder contributed by the RAP material from each RAP stockpile is determined as follows:

$$W_{rb} = \left(\frac{P_{br}}{100} \right) \text{ x } \left(W_{rap} \right)$$

Where:

W_{rb} = Weight of binder contributed by each RAP stockpile
P_{br} = Percent binder content of each RAP stockpile
W_{rap} = Weight of RAP from each RAP stockpile

Example (for fine RAP stockpile):

$$W_{rb} = \left(\frac{5.82}{100} \right) \text{ x } (350.4) = 20.39 \text{ grams}$$

Example (for coarse RAP stockpile):

$$W_{rb} = \left(\frac{3.43}{100} \right) \text{ x } (227.8) = 7.81 \text{ grams}$$

4.6.8.2 The weight of total binder is determined as follows:

$$W_{tb} = \left(\frac{W_{va} + T_{wra} + W_{ad}}{100 - P_{tb}} \right) \text{ x } (P_{tb})$$

Where:

W_{tb} = Weight of total binder
W_{va} = Weight of virgin aggregate
T_{wra} = Total weight of RAP aggregate
W_{ad} = Weight of mineral admixture
P_{tb} = Percent total binder (mix design percent binder content)

Example:

$$W_{tb} = \left(\frac{1650 + (330 + 220) + 22}{100 - 5.4} \right) \text{ x } (5.4) = 126.84 \text{ grams}$$

4.6.8.3 The weight of virgin asphalt binder to be added is determined as follows:

$$W_{vb} = (W_{tb}) - (W_{trb})$$

Where:

W_{vb} = Weight of virgin asphalt binder to be added
W_{tb} = Weight of total binder
W_{trb} = Total weight of binder contributed by RAP stockpiles

Example:

$$W_{vb} = (126.84) - (20.39 + 7.81) = 98.6 \text{ grams}$$

Note: If desired, the percent of the total binder which is contributed by RAP can be calculated as follows:

$$\left[\begin{array}{c} \text{Percent of Total} \\ \text{Binder Contributed} \\ \text{by RAP} \end{array} \right] = \left(\frac{W_{trb}}{W_{tb}} \right) \text{ x } (100)$$

Where:

W_{trb} = Total weight of binder contributed by RAP stockpiles
W_{tb} = Weight of total binder required

Example:

$$\begin{bmatrix} \text{Percent of Total} \\ \text{Binder Contributed} \\ \text{by RAP} \end{bmatrix} = \left(\frac{(20.39 + 7.81)}{126.84} \right) \text{ x } (100) = 22.23\%$$

4.6.8.4 All bowls, sample pans, and mixing tools shall be preheated to approximately the laboratory mixing temperature prescribed in the mix design. At the time mixing of the samples begins, the temperature of the asphalt binder, virgin aggregate, RAP, and mineral admixture shall be in accordance with the prescribed laboratory mixing temperature $\pm$ 5 °F. Each individual sample shall be thoroughly mixed. All samples shall be mixed at the same mixing temperature $\pm$ 5 °F.

Note: If the mix design laboratory mixing temperature is not specified, a temperature of 300 $\pm$ 5 °F shall be used.

4.7 Preheat the ignition furnace to 538 $\pm$ 5 °C (1000 $\pm$ 9 °F), or as modified in Subsection 4.13. Do not preheat the sample basket.

4.8 Weigh and record the mass of the basket assembly to the nearest 0.1 gram.

4.9 The freshly mixed samples may be placed directly in the sample basket assembly. If the samples are allowed to cool, they must be reheated in a 290 $\pm$ 10 °F oven for 25 minutes.

4.10 Test samples in accordance with Subsections 5.6 through 5.14.

4.11 If the difference between the measured asphalt binder content of the two samples exceeds 0.07, repeat the test using two additional samples, and from the four results discard the high and the low values.

4.12 Subtract the actual asphalt binder content for each of the two samples from their respective measured asphalt binder content. The asphalt binder content calibration factor is the average of the two resultant values expressed in percent by mass of the asphalt mixture.

4.13 If the asphalt binder content calibration factor exceeds ± 1.25 percent, lower the test temperature to 482 ± 5 °C (900 ± 9 °F) and repeat the test to determine a new calibration factor. If the calibration factor continues to exceed ± 1.25 percent, lower the test temperature to 427 ± 5 °C (800 ± 9 °F) and repeat the test to determine a new calibration factor. Use the calibration factor obtained at 427 ± 5 °C (800 ± 9 °F) even if it exceeds ± 1.25 percent.

4.14 Perform a gradation analysis on the residual aggregate as indicated in Section 6. Subtract the actual percent passing the No. 200 sieve for each sample from the measured percent passing the No. 200 sieve (as determined in Subsection 4.5.5). Determine the average of the two values. If the resultant average value is greater than ± 0.50, an aggregate gradation correction factor (equal to the resultant average value) for the passing No. 200 material may be applied to the production field sample test results.

5. PROCEDURE

5.1 The moisture content of the asphaltic concrete shall be determined in accordance with Arizona Test Method 406. The moisture content sample shall be obtained at the same time and subjected to the same treatment prior to testing as the asphalt binder content test sample. As an alternate to performing the moisture determination, the test sample may be dried to a constant mass in an oven at 290 ± 10 °F.

5.2 Preheat the ignition furnace to 538 ± 5 °C (1000 ± 9 °F), or to the alternate temperature determined during the calibration (Subsection 4.13). Do not preheat the sample basket. Record the furnace temperature set point prior to the initiation of the test.

5.3 Record the asphalt binder content calibration factor, determined in accordance with Subsections 4.11 through 4.13, for the specific mix to be tested.

5.4 Weigh and record the mass of the basket assembly to the nearest 0.1 gram.

5.5 Obtain the asphalt binder content test sample in accordance with Subsection 3.2, ensuring that the size of the test sample is within ± 150 grams of the sample size used for calibration and that the test sample conforms to the requirements shown in Table 1.

5.6 Evenly distribute the test sample over the center of the sample basket(s) and level the material. Use a spatula or trowel to pull material approximately one inch away from the outside edge of basket(s).

5.7 Weigh and record the mass of the sample and basket assembly to the nearest 0.1 gram.

5.8 Calculate and record the initial mass of the sample to the nearest 0.1 gram.

5.9 Set the ignition furnace controller print mode to give a printout of the test data required in Subsection 2.1.1. Input the initial mass of the sample into the ignition furnace controller. Verify that the correct mass has been entered.

5.10 Open the furnace door and place the sample and basket assembly so that it is centered in the chamber. After assuring that the sample basket assembly is not in contact with any wall, close the door. Initiate the test by pressing the start button. This will lock the furnace door and start testing.

5.11 Allow the test to continue until the stable light and audible stable indicator indicates the test is complete. The test is deemed complete when the measured mass loss does not exceed 0.01 percent of the sample mass for three consecutive one minute intervals. If required, press the stop button. This will unlock the furnace door and cause the printer to print out the test results.

5.12 Open the furnace door and remove the sample and basket assembly. Allow the sample to cool 30 ± 5 minutes in the basket assembly. Weigh and record the mass of the sample and basket assembly after ignition to the nearest 0.1 gram.

5.13 Calculate and record the mass of sample after ignition to the nearest 0.1 gram.

5.14 Calculate and record the corrected asphalt binder content of the sample, to the nearest 0.01%, as follows:

$$\%AC = \left[\frac{W_i - W_A}{W_i} \times 100 \right] - C_F - \%M$$

Where: %AC = measured (corrected) asphalt binder content in percent by mass of the sample
W_i = mass of the sample prior to ignition
W_A = mass of the sample after ignition
C_F = asphalt binder content calibration factor, percent by mass of the sample
%M = percent moisture in the sample

Note: During calibration, C_F and %M are zero.

5.14.1 If an ignition furnace correction (tank stab correction) is made, the %AC determined in Subsection 5.14 is adjusted by that correction.

5.15 Attach the original printed ticket to the back of the card.

5.16 Empty the contents of the baskets into a flat pan. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets. Take care not to lose any material, as this will affect gradation results.

5.17 If needed, perform a gradation analysis of the residual aggregate according to Section 6.

6. SIEVE ANALYSIS OF AGGREGATE

6.1 If required, the aggregate shall be subjected to sieve analysis as described below. The coarse sieving shall be performed in accordance with Subsection 6.2, and the fine sieving in accordance with Subsection 6.3. The quantity of material on a given sieve at the completion of sieving shall not exceed the amount shown Table 2.

6.2 The coarse sieving of the aggregate shall be performed as follows:

6.2.1 Weigh and record the mass of the sample to be sieved to the nearest gram. Place sample on the top sieve of a nest of 12 inch sieves. The nest of sieves shall consist of sieves starting with the smallest size sieve that 100% of the material will pass, down through and including the No. 8 sieve and pan. Place lid on nested sieves and screen the material by either mechanical or hand shaking, until not more than 0.5 percent by mass of sample passes any sieve during one minute.

6.2.2 Weigh and record separately, to the nearest gram, the mass of the material retained on the individual sieves and in the pan. The material retained in the pan is recorded as the minus No. 8 material.

TABLE 2			
Sieve Size	**Maximum Mass Allowed (grams/sq. in.)**	**Maximum Mass Allowed (grams)**	
		8 inch Diameter Sieve	**12 inch Diameter Sieve**
1-1/2”	25	---	2827
1”	18	---	2036
3/4”	14	---	1583
1/2”	10	---	1131
3/8”	8	---	905
1/4”	6	---	679
No. 4	5	---	565
No. 8 and smaller	4	201	452

6.2.3 Do not discard any of the sieved material until the sum of the individual masses is compared to the mass of the sample prior to sieving. If the difference between the two masses is less than or equal to 1.0% of the mass of the sample prior to sieving, an adjustment in mass shall be made on the sieve which has the largest mass retained, except no adjustment shall be made on the minus No. 8 material. If the difference is greater than 1.0%, the sample shall be recombined, resieved, and carefully reweighed.

6.2.4 Determine the coarse sieve factor by dividing 100 by the total mass sieved. Record the factor to six decimal places.

6.2.5 The percent passing for each sieve in the coarse sieve analysis is determined by multiplying the mass retained on that sieve by the coarse sieve factor, and subtracting the result from the unrounded % passing for the next larger sieve. Values for "mass retained multiplied by the coarse sieve factor" and "percent passing each sieve" shall be determined and used in the calculations to six decimal places. The percent passing value for each sieve is recorded in the sieve analysis to the nearest percent.

6.2.6 As a check on the coarse sieve analysis, multiply the mass of minus No. 8 material by the coarse sieve factor. The result of this calculation, rounded to the nearest percent, should be the same as the value for percent passing the No. 8 sieve determined in Subsection 6.2.5 above.

6.2.7 The material passing the No. 8 sieve is split, if necessary, to obtain a minimum 500 gram sample for fine fine sieving; however, the sample size may be less than 500 grams if a minimum of 500 grams is not obtained from coarse sieving. If less than 800 grams passes the No. 8 sieve, the entire amount shall be subjected to fine sieving. The mass of the sample for fine sieving is recorded to the nearest gram as mass of pass No. 8 split.

6.3 The elutriation and fine sieving of the pass No. 8 material shall be performed as follows:

6.3.1 Subject sample to elutriation through a No. 200 screen either by hand or mechanical washing.

6.3.2 Dry sample to constant mass, allow to cool, then weigh and record the dry mass to the nearest gram.

6.3.3 Place sample on the top sieve of a nest of fine sieves. The nest of sieves shall consist of sieves starting with the No. 10 sieve, down through and including the No. 200 sieve and pan. Place lid on nested sieves and screen the material by either mechanical or hand shaking, until not more than 0.5 percent by mass of sample passes any sieve during one minute.

6.3.4 Weigh and record separately, to the nearest gram, the mass of material retained on the individual sieves and in the pan.

6.3.5 Do not discard any of the sieved material until the sum of the individual masses is compared to the mass of the sample prior to sieving. If the difference between the two masses is less than or equal to 1.0% of the mass of the sample prior to sieving, an adjustment in mass shall be made on the sieve which has the largest mass retained, except no adjustment shall be made on the minus No. 200 material. If the difference is greater than 1.0%, the sample shall be recombined, resieved, and carefully reweighed.

6.3.6 Determine and record elutriation to nearest gram by determining the difference between the dry mass and the mass of the pass No. 8 split.

6.3.7 Determine a factor for calculating the fine sieve analysis by dividing the percent passing the No. 8 sieve (recorded to the nearest percent) by the mass of pass No. 8 split. Record the factor to six decimal places. If all the pass No. 8 material from coarse sieving was subjected to elutriation and fine sieving, a fine sieve factor is not determined. Rather, the coarse

sieve factor is utilized and the calculation of the percent passing each sieve is continuous through the entire sieve analysis.

6.3.8 The percent passing for each sieve in the fine sieve analysis is determined by multiplying the mass retained on that sieve by the fine sieve factor, and subtracting the result from the unrounded % passing the next larger sieve, with the exception of the percent passing the No. 8 which has previously been recorded to the nearest percent. Values for "mass retained multiplied by the fine sieve factor" and "percent passing each sieve" shall be determined and used in the calculations to six decimal places. The percent passing value for each sieve is recorded in the sieve analysis to the nearest percent, except the percent passing the No. 200 sieve is recorded to the nearest 0.1 percent.

6.3.9 As a check on the fine sieve analysis, the mass of material passing the No. 200 sieve is added to the elutriation mass, and this total is multiplied by the fine sieve factor. The result of this calculation, rounded to the nearest 0.1 percent, should be the same as the value for the percent passing the No. 200 sieve determined in Subsection 6.3.8 above.

6.3.10 If an aggregate gradation correction factor is utilized, the percent passing the No. 200 sieve shall be adjusted by subtracting the correction factor determined in Subsection 4.14.

6.4 Other methods may be used that differ from that specified in Subsections 6.2 and 6.3 above to determine % passing each sieve, so long as the method utilized has been proven to give equivalent results. However, any procedure which includes recording percent retained values prior to completing the calculation of all percent passing values is not allowed.

7. REPORT AND EXAMPLE

7.1 Report test information on the Asphaltic Concrete Tabulation – Ignition Furnace laboratory card. An example for the testing performed on a field sample is shown in Figure 4. Only the portion of the laboratory card relevant to the ignition furnace test is used for the example. A blank Asphaltic Concrete Tabulation – Ignition Furnace laboratory card is shown in Figure 5.

7.1.1 Mass of basket assembly.

7.1.2 Mass of sample and basket assembly.

7.1.3 Calculated initial mass of the sample.

7.1.4 Mass of sample and basket assembly after ignition.

7.1.5 Calculated mass of sample after ignition.

7.1.6 Asphalt binder content calibration factor.

7.1.7 Percent moisture from moisture test, if one was performed.

7.1.8 Corrected percent asphalt binder content.

7.1.9 Elapsed time of test.

7.1.10 Name of the operator.

7.1.11 Sample test date.

7.1.12 Design percent asphalt binder content.

7.1.13 Ignition furnace set temperature.

7.1.14 If determined, the sieve analysis of the residual aggregate (corrected for passing the No. 200 sieve if applicable).

Ignition Furnace Calibration
Mix Design Weigh-Up Information

Weight of Total Virgin Aggregate Required if Bulk Batching is Used (grams) (Furnace Calibration, Aggregate Properties Testing, etc.)	10000
Total Weight of Aggregate Charge (grams) (Virgin + RAP Aggregate needed for each Gradation Check and Burn)	2200

EXAMPLE

Total Binder Content (% by wt of total mix)	5.40	
Virgin Binder Content (% by wt of total mix)	4.20	
RAP Binder Content (% by wt of total mix)	1.20	
Total Virgin Aggregate (% by weight of total aggregate)		75.0
Total RAP Aggregate (% by weight of total aggregate)		25.0
	Total	100.0
Admixture (% by weight of total aggregate)		1.0

	Virgin Aggregate Stockpiles (Composite #2)					
	Sieve Analysis (Percent Passing)					Adjusted
Stockpile Description	WCF	CF	3/8	3/4	Total	Virgin Composite
Percent Used (w/o Admix)*	35.0	13.0	8.0	19.0	75.0	100.00
Adjusted Percent Used	46.67	17.33	10.67	25.33	100.00	
Sieve Size						
1.5"	100.0	100.0	100.0	100.0		100.00
1"	100.0	100.0	100.0	100.0		100.00
3/4"	100.0	100.0	100.0	82.0		95.44
1/2"	100.0	100.0	100.0	13.6		78.11
3/8"	100.0	100.0	100.0	4.0		75.68
1/4"	100.0	100.0	59.0	1.6		70.70
#4	97.1	98.8	22.5	1.6		65.24
#8	60.8	70.1	1.3	1.5		41.04
	* If unadjusted percent virgin agggregate stockpile use is not shown in Compostite #2, see Composite #1.					

Total Weight Required from each Stockpile if Bulk Batching Virgin Aggregates					Total
	4666.7	1733.3	1066.7	2533.3	10000.0

	Dry Screened RAP (Composite #3)		RAP Aggregate (Composite #1)		
	Sieve Analysis (Percent Passing)		Sieve Analysis (Percent Passing)		
Stockpile Description	Fine	Coarse	Fine	Coarse	Total
Percent Used (w/o Admix)			15.0	10.0	25.0
Adjusted Percent Used			60.0	40.0	100.0
Sieve Size					
1.5"	100.0	100.0	100.0	100.0	
1.25"	100.0	100.0	100.0	100.0	
1"	100.0	100.0	100.0	100.0	
3/4"	100.0	94.4	100.0	100.0	
1/2"	100.0	57.1	100.0	63.0	
3/8"	100.0	13.7	100.0	10.5	
1/4"	68.1	8.0	93.3	8.0	
#4	54.5	4.9	77.6	6.0	
#8	24.8	2.2	66.1	5.0	
	NOTE: Overall, Composite #2 (RAP Aggregate) will be finer than Composite #3 (Dry Screened RAP).				
RAP Mat'l Binder Content (%)	5.82	3.43			

FIGURE 1

Ignition Furnace Calibration
Weigh-Up Requirements for Gradation Check

Stockpile Description	Virgin Aggregate Stockpiles (Composite #2)				
	WCF	CF	3/8	3/4	Total
Percent Used (w/o Admix)	35.0	13.0	8.0	19.0	75.0
Adjusted Percent Used	46.67	17.33	10.67	25.33	100.00
Sieve Size	Accumulative Weights Required (grams)				
1.5"	0.0	0.0	0.0	0.0	0.0
1"	0.0	0.0	0.0	0.0	0.0
3/4"	0.0	0.0	0.0	75.2	75.2
1/2"	0.0	0.0	0.0	361.2	361.2
3/8"	0.0	0.0	0.0	401.3	401.3
1/4"	0.0	0.0	72.2	411.3	483.5
#4	22.3	3.4	136.4	411.3	573.5
#8	301.8	85.5	173.7	411.7	972.8
-#8	770.0	286.0	176.0	418.0	1650.0

NOTE: Use individual stockpile accumulative weights if Virgin Aggregate is not Bulk Batched. Use total accumulative weights if Virgin Aggregate is Bulk Batched prior to sieving.

Stockpile Description	Dry Screened RAP (Composite #3)	
	Fine	Coarse
Percent Used (w/o Admix)		
Adjusted Percent Used		
Sieve Size	Accumulative Weights Required (grams)	
1.5"	N/A	N/A
1.25"	N/A	N/A
1"	N/A	N/A
3/4"	N/A	N/A
1/2"	N/A	N/A
3/8"	N/A	N/A
1/4"	N/A	N/A
#4	N/A	N/A
#8	N/A	N/A
-#8	N/A	N/A
RAP Mat'l Binder Content (%)	5.82	3.43

RAP Aggregate (Composite #1)		
Fine	Coarse	Total
15.0	10.0	25.0
60.0	40.0	100.0
Accumulative Weights Required (grams)		
0.0	0.0	
0.0	0.0	
0.0	0.0	
0.0	0.0	
0.0	81.4	
0.0	196.9	
22.1	202.4	
73.9	206.8	
111.9	209.0	
330.0	220.0	

EXAMPLE

Gradation Check Material Requirements

Total Virgin Aggregate Weight Required (grams)	1650.0
Total RAP Aggregate Weight Required (grams)	550.0
Admixture Weight Required (grams)	22.0
Final Charge Weight (grams)	2222.0

FIGURE 2

Ignition Furnace Calibration
Weigh-Up Requirements for Burn 1 & 2

	Virgin Aggregate Stockpiles (Composite #2)				
Stockpile Description	WCF	CF	3/8	3/4	Total
Percent Used (w/o Admix)	35.0	13.0	8.0	19.0	75.0
Adjusted Percent Used	46.67	17.33	10.67	25.33	100.00
Sieve Size	Accumulative Weights Required (grams)				
1.5"	0.0	0.0	0.0	0.0	0.0
1"	0.0	0.0	0.0	0.0	0.0
3/4"	0.0	0.0	0.0	75.2	75.2
1/2"	0.0	0.0	0.0	361.2	361.2
3/8"	0.0	0.0	0.0	401.3	401.3
1/4"	0.0	0.0	72.2	411.3	483.5
#4	22.3	3.4	136.4	411.3	573.5
#8	301.8	85.5	173.7	411.7	972.8
-#8	770.0	286.0	176.0	418.0	1650.0
NOTE: Use individual stockpile accumulative weights if Virgin Aggregate is Bulk Batched. Use total accumulative weights is Virgin Aggregate is Batched prior to sieving.					

	Dry Screened RAP (Composite #3)		RAP Aggregate (Composite #1)	
Stockpile Description	Fine	Coarse	Fine	Coarse
Percent Used (w/o Admix)			N/A	N/A
Adjusted Percent Used			N/A	N/A
Sieve Size	Accumulative Weights Required (grams)		Accumulative Weights Required (grams)	
1.5"	0.0	0.0	N/A	N/A
1.25"	0.0	0.0	N/A	N/A
1"	0.0	0.0	N/A	N/A
3/4"	0.0	12.8	N/A	N/A
1/2"	0.0	97.7	N/A	N/A
3/8"	0.0	196.6	N/A	N/A
1/4"	111.8	209.6	N/A	N/A
#4	159.4	216.7	N/A	N/A
#8	263.5	222.8	N/A	N/A
-#8	350.4	227.8	N/A	N/A
RAP Mat'l Binder Content (%)	5.82	3.43		
Total Wt. of RAP Mat'l (grams)	350.4	227.8		
			Total	
Weight of RAP Binder (grams)	20.39	7.81	28.20	

Weight of Total Binder (grams)	126.84
RAP Binder Content (% by weight of total binder)	22.23
Total RAP Aggregate (% by weight of total aggregate)	25.00

EXAMPLE

Burn 1 & 2 Material Requirements

Total Virgin Aggregate Weight Required (grams)	1650.0
Total RAP Material Weight Required (grams)	578.2
Admixture Weight Required (grams)	22.0
Virgin Binder Weight Required (grams)	98.6
Final Charge Weight (grams)	2348.8

FIGURE 3

ARIZONA DEPARTMENT OF TRANSPORTATION
ASPHALTIC CONCRETE TABULATION – IGNITION FURNACE

USE CAPITAL LETTERS

LAB NUMBER	ORG NUMBER	MATL	TYPE	PURPOSE	TEST LAB	SIZE	SIZE %
13-0079	5555	AC	RC	A	P		

TEST NO.	LOT OR SUFFIX	SAMPLED BY	MO	DAY	YEAR	TIME
3	5	BETTY BOOP	05	02	13	1415 (MILITARY TIME)

SAMPLED FROM	LIFT NO.	RDWY	STATION
ROADWAY - 10' Rt. of ℄	1	NB	999+00 (IF MILEPOST, INPUT DECIMAL)

ORIGINAL SOURCE	PROJECT ENGINEER / SUPERVISOR	PROJECT NUMBER	TRACS NUMBER
RED RIVER VALLEY PIT	Bob Heidman	F-099-9(99)	H099901C

REMARKS
416 3/4" SPECIAL MIX (WITH RAP)

EXAMPLE

COARSE FACTOR 043860 = 100 / COARSE SIEVE TOTAL

WEIGHTS RETAINED		% RET	% PASS	SPECS
3″				
2 1/2″				
2″				
1 1/2″				
1″		0	100	
3/4″	91	4	96	
1/2″	319	14	82	
3/8″	160	7	75	
1/4″	182	8	67	
#4	137	6	61	
#8	433	19		
-#8	958	✓	42	
Total	2280	= i (Rounded)		

Weight of Pass #8 Split: 493 = p

FINE FACTOR 085193 = % Pass #8 / Wt. of Pass #8 Split

WEIGHTS RETAINED		% RET	% PASS	SPECS
#10	46	4	38	
#16	162	14	24	
#30	81	7	17	
#40	39	3	14	
#50	24	2	12	
#100	33	3	9	
#200	45	4		
-#200	31	r	5.4	
Total	461	q = Dry Weight		
Elutriation	32	= p - q		

r - s = 4.8 Corrected % Pass No. 200

% Pass No. 200 Correction Factor (±) + 0.6 s

IGNITION FURNACE ARIZ. 427☐ ARIZ. 428☒

a. Wet Mass of Moisture Sample	1023.2 g
b. Dry Mass of Moisture Sample	1020.5 g
c. Moisture Content (ARIZ 406) [(a - b) / a] x 100	0.26 %
d. Mass of Basket Assembly	3057.3 g
e. Mass of Sample and Basket Assembly	5471.5 g
f. Initial Mass of Sample (e - d)	2414.2 g
g. Ignition Furnace Set Temperature	538 °C
h. Mass of Sample and Basket Assembly After Ignition	5337.3 g
i. Mass of Sample After Ignition (h - d)	2280.0 g
j. Uncorrected Asphalt Binder Content [(f - i) /f] x 100	5.56 %
k. Asphalt Binder Content Calibration Factor (±)	+ 0.23 %
l. Ignition Furnace Correction (Tank Slab Correction) (±)	- 0.17 %
m. Corrected Asphalt Binder Content (j - k - c - l)	5.24 %
n. Design Asphalt Binder Content	5.40 %
o. Elapsed Time of Test (minutes)	67

COMPACTION
Marshall = M Gyratory = G Core = C ☐

RICE
Sample Max. Sp. Gr. (Gmm)
Sample Max. Density [(Gmm) x (62.3)] pcf

MARSHALL
Average Bulk O.D. Sp. Gr. (Gmb)
Average Bulk Density [(Gmb) x (62.3)] pcf
Air Voids = %
[1 - (Average Bulk Density / Max Density From Rice Test)] x 100
Stability lbs
Flow 0.01 in

GYRATORY
Average Relative Density (% Gmm) at Ndesign pcf
Air Voids = %
100 - [Average Relative Density % (Gmm) at Ndesign]

WHITE ☐
YELLOW ☐
BLUE ☐

05-02-13
RECEIVED DATE

M. Twain 05-03-13
TEST OPERATOR AND DATE

T. Sawyer 05-03-13
SUPERVISOR AND DATE

44-9372 R03/13

SEE BACK ALSO

FIGURE 4

ARIZONA DEPARTMENT OF TRANSPORTATION
ASPHALTIC CONCRETE TABULATION – IGNITION FURNACE

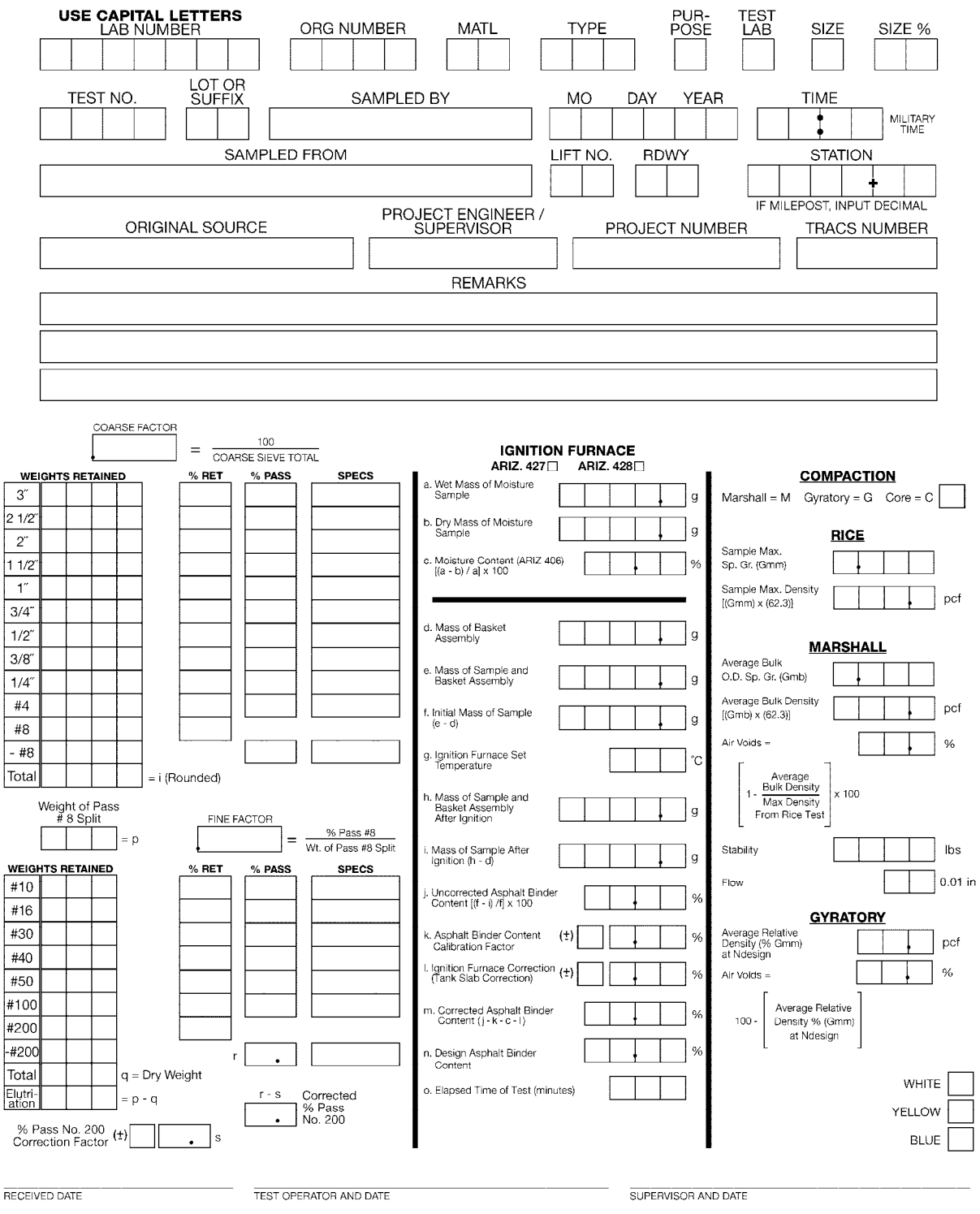

FIGURE 5

APPENDIX A

DETERMINATION OF GRADATION, MOISTURE CONTENT, AND BINDER CONTENT OF THE RAP MATERIAL

A.1 Obtain a representative sample of the RAP material in accordance with Arizona Test Method 105. When multiple RAP stockpiles are used, a separate representative sample shall be obtained from each stockpile.

A.1.1 The sample shall be split to provide a sufficient amount of material for gradation testing, moisture content testing, and binder content testing.

A.2 The entire split sample of RAP material from each stockpile is dried at 140 °F and the percent moisture content determined as described below.

Note: A higher drying temperature is not appropriate because it will soften the binder causing the RAP material to break into smaller particles and adhere to the drying pan.

A.2.1 The weight of the RAP material from each stockpile is determined and recorded to the nearest 0.1 gram.

A.2.2 The material is dried to constant weight at 140 ± 10 °F.

Note: Drying to constant weight at 140 °F will typically take overnight.

A.2.3 After drying to constant weigtht at 140 ± 10 °F, cover the material and allow to cool 30 ± 10 minutes at room temperature. The weight of the RAP material is then determined and recorded to the nearest 0.1 gram.

A.2.4 The percent moisture content of the RAP material from each stockpile is determined and recorded to the nearest 0.01 percent by the following:

$$\left[\begin{array}{c}\text{Percent Moisture} \\ \text{Content}\end{array}\right] = \left[\frac{\left(\begin{array}{c}\text{Weight of Material} \\ \text{Prior to Drying}\end{array}\right) - \left(\begin{array}{c}\text{Weight of Material} \\ \text{After Drying}\end{array}\right)}{\left(\begin{array}{c}\text{Weight of Material} \\ \text{After Drying}\end{array}\right)}\right] \text{ x } 100$$

A.3 After drying and determining the moisture content at 140 °F, the RAP material shall be tested for gradation, moisture content (at 290 °F), and binder content.

A.3.1 The gradation of the RAP material from each stockpile shall be determined as described below.

A.3.1.1 Split out a representative sample of the RAP material from each stockpile which conforms to the size specified in Table 3.

TABLE 3

Maximum Size of Particle (See Note)	Minimum Weight of Sample, grams
3/4 in. and larger	5000
1/2 in.	2000
3/8 in.	1000

Note: The smallest sieve opening through which the entire amount of material will pass.

A.3.1.2 Dry sieve the material in accordance with Arizona Test Method 240, with the exception that the No. 8 sieve shall be used as the smallest sieve. (Arizona Test Method 240 limits the time for shaking the sample to 5 minutes ± 15 seconds to control breakdown of the particles of RAP material into smaller size fractions.) The gradation of the RAP material from each stockpile is then determined in accordance with Arizona Test Method 248, Alternate #2.

A.3.2 The percent moisture content of the RAP material from each stockpile shall be determined by drying at 290 °F as described below.

Note: The sample for determining the moisture content at 290 °F shall be obtained at the same time and subjected to the same treatment prior to testing as the sample obtained for determining the RAP binder content.

A.3.2.1 Split out a representative 1000 ± 50 gram sample of the RAP material from each stockpile. The weight of each sample is determined and recorded to the nearest 0.1 gram.

A.3.2.2 Each sample is dried at 290 ± 10 °F to constant weight. Constant weight is defined as the weight at which further drying does not alter the weight more than 0.1 gram at intervals of a minimum of 30 minutes.

A.3.2.3 After drying to constant weight at 290 ± 10 °F, cover the sample and allow to cool 30 ± 10 minutes at room temperature. The weight of the sample is then determined and recorded to the nearest 0.1 gram.

A.3.2.4 The percent moisture content of the RAP material from each stockpile is determined and recorded to the nearest 0.01 percent by the following:

$$\left[\begin{array}{c}\text{Percent Moisture} \\ \text{Content}\end{array}\right] = \left[\frac{\left(\begin{array}{c}\text{Weight of Material} \\ \text{Prior to Drying}\end{array}\right) - \left(\begin{array}{c}\text{Weight of Material} \\ \text{After Drying}\end{array}\right)}{\left(\begin{array}{c}\text{Weight of Material} \\ \text{Prior to Drying}\end{array}\right)}\right] \text{ x } 100$$

A.3.3 The total percent moisture content of the RAP material from each stockpile is determined by adding the percent moisture content by drying at 140 °F (Subsection A.2) to the percent moisture content by drying at 290 °F (Subsection A.3.2).

A.3.4 The binder content of the RAP material from each stockpile shall be determined as described below.

A.3.4.1 Split out a representative sample of the RAP material from each stockpile which conforms to the size specified in Table 4.

TABLE 4

Nominal Maximum RAP Aggregate Size (See Notes)	Mass of Sample, grams
1 in.	2500 – 3000
3/4 in.	2000 – 2500
1/2 in.	1500 – 2000
3/8 in.	1200 – 1700
No. 4	1200 – 1700

Note: The nominal maximum RAP aggregate size is defined as: One size larger than the first sieve that retains more than 10 percent RAP aggregate.

Note: To determine the nominal maximum RAP aggregate size, the RAP aggregate gradation of each RAP stockpile, as shown in the mix design or as detemined from previous testing, may provide information.

A.3.4.2 Preheat the ignition furnace to 538 ± 5 °C (1000 ± 9 °F). Do not preheat the sample basket.

A.3.4.3 Weigh and record the mass of the basket assembly to the nearest 0.1 gram.

A.3.4.4 Perform ignition furnace testing on the RAP material from each stockpile in accordance with Subsections 5.6 through 5.13.

A.3.4.5 Calculate and record the binder content of the material from each RAP stockpile, to the nearest 0.01%, as follows:

$$\%AC = \left[\frac{W_i - W_A}{W_i} \times 100 \right] - \%M$$

Where:
- %AC = measured RAP binder content in percent by mass of the sample
- W_i = mass of the sample prior to ignition
- W_A = mass of the sample after ignition
- %M = percent moisture in the sample (determined by drying at 290 °F, per Subsection A.3.2)

A.3.4.5.1 Retain the original printed ticket and save with other test documentation.

A.3.4.6 Each measured binder content test result, as determined in Subsection A.3.4.5, is adjusted by the appropriate RAP binder content correction factor (See Appendix B). This adjustment is made by adding the RAP binder correction factor to each measured binder content. The corrected RAP binder content is recorded to the nearest 0.01%.

A.4 If needed, determine the RAP aggregate gradation by performing a sieve analysis of the residual aggregate in accordance with Section 6.

Note: Subsection 6.3.10 does not apply when determining the RAP aggregate gradation.

A.5 Report test information on the “RAP Material Tabulation - Ignition Furnace” laboratory card. An example is shown in Figure 6. A blank “RAP Material Tabulation - Ignition Furnace” laboratory card is shown in Figure 7.

ARIZONA DEPARTMENT OF TRANSPORTATION
RAP MATERIAL TABULATION – IGNITION FURNACE
(Arizona Test Method 428 - Appendix A)

WHITE ☐ YELLOW ☐ BLUE ☐

USE CAPITAL LETTERS

LAB NUMBER	ORG NUMBER	MATL	TYPE	PURPOSE	TEST LAB	SIZE	SIZE %
13-0027	5555	RP	C	A	P		

TEST NO.	LOT OR SUFFIX	SAMPLED BY	MO	DAY	YEAR	TIME
		BETTY BOOP	04	29	13	1035 MILITARY TIME

SAMPLED FROM	LIFT NO.	RDWY	STATION
STOCKPILE			+ (IF MILEPOST, INPUT DECIMAL)

ORIGINAL SOURCE	PROJECT ENGINEER / SUPERVISOR	PROJECT NUMBER	TRACS NUMBER
EXISTING ROADWAY MILLINGS	Bob Heidman	F-099-9(99)	H099901C

REMARKS

EXAMPLE

RAP Material Moisture Content @ 140°F

p. Wet Mass of RAP Material	10185.5	g
q. Dry Mass of RAP Material	10134.8	g
r. Moisture Content @ 140°F [(p - q) / q] x 100	0.50	%

RAP Material Gradation (ARIZ 240 / ARIZ 248, Alt. #2)

FACTOR 015293 = 100 / TOTAL

	WEIGHTS RETAINED	% RET	% PASS	SPECS
3"				
2 1/2"				
2"				
1 1/2"				
1 1/4"		0	100	100
1"	134	2	98	
3/4"	455	7	91	
1/2"	1942	30	61	
3/8"	2977	45	16	0-25
1/4"	585	9	7	
#4	129	2	5	
#8	140	2		
- #8	177	✓	3	
Total	6539			

Total RAP Material Moisture Content

r. Moisture Content @ 140°F	0.50	%
c. Moisture Content @ 290°F	0.16	%
s. Total Moisture Content (r + c)	0.66	%

Ignition Furnace

a. Wet Mass of Moisture Sample	989.3	g
b. Dry Mass of Moisture Sample	987.7	g
c. Moisture Content @ 290°F [(a - b) / a] x 100	0.16	%
d. Mass of Basket Assembly	3045.7	g
e. Mass of Sample and Basket Assembly	5631.3	g
f. Initial Mass of Sample (e - d)	2585.6	g
g. Ignition Furnace Set Temperature	538	°C
h. Mass of Sample and Basket Assembly After Ignition	5525.3	g
i. Mass of Sample After Ignition (h - d)	2479.6	g
j. Measured RAP Binder Content {[(f - i) /f] x 100} - c	3.94	%
k. RAP Binder Content Correction Factor	(±) - 0.37	%
l. Corrected RAP Binder Content (j + k)	3.57	%
m. Elapsed Time of Test (minutes)	43	

RAP Aggregate Gradation

COARSE FACTOR 040323 = 100 / Total [i (Rounded)]

	WEIGHTS RETAINED	% RET	% PASS
3"			
2 1/2"			
2"			
1 1/2"			
1"		0	100
3/4"	24	1	99
1/2"	794	32	67
3/8"	1287	52	15
1/4"	75	3	12
#4	49	2	10
#8	102	4	
- #8	149	✓	6
Total	2480	= i (Rounded)	

Weight of Pass # 8 Split ___ = n ; FINE FACTOR ___ = % Pass #8 / n

	WEIGHTS RETAINED	% RET	% PASS
#10	29	1	5
#16	13	1	4
#30	9	0	4
#40	20	1	3
#50	7	0	3
#100	16	1	2
#200	20	1	
-#200	17	✓	1.4
Total	131	o = Dry Weight	
Elutriation	18	= n - o	

04-29-13
RECEIVED DATE

M. TWAIN 04-30-13
TEST OPERATOR AND DATE

T. SAWYER 04-30-13
SUPERVISOR AND DATE

44-9379 03/13

FIGURE 6

ARIZONA DEPARTMENT OF TRANSPORTATION
RAP MATERIAL TABULATION – IGNITION FURNACE
(Arizona Test Method 428 - Appendix A)

WHITE ☐
YELLOW ☐
BLUE ☐

USE CAPITAL LETTERS
LAB NUMBER | ORG NUMBER | MATL | TYPE | PUR-POSE | TEST LAB | SIZE | SIZE %

TEST NO. | LOT OR SUFFIX | SAMPLED BY | MO | DAY | YEAR | TIME (MILITARY TIME)

SAMPLED FROM | LIFT NO. | RDWY | STATION (IF MILEPOST, INPUT DECIMAL)

ORIGINAL SOURCE | PROJECT ENGINEER / SUPERVISOR | PROJECT NUMBER | TRACS NUMBER

REMARKS

RAP Material Moisture Content @ 140°F

p. Wet Mass of RAP Material ____ g
q. Dry Mass of RAP Material ____ g
r. Moisture Content @ 140°F [(p - q) / q] x 100 ____ %

RAP Material Gradation (ARIZ 240 / ARIZ 248, Alt. #2)

FACTOR ____ = 100 / TOTAL

WEIGHTS RETAINED		% RET	% PASS	SPECS
3″				
2 1/2″				
2″				
1 1/2″				
1 1/4″				
1″				
3/4″				
1/2″				
3/8″				
1/4″				
#4				
#8				
- #8				
Total				

Total RAP Material Moisture Content

r. Moisture Content @ 140°F ____ %
c. Moisture Content @ 290°F ____ %
s. Total Moisture Content (r + c) ____ %

Ignition Furnace

a. Wet Mass of Moisture Sample ____ g
b. Dry Mass of Moisture Sample ____ g
c. Moisture Content @ 290°F [(a - b) / a] x 100 ____ %

d. Mass of Basket Assembly ____ g
e. Mass of Sample and Basket Assembly ____ g
f. Initial Mass of Sample (e - d) ____ g
g. Ignition Furnace Set Temperature ____ °C
h. Mass of Sample and Basket Assembly After Ignition ____ g
i. Mass of Sample After Ignition (h - d) ____ g
j. Measured RAP Binder Content {[(f - i) /f] x 100} - c ____ %
k. RAP Binder Content Correction Factor (±) ____ %
l. Corrected RAP Binder Content (j + k) ____ %
m. Elapsed Time of Test (minutes) ____

RAP Aggregate Gradation

COARSE FACTOR ____ = 100 / Total [i (Rounded)]

WEIGHTS RETAINED		% RET	% PASS
3″			
2 1/2″			
2″			
1 1/2″			
1″			
3/4″			
1/2″			
3/8″			
1/4″			
#4			
#8			
- #8			
Total			= i (Rounded)

Weight of Pass # 8 Split ____ = n
FINE FACTOR ____ = % Pass #8 / n

WEIGHTS RETAINED		% RET	% PASS
#10			
#16			
#30			
#40			
#50			
#100			
#200			
-#200			.
Total		o = Dry Weight	
Elutri-ation		= n - o	

RECEIVED DATE | TEST OPERATOR AND DATE | SUPERVISOR AND DATE

44-9379 03/13

FIGURE 7

APPENDIX B

DETERMINATION OF THE RAP BINDER CORRECTION FACTOR

B.1 A RAP binder content correction factor is determined for each RAP stockpile used in the asphaltic concrete mixture.

B.2 At the start of asphaltic concrete production, the first two samples of RAP material from each stockpile are split and tested for asphalt binder content; one split is tested by ignition furnace as described in Subsections A.3.4.2 through A.3.4.5.1, and the other split is tested by solvent extraction in accordance with AASHTO T 164.

Note: Generally, 9000 grams of RAP material from each stockpile will be adequate to obtain the split samples for determining the RAP binder content correction factor.

Note: At the discretion of the Engineer, the RAP binder correction factor may be determined prior to the start of asphaltic concrete production provided representative RAP samples are available.

B.3 The average asphalt binder content determined by ignition furnace is recorded to the nearest 0.001%.

B.4 The average asphalt binder content determined by solvent extraction is recorded to the nearest 0.001%.

B.5 The RAP binder content correction factor is determined by subtracting the average ignition furnace result from the average solvent extraction result. The RAP binder content correction factor is recorded to the nearest 0.01%.

B.6 A new RAP binder correction factor may be determined at any time the Engineer believes it is necessary due to a change in material or other circumstances.

B.7 Report the determination of the RAP binder content correction factor on the “RAP Binder Content Correction Factor” laboratory card. An example is shown in Figure 8. A blank “RAP Binder Content Correction Factor” laboratory card is shown in Figure 9.

ARIZONA DEPARTMENT OF TRANSPORTATION

RAP BINDER CONTENT CORRECTION FACTOR

(Arizona Test Method 428 - Appendix B)

Project Number: F-099-9(99)

TRACS Number: H099901C

RAP Material Type: COARSE

Sample # : 1 Sampled By: JACK B. NIMBLE Sampled From: STOCKPILE

Date Sampled: 04-23-13 Time Sampled: 8:28

Sample # : 2 Sampled By: MARY MUFFETT Sampled From: STOCKPILE

Date Sampled: 04-24-13 Time Sampled: 14:26

RAP BINDER CONTENT CORRECTION FACTOR
(Ignition Furnace vs. Solvent Extraction)

Sample #	RAP Binder Content (%)		RAP Binder Content Correction Factor
	Ignition Furnace (ARIZ 428)	Solvent Extraction (AASHTO T 164)	(Average Solvent Extraction Value) Minus (Average Ignition Furnace Value)
1	3.81	3.39	
2	3.96	3.65	
Average	3.885	3.520	(±) − 0.37

Remarks: EXAMPLE

04-24-13
Received Date

M. TWAIN
Test Operator and Date

T. SAWYER
Supervisor and Date

44-9380 03/13

FIGURE 8

ARIZONA DEPARTMENT OF TRANSPORTATION

RAP BINDER CONTENT CORRECTION FACTOR

(Arizona Test Method 428 - Appendix B)

Project Number: _____

TRACS Number: _____

RAP Material Type: _____

Sample # : _____ Sampled By: _____ Sampled From: _____

Date Sampled: _____ Time Sampled: _____

Sample # : _____ Sampled By: _____ Sampled From: _____

Date Sampled: _____ Time Sampled: _____

RAP BINDER CONTENT CORRECTION FACTOR
(Ignition Furnace vs. Solvent Extraction)

Sample #	RAP Binder Content (%)		RAP Binder Content Correction Factor
	Ignition Furnace (ARIZ 428)	Solvent Extraction (AASHTO T 164)	(Average Solvent Extraction Value) Minus (Average Ignition Furnace Value)
	.	.	
	.	.	
Average	.	.	(±) .

Remarks:

Received Date

Test Operator and Date

Supervisor and Date

44-9380 03/13

FIGURE 9