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PREFACE

This module is one of a set developed for the Western Alliance for Quality Transportation Construction (WAQTC). WAQTC is an alliance supported by the western state Transportation Departments, along with the Federal Highway Administration (FHWA) and the Western Federal Lands Highway Division (WFLHD) of FHWA. WAQTC’s charter includes the following mission.

MISSION

Provide continuously improving quality in transportation construction.

Through our partnership, we will:

• Promote an atmosphere of trust, cooperation, and communication between government agencies and with the private sector.

• Assure personnel are qualified.

• Respond to the requirements of identified needs and new technologies that impact the products that we provide.

BACKGROUND

There are two significant driving forces behind the development of the WAQTC qualification program. One, there is a trend to the use of quality control/quality assurance (QC/QA) specifications. QC/QA specifications include qualification requirements for a contractor’s QC personnel and will be requiring WAQTC qualified technicians. Two, Federal regulation on materials sampling and testing (23 CFR 637, Quality Assurance Procedures for Construction, published in June 1995) mandates that by June 29, 2000 all testing technicians whose results are used as part of the acceptance decision shall be qualified. In addition, the regulation allows the use of contractor test results to be used as part of the acceptance decision.

OBJECTIVES

WAQTC’s objectives for its Transportation Technician Qualification Program include the following:

• To provide highly skilled, knowledgeable materials sampling and testing technicians.

• To promote uniformity and consistency in testing.

• To provide reciprocity for qualified testing technicians between states.

• To create a harmonious working atmosphere between public and private employees based upon trust, open communication, and equality of qualifications.
Training and qualification of transportation technicians is required for several reasons. It will increase the knowledge of laboratory, production, and field technicians – both industry and agency personnel – and increase the number of available, qualified testers. It will reduce problems associated with test result differences. Regional qualification eliminates the issue of reciprocity between states and allows qualified QC technicians to cross state lines without having the concern or need to be requalified by a different program.

The WAQTC Executive Board
QUALITY ASSURANCE CONCEPTS

The Federal Highway Administration (FHWA) has established requirements that each State Transportation Department must develop a Quality Assurance (QA) Program that is approved by the FHWA for projects on the National Highway System (NHS). In addition to complying with this requirement, implementing QA specifications in a construction program includes the benefit of improvement of overall quality of highway and bridge construction.

A QA Program may include three separate and distinct parts as illustrated below.

Quality Assurance (QA) are those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.

Quality Control (QC) are those operational, process control techniques or activities that are performed or conducted to fulfill contract requirements for material and equipment quality. In some states, the constructor is responsible for providing QC sampling and testing, while in other states the STD handles QC. Where the constructor is responsible for QC tests, the results may be used for acceptance only if verified or accepted by additional tests performed by an independent group.

Verification/Acceptance consists of the sampling and testing performed to validate QC sampling and testing and, thus, the quality of the product. Verification/Acceptance samples are obtained and tests are performed independently from those involved with QC. Samples taken for QC tests may not be used for Verification/Acceptance testing.

Independent Assurance (IA) are those activities that are an unbiased and independent evaluation of all the sampling and testing procedures used in QC and Verification/Acceptance. IA may use a combination of laboratory certification, technician qualification or certification, proficiency samples, or split samples to assure that QC and Verification/Acceptance activities are valid. Agencies may qualify or certify laboratories and technicians, depending on the state in which the work is done.
ALASKA SAMPLING QUALIFICATION PROCESS
FOR MATERIALS TESTING TECHNICIANS

The Alaska Sampling Qualification is not part of the Western Alliance for Quality Transportation Construction (WAQTC) Technician Qualification program, however, all the material and procedures are WAQTC. A WAQTC qualification number will be issued for successful completion of this module.

Sampling Qualification is designed for those individuals responsible for field sampling of:

- aggregates for bases, bituminous mixes, soils, and soil aggregate mixture,
- asphalt cement and emulsified asphalt, and
- bituminous mixes.

Participants may include contractor and supplier quality control personnel, consulting engineering and materials testing firm personnel, quality assurance technicians, and public agency personnel.

The Process for Qualifying in Sampling:

- Meet the prerequisites. (see below)
- Pass the written and performance examinations.

Course Length: approximately 2 days
Course Size: 12-15 recommended

Prerequisites for being Qualified in Sampling: None

Recommendation: The participant should exhibit basic mathematics and reading comprehension skills.

The methods that are presented herein are excerpted from the following manuals: WAQTC Aggregate; WAQTC Embankment & Base & In-Place Density; and WAQTC Asphalt.
## TEST METHODS FOR Sampling QUALIFICATION

<table>
<thead>
<tr>
<th>AASHTO/WAQTC</th>
<th>PROCEDURE</th>
<th>TRAINING Classroom (C) Laboratory (L)</th>
<th>EXAM Written (W) Performance (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 90</td>
<td>Random Sampling Of Construction Materials</td>
<td>C</td>
<td>W</td>
</tr>
<tr>
<td>T 248</td>
<td>Reducing Samples of Aggregate to Testing Size</td>
<td>C,L**</td>
<td>W,P*</td>
</tr>
<tr>
<td>R 66</td>
<td>Sampling Bituminous Materials</td>
<td>C</td>
<td>W, P*</td>
</tr>
<tr>
<td>T 168</td>
<td>Sampling Bituminous Paving Mixtures</td>
<td>C</td>
<td>W, P*</td>
</tr>
<tr>
<td>R 47</td>
<td>Reducing Samples of Hot Mix Asphalt to Testing Size</td>
<td>C,L**</td>
<td>W,P*</td>
</tr>
</tbody>
</table>

* The Examinee will be asked to explain the sampling or reducing process during this portion of the performance examination.

** The Instructor will demonstrate the procedure to the participants in the lab, and participants will not be required to practice the procedure in the lab.
RANDOM SAMPLING OF CONSTRUCTION MATERIALS

**Significance**

Sampling and testing are two of the most important functions in quality control (QC). Data from the tests are the tools with which the quality of product is controlled. For this reason, great care must be used in following standardized sampling and testing procedures.

In controlling operations, it is necessary to obtain numerous samples at various points along the production line. Unless precautions are taken, sampling can occur in patterns that can create a bias to the data gathered. Sampling at the same time, say noon, each day may jeopardize the effectiveness of any quality program. This might occur, for example, because a material producer does certain operations, such as cleaning screens at an aggregate plant, late in the morning each day. To obtain a representative sample, a reliable system of random sampling must be employed.

**Scope**

The procedure presented here eliminates bias in sampling materials. Randomly selecting a set of numbers from a table or calculator will eliminate the possibility for bias. Random numbers are used to identify sampling times, locations, or points within a lot or sublot. This method does not cover how to sample, but rather how to determine sampling times, locations, or points.

**Sampling Concepts**

A lot is the quantity of material evaluated by QC procedures. A lot is a preselected quantity that may represent hours of production, a quantity or number of loads of material, or an interval of time. A lot may be comprised of several portions that are called sublots or units. The number of sublots comprising a lot will be determined by the agency’s specifications.
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**Straight Random Sampling vs. Stratified Random Sampling:** Straight random sampling considers an entire lot as a single unit and determines each sample location based on the entire lot size. Stratified random sampling divides the lot into a specified number of sublots or units and then determines each sample location within a distinct sublot. Both methods result in random distribution of samples to be tested for compliance with the agency’s specification.

Agencies stipulate when to use straight random sampling or stratified random sampling. AASHTO R 90, Sampling Aggregate Products, for example, specifies a straight random sampling procedure.

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### Picking Random Numbers from a Table

Table 1 contains pairs of numbers. The first number is the “pick” number and the second is the Random Number, “RN”. The table was generated with a spreadsheet and the cells (boxes at the intersection of rows and columns) containing the RNs actually contain the “random number function.” Every time the spreadsheet is opened or changed, all the RNs change.

1. Select a Pick number in a random method. The first two or last two digits in the next automobile license plate you see would be one way to select. Another would be to start a digital stop watch and stop it several seconds later, using the decimal part of the seconds as your Pick number.

2. Find the RN matching the Pick number.

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### Picking Random Numbers with a Calculator

Many calculators have a built-in random number function. To obtain a random number, key in the code or push the button(s) the calculator’s instructions call for. The display will show a number between 0.000 and 1.000 and this will be your random number.
### Table 1
Random Numbers

<table>
<thead>
<tr>
<th>Pick</th>
<th>RN</th>
<th>Pick</th>
<th>RN</th>
<th>Pick</th>
<th>RN</th>
<th>Pick</th>
<th>RN</th>
<th>Pick</th>
<th>RN</th>
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<td>0.998</td>
<td>21</td>
<td>0.758</td>
<td>41</td>
<td>0.398</td>
<td>61</td>
<td>0.895</td>
<td>81</td>
<td>0.222</td>
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<tr>
<td>02</td>
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<td>22</td>
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<td>42</td>
<td>0.603</td>
<td>62</td>
<td>0.442</td>
<td>82</td>
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<tr>
<td>04</td>
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<td>24</td>
<td>0.217</td>
<td>44</td>
<td>0.001</td>
<td>64</td>
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<td>84</td>
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<tr>
<td>05</td>
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<td>25</td>
<td>0.000</td>
<td>45</td>
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<td>06</td>
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<td>0.462</td>
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<td>86</td>
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<td>07</td>
<td>0.370</td>
<td>27</td>
<td>0.317</td>
<td>47</td>
<td>0.553</td>
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<tr>
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<td>0.499</td>
<td>30</td>
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<td>50</td>
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<td>11</td>
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<td>91</td>
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<tr>
<td>12</td>
<td>0.271</td>
<td>32</td>
<td>0.530</td>
<td>52</td>
<td>0.526</td>
<td>72</td>
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<td>92</td>
<td>0.656</td>
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<td>13</td>
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<td>14</td>
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<td>0.100</td>
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<td>15</td>
<td>0.188</td>
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<td>55</td>
<td>0.609</td>
<td>75</td>
<td>0.292</td>
<td>95</td>
<td>0.287</td>
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<tr>
<td>16</td>
<td>0.185</td>
<td>36</td>
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<td>56</td>
<td>0.579</td>
<td>76</td>
<td>0.854</td>
<td>96</td>
<td>0.461</td>
</tr>
<tr>
<td>17</td>
<td>0.809</td>
<td>37</td>
<td>0.509</td>
<td>57</td>
<td>0.887</td>
<td>77</td>
<td>0.240</td>
<td>97</td>
<td>0.703</td>
</tr>
<tr>
<td>18</td>
<td>0.105</td>
<td>38</td>
<td>0.013</td>
<td>58</td>
<td>0.495</td>
<td>78</td>
<td>0.851</td>
<td>98</td>
<td>0.866</td>
</tr>
<tr>
<td>19</td>
<td>0.715</td>
<td>39</td>
<td>0.497</td>
<td>59</td>
<td>0.039</td>
<td>79</td>
<td>0.678</td>
<td>99</td>
<td>0.616</td>
</tr>
<tr>
<td>20</td>
<td>0.380</td>
<td>40</td>
<td>0.587</td>
<td>60</td>
<td>0.812</td>
<td>80</td>
<td>0.122</td>
<td>00</td>
<td>0.759</td>
</tr>
</tbody>
</table>

### Examples of Straight Random Sampling Procedures Using Random Numbers

#### Sampling from a Belt or Flowing Stream:

Agencies specify the frequency of sampling in terms of time, volumes, or masses. The specification might call for one sample from every 1,000,000 kg (1000 t) or 1100 Tons (T) of aggregate. If the random number was 0.317, the sample would be taken at \((0.317)(1,000,000 \text{ kg}) = 317,000 \text{ kg} \) (317 t). Or \((0.317)(1100 \text{ T}) = 349 \text{ T})

One sample per day might also be specified. If the day were 9 hours long and the random number 0.199, the sample would be taken at \((0.199)(9 \text{ hrs}) = 1.79 \text{ hr} = 1 \text{ hr}, 48 \text{ minutes} \) into the day. AASHTO R 90 permits this time to be rounded to the nearest 5 minutes.

#### Sampling from Haul Units:

Based on the agency’s specifications – in terms of time, volume, or mass – determine the number of haul units that comprise a lot. Multiply the selected random
number(s) by the number of units to determine which unit(s) will be sampled.

For example, if 20 haul units comprise a lot and one sample is needed, pick one RN. If the RN were 0.773, then the sample would be taken from the \((0.773)(20) = 15.46\), or 16th haul unit.

**Sampling from a Roadway with Previously Placed Material:** The agency’s specified frequency of sampling – in time, volume, or mass – can be translated into a location on a job. For example, if a sample is to be taken every 800 m \(^3\) (1000yd \(^3\)) and material is being placed 0.15 m (0.50 ft) thick and 4.0 m (13 ft) wide, then the lot is 1330 m (4154 ft) long. You would select two RNs in this case. To convert yd \(^3\) to ft \(^3\) multiply by 27.

The first RN would be multiplied by the length to determine where the sample would be taken along the project. The second would be multiplied by the width to determine where, widthwise, the sample would be taken. For example, a first RN of 0.759 would specify that the sample would be taken at \((0.759)(1330 \text{ m})\) or \((4154 \text{ ft}) = 1010 \text{ m or 3153 ft}\) from the beginning. A second RN of 0.255 would specify that the sample would be taken at \((0.255)(4.0 \text{ m})\) or \((13 \text{ ft}) = 1.02 \text{ m or 3.3 ft}\) from the right edge of the material. To avoid problems associated with taking samples too close to the edge, no sample is taken closer than 0.3 m (1 ft) to the edge. If the RN specifies a location closer than 0.3 m (1 ft), then 0.3 m (1 ft) is added to or subtracted from the distance calculated.

**Sampling from a Stockpile:** AASHTO R 90 recommends against sampling from stockpiles. However, some agencies use random procedures in determining sampling locations from a stockpile. Bear in mind that stockpiles are prone to segregation and that a sample obtained from a stockpile may not be representative. Refer to AASHTO R 90 for guidance on how to sample from a stockpile.
**In-Place Density Testing:** Agency specifications will indicate the frequency of tests. For example, one test per 500 m³ (650 yd³) might be required. If the material is being placed 0.15 m (0.50 ft) thick and 10.0 m (33 ft) wide, then the lot is 333 m (1090 ft) long. You would select two RNs in this case.

The first RN would be multiplied by the length to determine where the sample would be taken along the project. The second would be multiplied by the width to determine where, widthwise, the sample would be taken. For example, a first RN of 0.387 would specify that the sample would be taken at (0.387)(333 m) or (1090 ft) = 129 m or (422 ft) from the beginning. A second RN of 0.558 would specify that the sample would be taken at (0.588)(10.0 m) or (33 ft) = 5.88 m or (19 ft) from the right edge of the material. To avoid problems associated with taking samples too close to the edge, no sample is taken closer than 0.3 m (1 ft) to the edge. If the RN specifies a location closer than 0.3 m (1 ft), then 0.3 m (1 ft) is added to or subtracted from the distance calculated.
**Significance**
Tests cannot be performed on all the material included in an entire project, so samples are taken from the whole. Proper material sampling is critical to all subsequent testing. If the representative portion obtained through sampling does not truly represent the material, any analysis of that portion is inappropriate for the project at hand. Since only a portion of the whole is used, that portion must be a reliable reflection of the whole. The size of the sample will depend upon the tests to be run and on the nominal maximum size of the aggregate.

**Scope**
This procedure covers sampling of coarse, fine, or a combination of coarse and fine aggregates (CA and FA) in accordance with AASHTO R 90-18. Sampling from conveyor belts, transport units, roadways, and stockpiles is covered.

**Apparatus**
- Shovels or scoops, or both
- Brooms, brushes, and scraping tools
- Sampling tubes of acceptable dimensions
- Mechanical sampling systems: normally a permanently attached device that allows a sample container to pass perpendicularly through the entire stream of material or diverts the entire stream of material into the container by manual, hydraulic, or pneumatic operation
- Belt template
- Sampling containers
Procedure - General

Sampling is as important as testing. The technician shall use every precaution to obtain samples that are representative of the material the sample represents. Determine the time or location for sampling in a random manner.

1. Wherever samples are taken, obtain multiple increments of approximately equal size.

2. Mix the increments thoroughly to form a field sample that meets or exceeds the minimum mass recommended in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Recommended Sample Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal Maximum Size</strong></td>
</tr>
<tr>
<td>mm (in.)</td>
</tr>
<tr>
<td>90 (3 1/2)</td>
</tr>
<tr>
<td>75 (3)</td>
</tr>
<tr>
<td>63 (2 1/2)</td>
</tr>
<tr>
<td>50 (2)</td>
</tr>
<tr>
<td>37.5 (1 1/2)</td>
</tr>
<tr>
<td>25.0 (1)</td>
</tr>
<tr>
<td>19.0 (3/4)</td>
</tr>
<tr>
<td>12.5 (1/2)</td>
</tr>
<tr>
<td>9.5 (3/8)</td>
</tr>
<tr>
<td>4.75 (No. 4)</td>
</tr>
<tr>
<td>2.36 (No. 8)</td>
</tr>
</tbody>
</table>

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum size. Maximum size is one size larger than nominal maximum size.

**Note 1:** Sample size is based upon the test(s) required. As a general rule, the field sample size should be such that, when split twice will provide a testing sample of proper size. For example, the sample size may be four times that shown in Table 2 of the FOP for AASHTO T 27/T 11, if that mass is more appropriate.
Nominal maximum size and maximum size are not the same.

**Example:**

<table>
<thead>
<tr>
<th>Sieve Size, mm (in)</th>
<th>Cumulative Percent Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 (3)</td>
<td>0</td>
</tr>
<tr>
<td>63 (2 1/2)</td>
<td>0</td>
</tr>
<tr>
<td>50 (2)</td>
<td>0</td>
</tr>
<tr>
<td>37.5 (1 1/2)</td>
<td>7</td>
</tr>
<tr>
<td>25.0 (1)</td>
<td>32</td>
</tr>
<tr>
<td>19.0 (3/4)</td>
<td>38</td>
</tr>
<tr>
<td>12.5 (1/2)</td>
<td>47</td>
</tr>
<tr>
<td>9.5 (3/8)</td>
<td>58</td>
</tr>
<tr>
<td>4.75 (No.4)</td>
<td>72</td>
</tr>
</tbody>
</table>

First sieve to cumulatively retain >10 percent: 25.0 mm (1 in.)
Nominal maximum size: 37.5 mm (1 ½ in.)
Maximum size: 50 mm (2 in.)

**Procedure – Specific Situations**

**Conveyor Belts**

Avoid sampling at the beginning or the end of an aggregate run due to the potential for segregation. Be careful when sampling in the rain. Make sure to capture fines that may stick to the belt or that the rain tends to wash away.

**Method A (From the Belt)**

1. Stop the belt.
2. Set the sampling template in place on the belt, avoiding intrusion by adjacent material.
3. Remove the material from inside the template, including all fines.
4. Obtain at least three approximately equal increments.
5. Combine the increments to form a single sample.

**Method B (From the Belt Discharge)**

1. Pass a sampling device through the full stream of the material as it runs off the end of the conveyor belt. The sampling device may be manually, semi-automatic or automatically powered.
2. The sampling device shall pass through the stream at least twice, once in each direction, without overfilling while maintaining a constant speed during the sampling process.

3. When emptying the sampling device into the container, include all fines.

4. Combine the increments to form a single sample.

**Transport Units**

1. Visually divide the unit into four quadrants.

2. Identify one sampling location in each quadrant.

3. Dig down and remove approximately 0.3 m (1 ft) of material to avoid surface segregation. Obtain each increment from below this level.

4. Combine the increments to form a single sample.

**Roadways**

**Method A (Berm or Windrow)**

1. Obtain sample before spreading.

2. Take the increments from at least three random locations along the fully-formed windrow or berm. Do not take the increments from the beginning or the end of the windrow or berm.

3. Obtain full cross-section samples of approximately equal size at each location. Take care to exclude the underlying material.

4. Combine the increments to form a single field sample.

**Note 2:** Obtaining samples from berms or windrows may yield extra-large samples and may not be the preferred sampling location.
Method B (In-Place)
1. Obtain sample after spreading and before compaction.
2. Take the increments from at least three random locations.
3. Obtain full-depth increments of approximately equal size from each location. Take care to exclude the underlying material.
4. Combine the increments to form a single sample.

Stockpiles
Method A–Loader sampling
1. Direct the loader operator to enter the stockpile with the bucket at least 150 mm (6 in.) above ground level without contaminating the stockpile.
2. Discard the first bucketful.
3. Have the loader re-enter the stockpile and obtain a full loader bucket of the material, tilt the bucket back and up.
4. Form a small sampling pile at the base of the stockpile by gently rolling the material out of the bucket with the bucket just high enough to permit free-flow of the material. (Repeat as necessary.)
5. Create a flat surface by having the loader back drag the small pile.
6. Visually divide the flat surface into four quadrants.
7. Collect an increment from each quadrant by fully inserting the shovel into the flat pile as vertically as possible, take care to exclude the underlying material, roll back the shovel and lift the material slowly out of the pile to avoid material rolling off the shovel.
Method B – Stockpile Face Sampling

1. Create horizontal surfaces with vertical faces in the top, middle, and bottom third of the stockpile with a shovel or loader.

2. Prevent sloughing by shoving a flat board against the vertical face. Sloughed material will be discarded to create the horizontal surface.

3. Obtain sample from the horizontal surface as close to the intersection as possible of the horizontal and vertical faces.

4. Obtain at least one increment of equal size from each of the top, middle, and bottom thirds of the pile.

5. Combine the increments to form a single sample.

Method C – Alternate Tube Method (Fine Aggregate)

1. Remove the outer layer that may have become segregated.

2. Using a sampling tube, obtain one increment of equal size from a minimum of five random locations on the pile.

3. Combine the increments to form a single sample.

Note 3: Obtaining samples at stockpiles should be avoided whenever possible due to problems involved in obtaining a representative gradation of material.

Identification and Shipping

- Identify samples according to agency standards.
- Include sample report (below).
- Ship samples in containers that will prevent loss, contamination, or damage.
Report
- On forms approved by the agency
- Date
- Time
- Sample ID
- Sampling method
- Location
- Quantity represented
- Material type
- Supplier

Tips!
- Remember, the sample must be representative of the whole.
- And the sample must be selected at random to avoid bias.
- Automatic mechanical sampling is preferred.
REVIEW QUESTIONS

1. How can power equipment, such as loaders and backhoes, be used to collect aggregate samples?

2. Describe the process for sampling from a conveyor belt using method “A.”

3. Which sampling location should be avoided whenever possible due to problems involved in obtaining a representative gradation of material?

4. Describe sampling from roadways.
### PERFORMANCE EXAM CHECKLIST (ORAL)

**SAMPLING OF AGGREGATE PRODUCTS**
**FOP FOR AASHTO R 90**

Participant Name ______________________________ Exam Date ______________

Record the symbols “P” for passing or “F” for failing on each step of the checklist.

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. How is a sample obtained from a conveyor belt using Method A?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Stop the belt.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>b) Set the sampling template on belt, avoiding intrusion of adjacent material.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>c) All the material is removed from belt including all fines.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>d) Take at least approximately three equal increments.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td><strong>2. How is a sample obtained from a conveyor belt using Method B?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Pass the sampling device through a full stream of material as it runs off the end of the belt.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>b) The device must be passed through at least twice (once in each direction).</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td><strong>3. How is a sample obtained from a Transport Unit?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Divide the unit into four quadrants.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>b) Dig 0.3 m (1 ft.) below surface.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>c) Obtain an increment from each quadrant.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td><strong>4. Describe the procedure for sampling from roadways Method A (Berm or Windrow).</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Sample before spreading</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>b) Sample the material full depth without obtaining underlying material.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>c) Take at least three approximately equal increments.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td><strong>5. Describe the procedure for sampling from roadway Method B (In-place).</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Sample after spreading, prior to compaction.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>b) Sample the material full depth without obtaining underlying material.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>c) Take at least three approximately equal increments.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td><strong>6. Describe the procedure for sampling a stockpile Method A (Loader Sampling).</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Loader removes contaminates and creates sampling pile.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>b) Loader back drags pile to create a flat surface.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>c) Divide the flat surface into four quadrants.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>d) Take an approximately equal increment from each quadrant, excluding the underlying material.</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

OVER
7. Describe the procedure for sampling a stockpile Method B (Stockpile Face Sampling).
   a) Create horizontal surfaces with vertical faces with a shovel. _____ _____
   b) At least one increment taken from each of the top, middle, and bottom thirds of the stockpile. _____ _____

8. Describe the procedure for sampling a stockpile Method C – Alternate Tube Method (Fine Aggregate).
   a) Remove the outer layer of segregated material. _____ _____
   b) Obtain increments from at least five locations. _____ _____

9. After obtaining the increments what should you do before performing R 76?
   a) Increments mixed thoroughly to form sample. _____ _____

Comments: First attempt: Pass_____Fail_____ Second attempt: Pass_____Fail_____

Examiner Signature ______________________ WAQTC #: ______________________
REDUCING SAMPLES OF AGGREGATES TO TESTING SIZE
FOP FOR AASHTO R 76

Significance
Aggregates and other materials sampled in the field in accordance with AASHTO R 90 are large composites and need to be reduced to the appropriate size for testing. It is extremely important that the procedure used to reduce the field sample not modify the material.

Scope
This procedure covers the reduction of samples to the appropriate size for testing in accordance with AASHTO R 76-16. Techniques are used that minimize variations in characteristics between test samples and field samples. Method A (Mechanical Splitter) and Method B (Quartering) are covered.

This FOP applies to fine aggregate (FA), coarse aggregate (CA), and mixes of the two (FA/CA) and may also be used on soils.

Apparatus
Method A – Mechanical Splitter

Splitter chutes:
- Even number of equal width chutes
- Discharge alternately to each side
- Minimum of 8 chutes total for CA and FA / CA, 12 chutes total for FA
- Width:
  - Minimum 50 percent larger than largest particle
  - Maximum chute width of 19 mm (3/4 in.) for fine aggregate passing 9.5 mm (3/8 in.) sieve
- Feed control:
  - Hopper or straightedge pan with a width equal to or slightly less than the overall width of the assembly of chutes
  - Capable of feeding the splitter at a controlled rate
- Splitter Receptacles / Pans:
- Capable of holding two halves of the sample following splitting

The splitter and accessory equipment shall be so designed that the sample will flow smoothly without restriction or loss of material.

**Method B – Quartering**

- Straightedge scoop, shovel, or trowel
- Broom or brush
- Canvas or plastic sheet, approximately 2 by 3 m (6 by 9 ft)

**Method Selection**

Samples of CA may be reduced by either Method A or Method B.

Samples of FA which are drier than the saturated surface dry (SSD) condition, as described in AASHTO T 84, shall be reduced by a mechanical splitter according to Method A. As a quick approximation, if the fine aggregate will retain its shape when molded with the hand, it is wetter than SSD.

Samples of FA / CA which are drier than SSD may be reduced by Method A or Method B.

Samples of FA that are at SSD or wetter than SSD shall be reduced by Method B, or the entire sample may be dried to the SSD condition – using temperatures that do not exceed those specified for any of the tests contemplated – and then reduced to test sample size using Method A.
Table 1

<table>
<thead>
<tr>
<th>Drier than SSD</th>
<th>Wetter than SSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Aggregate (FA)</td>
<td>Method A (Mechanical)</td>
</tr>
<tr>
<td>Mixture of FA/CA</td>
<td>Either Method</td>
</tr>
<tr>
<td>Coarse Aggregate (CA)</td>
<td>Either Method</td>
</tr>
</tbody>
</table>

Procedure

Method A – Mechanical Splitter

1. Place the sample in the hopper or pan and uniformly distribute it from edge to edge so that approximately equal amounts flow through each chute. The rate at which the sample is introduced shall be such as to allow free flowing through the chutes into the pans below.

2. Reduce the sample from one of the two pans as many times as necessary to reduce the sample to meet the minimum size specified for the intended test. The portion of the material collected in the other pan may be reserved for reduction in size for other tests.

3. As a check for effective reduction, determine the mass of each reduced portion. If the percent difference of the two masses is greater than 5 percent, corrective action must be taken. In lieu of the check for effective reduction, use the method illustrated in Figure 1.

Example:

- Sample (S) is an amount greater than or equal to twice the mass needed for testing. Sample (S) is split in a mechanical splitter to yield parts (1) and (2).
- Part (1) is further reduced, yielding (A) and (B), while Part (2) is reduced to yield (B) and (A).
- Final testing sample is produced by combining alternate pans, i.e. (A)/(A) or (B)/(B) only.
Calculation

\[
\frac{\text{Smaller Mass}}{\text{Larger Mass}} = \text{Ratio} \quad (1 - \text{Ratio}) \times 100 = \% \text{Difference}
\]

Splitter check: 5127 g total sample mass
Splitter pan #1: 2583 g
Splitter pan #2: 2544 g

\[
\frac{2544 \text{ g}}{2583 \text{ g}} = 0.985 \quad (1 - 0.985) \times 100 = 1.5\%
\]

Method B – Quartering

Use either of the following two procedures or a combination of both.

Procedure #1: Quartering on a clean, hard, level surface:

1. Place the sample on a hard, clean, level surface where there will be neither loss of material nor the accidental addition of foreign material.
2. Mix the material thoroughly by turning the entire sample over a minimum of four times. With the last turning, shovel the entire sample into a conical pile by depositing each shovelful on top of the preceding one.
3. Flatten the conical pile to a uniform thickness and diameter by pressing down with a shovel. The diameter should be four to eight times the thickness.
4. Divide the flattened pile into four approximately equal quarters with a shovel or trowel.
5. Remove two diagonally opposite quarters, including all fine material, and brush the cleared spaces clean.
6. Successively mix and quarter the remaining material until the sample is reduced to the desired size.
7. The final test sample consists of two diagonally opposite quarters.

**Procedure #2**: Quartering on a canvas or plastic sheet:

1. Place the sample on the sheet.

2. Mix the material thoroughly a minimum of four times by pulling each corner of the sheet horizontally over the sample toward the opposite corner. After the last turn, form a conical pile.

3. Flatten the conical pile to a uniform thickness and diameter by pressing down with a shovel. The diameter should be four to eight times the thickness.

4. Divide the flattened pile into four approximately equal quarters with a shovel or trowel, or insert a stick or pipe beneath the sheet and under the center of the pile, then lift both ends of the stick, dividing the sample into two roughly equal parts. Remove the stick, leaving a fold of the sheet between the divided portions. Insert the stick under the center of the pile at right angles to the first division and again lift both ends of the stick, dividing the sample into four roughly equal quarters.

5. Remove two diagonally opposite quarters, being careful to clean the fines from the sheet.

6. Successively mix and quarter the remaining material until the sample size is reduced to the desired size.

7. The final test sample consists of two diagonally opposite quarters.
Tips!

- Remember, the reduced sample must be representative of the whole.
- Method A – mechanical splitter – is preferred.
- Method A cannot be used for FA wetter than SSD condition.
- Keep the mechanical splitter dry to avoid having particles “stick” to it.
- Make sure your splitter is level.
REVIEW QUESTIONS

1. When using the mechanical splitter for FA, the minimum width of the individual chutes should be approximately how much larger than the largest particles in the sample to be split?

2. What is the maximum width of the chute for material passing the 9.5 mm (3/8 in) sieve?

3. How does the moisture content of the sample influence reduction?

4. Define the SSD condition.

5. Describe two methods of mixing the sample.
PERFORMANCE EXAM CHECKLIST

REDUCING FIELD SAMPLES OF AGGREGATES TO TESTING SIZE
FOP FOR AASHTO R 76

Participant Name ______________________________ Exam Date ______________

Record the symbols “P” for passing or “F” for failing on each step of the checklist.

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method A - Splitting

1. Chutes appropriate size and number? _____ _____
2. Material spread uniformly on feeder? _____ _____
3. Rate of feed slow enough so that sample flows freely through chutes? _____ _____
4. Material in one pan re-split until desired mass is obtained? _____ _____
5. Material reduced effectively (within 5 percent or Figure 1)? _____ _____

Method B - Quartering

1. Sample placed on clean, hard, and level surface? _____ _____
2. Mixed by turning over 4 times with shovel or by pulling sheet horizontally over pile? _____ _____
3. Conical pile formed without loss of material? _____ _____
4. Pile flattened to uniform thickness and diameter? _____ _____
5. Diameter equal to about 4 to 8 times thickness? _____ _____
6. Divided into 4 equal portions with shovel or trowel without loss of material? _____ _____
7. Two diagonally opposite quarters, including all fine material, removed? _____ _____
8. Process continued until desired sample size is obtained when two opposite quarters combined? _____ _____

The sample may be placed upon a sheet and a stick or pipe may be placed under the sheet to divide the pile into quarters.

Comments: First attempt: Pass Fail _____ Second attempt: Pass Fail _____

Examiner Signature ____________________________   WAQTC #:_______________
Significance
The quality of asphalt materials has a tremendous impact on a roadway project. The grade of binder selected is based on a number of factors, including local temperature extremes and characteristics of expected traffic. Using a grade of binder material other than that specified will have serious impacts on roadway performance and durability.

Scope
The procedure covers obtaining samples of liquid asphalt materials in accordance with AASHTO R 66-16. Sampling of solid and semi-solid asphalt materials – included in AASHTO R 66 – is not covered here. Agencies may be more specific on exactly who samples, where to sample, and what type of sampling device to use.

Warning: Always use appropriate safety equipment and precautions for hot liquids.

Terminology
- Asphalt binder: Asphalt cement or modified asphalt cement that binds the aggregate particles into a dense mass.
- Asphalt emulsion: A mixture of asphalt binder and water.
- Cutback asphalt: Asphalt binder that has been modified by blending with a chemical solvent.

Procedure
1. Coordinate sampling with contractor or supplier.
2. Allow a minimum of 4 L (1 gal) to flow before obtaining a sample(s).
3. Obtain samples of:
   - Asphalt binder from the line between the storage tank and the mixing plant while the
plant is in operation, or from the delivery truck.

- Cutback and emulsified asphalt from distributor spray bar or application device, or from the delivery truck before it is pumped into the distributor: Sample emulsified asphalt at delivery or prior to dilution.

**Containers**

Sample containers must be new, and the inside may not be washed or rinsed. The outside may be wiped with a clean, dry cloth.

All samples shall be put in 1 L (1 qt) containers and properly identified on the outside of the container with contract number, date sampled, data sheet number, brand and grade of material, and sample number. Include lot and sublot numbers when appropriate.

- Emulsified asphalt: Use wide-mouth plastic jars with screw caps. Protect the samples from freezing since water is a part of the emulsion. The sample container should be completely filled to minimize a skin formation on the sample.

- Asphalt binder and cutbacks: Use metal cans.

**Note:** The filled sample container shall not be submerged in solvent, nor shall it be wiped with a solvent saturated cloth. If cleaning is necessary, use a clean dry cloth.

**Report**

- On forms approved by the agency
- Sample ID
- Date
- Time
- Location
- Quantity represented

**Tips!**

- Remember to identify sample on outside of container.
REVIEW QUESTIONS

1. Describe how liquid asphalt material is obtained at an HMA plant.

2. Describe how liquid asphalt material is obtained from a spray distributor.

3. Describe the containers used for sampling.
PERFORMANCE EXAM CHECKLIST (ORAL)

SAMPLING BITUMINOUS MATERIALS
FOP FOR AASHTO T 40

Participant Name ___________________________ Exam Date _______________

Record the symbols “P” for passing or “F” for failing on each step of the checklist.

Procedure Element Trial 1 Trial 2

1. Describe the container that is used to sample bituminous liquids.
   a. New metal can, 1 L (1 qt) in size. _____ _____

2. Describe the container that is used to sample emulsified liquids.
   a. New wide mouth plastic jar, 1 L (1 qt) in size. (Alaska uses 1 gal) _____ _____

3. How much material must be wasted before a sample can be obtained?
   a. A minimum of 4 L (1 gal). _____ _____

4. At a hot plant where must a sample be taken?
   a. In the line between storage tank and mixing plant or from delivery vehicle. _____ _____

5. Where is an emulsified sample taken?
   a. Spray bar or application device, if not diluted. _____ _____
   b. From delivery vehicle or prior to dilution, if diluted. _____ _____

Comments: First attempt: Pass [ ] Fail [ ] Second attempt: Pass [ ] Fail [ ]

Examiner Signature ___________________________ WAQTC #: _____________
SAMPLING OF BITUMINOUS PAVING MIXTURES
FOP FOR AASHTO T 168

Significance
Testing bituminous paving mixtures in the field begins with obtaining and preparing the sample to be tested. Standardized procedures for obtaining a representative sample have been established. Producing strong, durable, reliable pavement in roadways requires careful sampling and accurate testing.

Technicians must be patient and follow these procedures. If one considers that the specifications require quality tests to be made on only a small portion of the total material placed, the need for a truly representative sample is apparent.

Scope
This procedure covers the sampling of bituminous paving mixtures from HMA plants; haul units, and roadways, in accordance with AASHTO T 168-03. Sampling is as important as testing, and every precaution must be taken to obtain a truly representative sample.

Apparatus
- Shovel
- Sample containers: Cardboard boxes, metal cans, stainless steel bowls, or other agency-approved containers
- Scoops, trowels, or other equipment to obtain mix
- Sampling plate: Thick metal plate, minimum 8 gauge, sized to accommodate sample requirements, with a wire attached to one corner long enough to reach from the center of the paver to the outside of the farthest auger extension. Holes ¼ in. in diameter should be provided in each corner.
- Cookie cutter sampling device: Formed steel angle with two 100 mm by 150 mm by 9 mm (4 in. by 6 in. by 3/8 in.) handles, sized to accommodate sample requirements. Minimum
2 in. smaller than the sampling plate when used together.

*Example:* Sampling plate 380 mm (15 in.) square and a cookie cutter sampling device 330 mm (13 in.) square.

- Mechanical sampling device

**Sample Size**

Sample size depends on the test methods specified by the agency for acceptance. Check agency requirement for the size required.

**Sampling General**

- The material shall be tested to determine variations. The supplier/contractor shall provide equipment for safe and appropriate sampling including sampling devices on plants, when required.

- For dense graded mixture samples use cardboard boxes, stainless steel bowls or other agency approved containers.

- For hot open graded mixture samples use stainless steel bowls. Do not put open graded mixture samples in boxes until they have cooled to the point that bituminous material will not migrate from the aggregate.

**Attached Sampling Devices**

Some agencies require mechanical sampling devices for hot mix asphalt (HMA) and cold feed aggregate on some projects. These are normally permanently attached devices that allow a sample container to pass perpendicularly through the entire stream of material or divert the entire stream of material into the container. Operation may be hydraulic, pneumatic, or manual and allows the sample container to pass through the stream twice, once in each direction, without overfilling. Special caution is necessary with manually operated systems since a consistent speed is difficult to maintain and non-representative samples may result. Check agency requirements for the specifics of required sampling systems.
1. Lightly coat the container attached to the sampling device with an agency-approved release agent or preheat it, or both to approximately the same discharge temperature of the mix.

2. Pass the container twice through the material perpendicularly without overfilling the container.

3. Repeat until proper sample size has been obtained.

4. Transfer the HMA to an agency-approved container without loss of material.

**Sampling from Haul Units**

1. Visually divide the haul unit into approximately four equal quadrants.

2. Identify one sampling location in each quadrant.

3. Dig down and remove approximately 0.3 m (1 ft.) of material to avoid surface segregation. Obtain each increment from below this level.

4. Combine the increments to form a sample of the required size.

**Sampling from Roadway Prior to Compaction (Plate Method)**

Plate Method using the “cookie cutter” sampling device.

There are two conditions that will be encountered when sampling Hot Mix Asphalt (HMA) from the roadway prior to compaction. The two conditions are:

- Laying HMA on grade or untreated base material requires Method 1.
- Laying HMA on existing asphalt or laying a second lift of HMA requires Method 2.

Cookie cutter and plate can be sized according to test sample needs.
SAFETY:

Sampling is performed behind the paving machine and in front of the breakdown roller. For safety, the roller must remain at least 3 m (10 ft.) behind the sampling operation until the sample has been taken and the hole filled with loose HMA.

Method 1 requires a plate to be placed in the roadway in front of the paving operation. There is always concern when working in the path of moving equipment. It is safest to stop the paving train while a plate is installed in front of the paver. When this is not possible the following safety rules must be followed.

1. The plate placing operation must be at least 3 m (10 ft.) in front of the paver or pickup device. The technician placing the plate must have eye contact and communication with the paving machine operator. If eye contact cannot be maintained at all time, a third person must be present to provide communication between the operator and the technician.

2. No technician is to be between the asphalt supply trucks and the paving machine. The exception to this rule is if the supply truck is moving forward creating a windrow, in which case the technician must be at least 3 m (10 ft.) behind the truck.

3. If at any time the Engineer feels that the sampling technique is creating an unsafe condition, the operation is to be halted until it is made safe or the paving operation will be stopped while the plate is being placed.

Method 1 - Obtaining a Sample on Untreated Base:

1. Following the safety rules detailed above, the technician is to:
   a. Smooth out a location in front of the paver at least 0.5 m (2 ft.) inside the edge of the mat.
   b. Lay the plate down diagonally with the direction of travel, keeping it flat and

Using the cookie cutter
tight to the base with the lead corner facing the paving machine.

2. Secure the plate in place with a nail through the hole in the lead corner of the plate.

3. Pull the wire, attached to the outside corner of the plate, taut past the edge of the HMA mat and secure with a nail.

4. Let the paving operation proceed over the plate and wire. Immediately proceed with the sampling.

5. Using the exposed end of the wire, pull the wire up through the fresh HMA to locate the corner of the plate. Place the “cookie cutter” sampling device, just inside the end of the wire; align the cutter over the plate. Press “cookie cutter” device down through the HMA to the plate.

6. Using a small square tipped shovel or scoop, or both, carefully remove all the HMA from inside of the cutter and place in a sample container. Care shall be taken to prevent contamination of bituminous mixes by dust or other foreign matter, and to avoid segregation of aggregate and bituminous materials.

7. Remove the sample cutter and the plate from the roadway. The hole made from the sampling must be filled by the contractor with loose HMA.

Method 2 – Obtaining a Sample on Asphalt Surface:

1. After the paving machine has passed the sampling point, immediately place the “cookie cutter” sampling device on the location to be sampled. Push the cutter down through the HMA until it is flat against the underlying asphalt mat.

2. Using a small square-tipped shovel or scoop, or both, carefully remove all the HMA from inside of the cutter and place in a sample container. The hole made from the sampling must be filled by the contractor with loose HMA.
Identification and Shipping

1. Identify sample containers as required by the agency.
2. Ship samples in containers that will prevent loss, contamination, or damage.

Report

- On forms approved by the agency
- Sample ID
- Date
- Time
- Location
- Quantity represented

Tips!

Check agency requirements for:

- Sample size needed
- Sampling device requirements
- Allowable sampling techniques
REVIEW QUESTIONS

1. Bituminous paving mixture sample sizes are based on what?

2. What types of containers are used for HMA samples?

3. Describe how samples are obtained from:
   - Plants with attached sampling devices
   - Truck transports
   - roadway
PERFORMANCE EXAM CHECKLIST (ORAL)

SAMPLING BITUMINOUS PAVING MIXTURES
FOP FOR AASHTO T 168

Participant Name ______________________________ Exam Date ______________

Record the symbols “P” for passing or “F” for failing on each step of the checklist.

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>At the hot plant how must a sample be obtained using an attached sampling device?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Coat or preheat sample container.</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>b. Sampling device passed through stream twice perpendicular to material.</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>c. The sampling device cannot be overfilled.</td>
<td>____</td>
<td></td>
</tr>
<tr>
<td>2. <strong>What must be done to sample from transport units?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Divide the unit into four quadrants.</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>b. Obtain increments from each quadrant, 300 mm (12 in) below surface.</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>3. <strong>Describe how to take samples from the roadway using a plate.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Place the plate well in front of the paver.</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>b. Pull the wire to locate the corner of the plate.</td>
<td>____</td>
<td></td>
</tr>
<tr>
<td>c. Place the cutter on the HMA above the plate and push it down to the plate.</td>
<td>____</td>
<td></td>
</tr>
<tr>
<td>d. Collect all the material inside the cutter.</td>
<td>____</td>
<td></td>
</tr>
<tr>
<td>4. <strong>What types of containers can be used?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Cardboard boxes, stainless steel bowls,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or other agency approved containers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. <strong>What dictates size of sample?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Agency requirements.</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>b. Specified by test method.</td>
<td>____</td>
<td>____</td>
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</tbody>
</table>

Comments: First attempt: Pass Fail Second attempt: Pass Fail

Examiner Signature ____________________________          WAQTC #:_______________
Significance

Samples of bituminous paving mixes taken in accordance with the FOP for AASHTO T 168 are composites and typically large in size. Materials sampled in the field need to be reduced to appropriate sizes for testing. It is extremely important that the procedure used to reduce the field sample not modify the material properties.

Scope

This procedure covers sample reduction of Hot Mix Asphalt (HMA) to testing size in accordance with AASHTO R 47-14. The reduced portion is to be representative of the original sample.

Apparatus

- Thermostatically controlled oven capable of maintaining a temperature of at least 110°C (230°F) or high enough to heat the material to a pliable condition for splitting.
- Non-contact temperature measuring device.
- Metal spatulas, trowels, metal straightedges, or drywall taping knives, or a combination thereof; for removing HMA samples from the quartering device, cleaning surfaces used for splitting, etc.
- Square-tipped, flat-bottom scoop, shovel or trowel for mixing HMA before quartering.
- Miscellaneous equipment including hot plate, non-asbestos heat-resistant gloves or mittens, pans, buckets, and cans.
- Sheeting: Non-stick heavy paper, heat-resistant plastic, or other material as approved by the agency.
- Agency-approved release agent, free of solvent or petroleum-based material that could affect asphalt binder.
• Mechanical Splitter Type A (Quartermaster): with four equal-width chutes discharging into four appropriately sized sample receptacles.

• Mechanical Splitter Type B (Riffle): having a minimum of eight equal-width chutes discharging alternately to each side with a minimum chute width of at least 50 percent larger than the largest particle size. A hopper or straight-edged pan with a width equal to or slightly smaller than the assembly of chutes in the riffle splitter to permit uniform discharge of the HMA through the chutes without segregation of loss of material. Sample receptacles of sufficient width and capacity to receive the reduced portions of HMA from the riffle splitter without loss of material.

• Quartering Template: formed in the shape of a cross with equal length sides at right angles to each other. Template shall be manufactured of metal that will withstand heat and use without deforming. The sides of the quartering template should be sized so that the length exceeds the diameter of the flattened cone of HMA by an amount allowing complete separation of the quartered sample. Height of the sides must exceed the thickness of the flattened cone of HMA.

• Non-stick mixing surface that is hard, heat-resistant, clean, level, and large enough to permit HMA samples to be mixed without contamination or loss of material.

Refer to AASHTO R 47, Figures 1 through 3, for configuration and required dimensions of the mechanical splitter.
Sampling
Obtain samples according to the FOP for AASHTO T 168.

Sample Preparation
The sample must be warm enough to separate. If not, warm in an oven until it is sufficiently soft to mix and separate easily. Do not exceed either the temperature or time limits specified in the test method(s) to be performed.

Selection of Procedure (Method)
Refer to agency requirements when determining the appropriate method(s) of sample reduction. It is recommended that, for large amounts of material, the initial reduction be performed using a mechanical splitter. In general, the selection of a particular method to reduce a sample depends on the initial size of the sample vs. the size of the sample needed for the specific test to be performed. It is recommended that, for large amounts of material, the initial reduction be performed using a mechanical splitter. This decreases the time needed for reduction and minimizes temperature loss. Further reduction of the remaining HMA may be performed by a combination of the following methods, as approved by the agency.

The methods for reduction are:
• Mechanical Splitter Method
  – Type A (Quartermaster)
  – Type B (Riffle Splitter)
• Quartering Method
  – Full Quartering
  – By Apex
• Incremental Method
Procedure

Mechanical Splitter Type A (Quartermaster)

1. Clean the splitter and apply a light coating of approved release agent to the surfaces that will contact HMA.
2. Close and secure hopper gates.
3. Place the four sample receptacles in the splitter so that there is no loss of material.
4. Remove the sample from the agency-approved container(s) and place in the mechanical splitter hopper. Avoid segregation, loss of HMA or the accidental addition of foreign material.
5. Release the handle, allowing the HMA to drop through the divider chutes and discharge into the four receptacles.
6. Any HMA that is retained on the surface of the splitter shall be removed and placed into the appropriate receptacle.
7. Close and secure the hopper gates.
8. Reduce the remaining HMA as needed by this method or a combination of the following methods as approved by the agency.
9. Combine the material contained in the receptacles from opposite corners and repeat the splitting process until an appropriate sample size is obtained.
10. Retain and properly identify the remaining unused portion of the HMA sample for further testing if required by the agency.
Mechanical Splitter Type B (Riffle)

1. When heating of the testing equipment is desired, it shall be heated to a temperature not to exceed 110°C (230°F).

2. Clean the splitter and apply a light coating of approved release agent to the surfaces that will come in contact with HMA (hopper or straight-edged pan, chutes, receptacles).

3. Place two empty receptacles under the splitter.

4. Carefully empty the HMA from the agency-approved container(s) into the hopper or straight-edged pan without loss of material. Uniformly distribute from side to side of the hopper or pan.

5. Discharge the HMA at a uniform rate, allowing it to flow freely through the chutes.

6. Any HMA that is retained on the surface of the splitter shall be removed and placed into the appropriate receptacle.

7. Reduce the remaining HMA as needed by this method or a combination of the following methods as approved by the agency.

8. Using one of the two receptacles containing HMA, repeat the reduction process until the HMA contained in one of the two receptacles is the appropriate size for the required test.

9. After each split, remember to clean the splitter hopper and chute surfaces if needed.

10. Retain and properly identify the remaining unused HMA sample for further testing if required by the agency.
Quartering Method

1. When heating of the testing equipment is desired, it shall be heated to a temperature not to exceed the maximum mixing temperature from the job mix formula (JMF).

2. If needed, apply a light coating of release agent to quartering template.

3. Dump the sample from the agency approved container(s) into a conical pile on a hard, “non-stick,” clean, level surface where there will be neither a loss of material nor the accidental addition of foreign material. The surface can be made non-stick by the application of an approved asphalt release agent or sheeting.

4. Mix the material thoroughly by turning the entire sample over a minimum of four times with a flat-bottom scoop; or by alternately lifting each corner of the sheeting and pulling it over the sample diagonally toward the opposite corner, causing the material to be rolled. Create a conical pile by either depositing each scoop or shovelful of the last turning on top of the preceding one, or lifting both opposite corners.

5. Flatten the conical pile to a uniform diameter and thickness where the diameter is four to eight times the thickness. Make a visual observation to ensure that the material is homogeneous.

6. Divide the flattened cone into four equal quarters using the quartering template or straightedges assuring complete separation.

7. Reduce to appropriate sample mass by full quartering or by apex.
Full Quartering

1. Remove diagonally opposite quarters, including all of the fine material.
2. Remove the quartering template, if used
3. Combine the remaining quarters.
4. Remix and form a conical pile.
5. Flatten the conical pile to a uniform diameter and thickness where the diameter is four to eight times the thickness. Make a visual observation to ensure that the material is homogeneous.
6. Divide the flattened cone into four equal quarters using the quartering template or straightedges assuring complete separation.
7. Remove two diagonally opposite quarters, including all of the fine material.
8. Repeat steps until appropriate sample mass is obtained. The final sample must consist of the two remaining diagonally opposite quarters.
9. Retain and properly identify the remaining unused portion of the HMA sample for further testing if required by the agency.
By Apex

1. Using a straightedge, slice through a quarter of the HMA from the center point to the outer edge of the quarter.

2. Pull or drag the material from the quarter with two straight edges or hold one edge of the straightedge in contact with quartering device.

3. Remove an equal portion from the diagonally opposite quarter and combine these increments to create the appropriate sample mass.

4. Continue using the apex method with the unused portion of the HMA until samples have been obtained for all required tests.

5. Retain and properly identify the remaining unused portion of the HMA sample for further testing if required by the agency.

Incremental Method

1. Cover a hard, clean, level surface with sheeting. This surface shall be large enough that there will be neither a loss of material nor the accidental addition of foreign material.

2. Place the sample from the agency approved container(s) into a conical pile on that surface.

3. Mix the material thoroughly by turning the entire sample over a minimum of four times
   a. Use a flat-bottom scoop; or
   b. Alternately lift each corner of the sheeting and pull it over the sample diagonally toward the opposite corner, causing the material to be rolled.

4. Create a conical pile by either depositing each scoop or shovelful of the last turning on top of the preceding one or lifting both opposite corners.

5. Grasp the sheeting and roll the conical pile into a cylinder (loaf), then flatten the top.
Make a visual observation to determine that the material is homogenous.

6. Remove one quarter of the length of the load and place in a container to be saved; by either:
   a. Pull sheeting over the edge of the counter and drop into a container.
   b. Use a straightedge to slice off material and place into a container.

7. Obtain an appropriate sample mass for the test to be performed.
   a. Pull sheeting over edge of counter and drop cross sections of the material into container until proper sample mass has been obtained.
   b. Use a straightedge to slice off cross sections of the material until proper sample mass has been obtained and place into container.

Note 1: When reducing the sample to test size it is advisable to take several small increments, determining the mass each time until the proper minimum size is achieved. Unless the sample size is grossly in excess of the minimum or exceeds the maximum test size, use the sample as reduced for the test.

8. Repeat step 7 until all the samples for testing have been obtained.

9. Retain and properly identify the remaining unused portion of the HMA sample for further testing if required by the agency.
Tips!

- Remember, the reduced sample must be representative of the whole.
- Proceed quickly so that splitting is done when the material is hot.
- Check agency requirements about what splitting device(s) or method(s) may be used.
- With Mechanical Method (Type A), further reduction requires using HMA from diagonally opposite receptacles.
- With both Mechanical Methods, inspect splitter surfaces for build-up of HMA, ensuring they are cleaned such that the material falls into the appropriate receptacles.
- With full quartering, remember that the final sample consists of the two remaining diagonally opposite quarters.
REVIEW QUESTIONS

1. Describe how the material is mixed before quartering.

2. What is the difference between full quartering and quartering by apex?

3. How many types of mechanical splitters are there and how are they different?

4. Are any of the reduction methods preferred? When and why?

5. Can multiple splitting methods be used in reducing a sample?
PERFORMANCE EXAM CHECKLIST

REDUCING SAMPLES OF HOT MIX ASPHALT (HMA) TO TESTING SIZE
FOP FOR AASHTO R 47

Participant Name ______________________________ Exam Date ______________

Record the symbols “P” for passing or “F” for failing on each step of the checklist.

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sample made soft enough to separate easily without exceeding temperature limits?</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

**Mechanical Splitter Method Type A (Quartermaster)**

1. Splitter cleaned and surfaces coated with release agent? | _____ | _____ |
2. Hopper closed and receptacles in place? | _____ | _____ |
3. Sample placed into hopper without segregation or loss of material? | _____ | _____ |
4. Hopper handle released allowing the HMA to uniformly flow into receptacles? | _____ | _____ |
5. Splitter surfaces cleaned of all retained HMA, allowing it to fall into appropriate receptacles? | _____ | _____ |
6. Further reduction with the quartermaster:
   a. Material in receptacles from opposite corners combined? | _____ | _____ |
   b. Splitting process repeated until appropriate sample mass is obtained? | _____ | _____ |
7. Remaining HMA stored in suitable container and properly labeled? | _____ | _____ |

**Mechanical Splitter Method Type B (Rifle)**

1. Splitting apparatus and tools, if preheated, not exceeding 110°C (230°F)? | _____ | _____ |
2. Splitter cleaned, and surfaces coated with release agent? | _____ | _____ |
3. Two empty receptacles placed under splitter? | _____ | _____ |
4. Sample placed in hopper or straight edged pan without loss of material and uniformly distributed from side to side? | _____ | _____ |
5. Material discharged across chute assembly at controlled rate allowing free flow of HMA through chutes? | _____ | _____ |
6. Splitter surfaces cleaned of all retained HMA allowing it to fall into appropriate receptacles? | _____ | _____ |

OVER
Procedure Element

7. Further reduction with the riffle splitter:
   a. Material from one receptacle discharged across chute assembly at controlled rate, allowing free flow of HMA through chutes? _____ _____
   b. Splitting process continued until appropriate sample mass obtained, with splitter surfaces cleaned of all retained HMA after every split? _____ _____

8. Remaining unused HMA stored in suitable container, properly labeled? _____ _____

Quartering Method

1. Testing equipment preheated to a temperature not to exceed mix temperature? _____ _____

2. Sample placed in a conical pile on a hard, non-stick, heat-resistant splitting surface such as metal or sheeting? _____ _____

3. Sample mixed by turning the entire sample over a minimum of 4 times? _____ _____

4. Conical pile formed and then flattened uniformly to diameter equal to about 4 to 8 times thickness? _____ _____

5. Sample divided into 4 equal portions either with a metal quartering template or straightedges such as drywall taping knives? _____ _____

6. Reduction by Full Quartering:
   a. Two diagonally opposite quarters removed and returned to sample container? _____ _____
   b. Two other diagonally opposite quarters combined and process continued until appropriate sample mass has been achieved? _____ _____

7. Reduction by Apex:
   a. Using two straightedges or a quartering device and one straightedge, was one of the quarters split from apex to outer edge of material? _____ _____
   b. Similar amount of material taken from the diagonally opposite quarter? _____ _____
   c. Increments combined to produce appropriate sample mass? _____ _____

8. Remaining unused HMA stored in suitable container, properly labeled? _____ _____

Incremental Method

1. Sample placed on hard, non-stick, heat-resistant splitting surface covered with sheeting? _____ _____

2. Sample mixed by turning the entire sample over a minimum of 4 times? _____ _____

OVER
### Procedure Element

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Conical pile formed?</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>4. HMA rolled into loaf and then flattened?</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>5. The first quarter of the loaf removed by slicing off or dropping off edge of counter and set aside?</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>6. Proper sample mass sliced off or dropped off edge of counter into sample container?</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>7. Process continued until all samples are obtained or final quarter is remaining?</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>8. All remaining unused HMA stored in suitable container, properly labeled?</td>
<td>______</td>
<td>______</td>
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</tbody>
</table>

### Comments:

<table>
<thead>
<tr>
<th>First attempt:</th>
<th>Pass Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second attempt:</td>
<td>Pass Fail</td>
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</tbody>
</table>

Examiner Signature ____________________________          WAQTC #:_______________