



**Arizona
Department of Transportation**

WORKBOOK

for

**FIELD SAMPLING & TESTING for
BITUMINOUS CONSTRUCTION
(Course Number 301)**

a training course developed
for the

ARIZONA DEPARTMENT OF TRANSPORTATION
Phoenix, Arizona

by

ROY JORGENSEN ASSOCIATES, INC.
Gaithersburg, Maryland

Last revised by ADOT on August 25, 2003

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Directions to Workbook Users

Field Sampling and Testing for Bituminous Construction (Course Number 301) is one in a series of courses on inspection and quality control for bituminous highway construction. Other courses in the series include:

- Prime, Flush and Tack Coats Inspection (Course Number 302);
- Chip Seal Coat Inspection (Course 303);
- Asphaltic Concrete Plant Inspection (Course 304);
- Asphaltic Concrete Paving Inspection (Course 305); and
- Inspecting Pavement Recycling (Course 306).

This course is designed primarily for highway construction inspection personnel, but it can also be used in training other personnel.

This Workbook is to be used in conjunction with a videotape presentation, discussion sessions with the trainee's instructor or supervisor, and other materials that make up the course. As sections of this Workbook are assigned, each trainee should:

1. read and study the material to review previously presented information and gain additional details;
2. complete the exercises and quizzes as they are provided;
3. check his answers against those provided following the exercise or quiz;
4. review the material as needed to correct and clarify any incorrect answers; and
5. discuss any areas that are still not clearly understood with his instructor or supervisor.

Each trainee should be provided with his own copy of this Workbook so that he can write in it and keep it for future reference and review.

This course is based primarily on the standards and methods established in the following Arizona Department of Transportation reference documents:

- Section 404, "Bituminous Treatments," in the *Standard Specifications for Road and Bridge Construction*;
- Section 404, "Bituminous Treatments," in the *Construction Manual*; and
- ADOT Materials Testing Manual, Material Sampling Guide Section 900, Appendix C.

Notes

From Discussion Period

Section One: Introduction

This course is intended to be the first exposure for the student embarking on their education with the Bituminous Series. The descriptions given are fundamental and serve as the basis for additional courses in this area. This text is also intended to complement the Arizona Technical Institute (ATI) certification currently in use at ADOT. We will review applicable sections of the *ADOT Standard Specifications* and all applicable tables (2, 3, 5, 7, and 8) of the ADOT Sampling Guide Schedule. Sampling and testing must both follow explicit guidelines in order to obtain the accurate results needed by the engineers and the contractors working on the project.

At the time of this writing, there have been many significant changes and updates included in the year 2000 Edition of the *ADOT Standard Specifications*. Some sections applicable to this course such as Section 406 have been revised almost entirely and there have been extensive changes to Sections 416 and 407 as well. All sections have been subject to some degree of modification. Section 417 has been added as a new section. Therefore, this course is a recommended refresher for all field personnel.

Background

Bituminous materials and mixtures have a wide variety of uses in the highway construction industry. The most common are:

- Seal coats, slurry seals, flush coats, fog coats, scrub seals, prime coats, and tack coats.
- As the binder portion of asphaltic concrete used for pavement, slope protection, or channel linings.

This course concentrates on the field inspector's role in sampling and testing for bituminous construction. We will primarily use the *ADOT Standard Specifications* and excerpts from the Materials Sampling Guide Schedule (Appendix C of ADOT Quality Assurance Program). ADOT QA Program is Section 900 of the *ADOT Materials Testing Manual*. Using these tools we will learn how to determine and carry out the Department's various responsibilities in differing situations or on projects with different specifications.

Terminology

Asphalt pavement construction, maintenance, repair, and rehabilitation has an extensive history in this country. Duplicate and sometimes contradictory terms can be common. We will review the terminology used in this workbook as well as the *ADOT Standard Specifications* and the *ADOT Construction Manual* to help the student avoid this type of confusion.

-

“Bituminous material,” “asphalt,” or “asphalt binder” refers to any or all of a variety of different types of asphaltic material as specified in Sections 1005 and 1009 of the ADOT *Standard Specifications* including the following:

1. asphalt cement (also called paving grade asphalt, asphalt or a blend of asphalt straight from the refinery),
 2. modified asphalt (also called polymerized asphalt),
 3. liquid asphalt (also called cutback; asphalt mixed with kerosene or other similar solvents),
 4. emulsified asphalt (asphalt mixed with emulsifier and water),
 5. recycling agents (may or may not be emulsified), and
 6. asphalt rubber (crumb rubber asphalt or CRA; generally a blend of 80% asphalt and 20% crumb rubber). AR stands for Asphalt Rubber and CRA stands for Crumb Rubber Asphalt.
- “Bituminous mixture” “AC mix,” “mix,” or “asphaltic concrete” refers to any of a variety of different types of mixtures in which bituminous material is blended together with aggregates.
 - There are dense graded mixes, used for base courses, leveling, and surface courses; and open graded mixes, used only for final riding surface courses. Dense graded mixes and open graded mixes include:
 1. Asphaltic Concrete (AC or ARAC) as identified in Sections 406, 409, 413, 416, and 417 of the ADOT *Standard Specifications* and/or the Contract Special Provisions, (dense graded);
 2. Asphaltic Concrete Friction Course (ACFC or AR-ACFC) (Sections 407, 411, and 414), (open graded)
 3. Recycled Asphaltic Concrete (Section 408) (dense graded), and
 4. Asphalt Road Mix (Section 405).

Material Components

Asphaltic concrete consists primarily of two essential components:

1. Coarse and Fine Aggregates (M.A. for mineral aggregate) as the basic building blocks (or stone skeleton) of the mix. Generally 95% ± of the mix (by weight).
2. Asphalt cement as the binder to hold the aggregates together. Generally about 5% ± of the mix (by weight).

Smaller amounts of other materials are sometimes added to these two primary components including mineral admixtures to help improve the stability and the resistance to stripping in the mix. They include:

1. portland cement or blended hydraulic cement
2. hydrated lime. For more information on hydrated lime, refer to *Construction Manual*, IV-130.

Materials used in bituminous surface treatments include:

- bituminous material (asphalt cement, liquid asphalt, emulsified asphalt, recycling agent, or asphalt rubber blend) to seal, protect, or rejuvenate the existing road,
- cover aggregate (to restore friction characteristics of the existing road), and
- blotter sand (also for friction and to keep the new surface from being damaged by the traffic as well as protecting the traffic from “flying black gunk”).

Key Characteristics

The various materials used in bituminous construction are selected to meet numerous specifications. This is necessary for the mixture to be consistent, effective, and to achieve predictable engineering properties and performance. These characteristics are summarized in the following paragraphs.

Bituminous Material

From the standpoint of field sampling and testing, the key characteristics of bituminous materials are:

- the type and grade of material,
- the temperature of the material at the time of sampling, and
- the quantity or lot (size) of material represented by the sample.

Aggregates

The key characteristics of aggregate used in bituminous construction include:

- gradation: the distribution of the different size particles of the aggregate (% by wt.).
- sand equivalent: the proportion of sand to finer clay-like particles.
- fractured faces: the angularity of the coarse particles (un-worn fractured surfaces versus smooth or rounded surfaces).
- flakiness index: particle shape in terms of flatness.
- percent carbonates: percent by weight of calcium-based aggregate.
- uncompacted voids: measure of the voids occurring in a loose sample of fine aggregate.
- flat and elongated particles: comparison of least-dimension to the greatest dimension.

Bituminous Mixes

The key characteristics of bituminous mixes include:

- particle coating: extent to which the mix is fully coated with asphalt, visual determination.
- moisture content: the amount of water contained in the mix.
- mix temperature: at the plant, at the paver, and prior to and during the compaction process.
- the proportioning of all materials in accordance with the mix design.
- the density, stability, flow, and volumetric relationships of the mix.

Division of Responsibilities

The contractor, ADOT labs, and the field personnel all have certain responsibilities for the sampling and testing of materials used in bituminous construction.

ADOT

The field inspectors' and project site lab's primary responsibilities for sampling and testing include:

- Sampling of the material (frequently this is witnessed by observation of the contractor's personnel as; for example see Section 413 or 414 of the Standard Specifications).
 1. aggregates,
 2. bituminous materials, and
 3. bituminous mixtures,
- Testing aggregates for:
 1. bulk specific gravity
 2. combined water absorption
 3. gradation,
 4. sand equivalent,
 5. fractured coarse aggregate particles,
 6. uncompacted voids, and
 7. flakiness index
- Testing bituminous mixes for:
 1. asphalt content,
 2. gradation, and
 3. density, stability, flow, and volumetric relationships.

Materials testing technicians from the Department's Central and Regional labs are generally responsible for:

- design testing,
- correlation (or split) testing,
- Independent Assurance Sampling (IAS) and testing,
- the testing of bituminous materials, and
- any other testing which requires more specialized equipment or a higher degree of expertise not readily available in the field or District labs.

Contractor

The contractor's responsibilities include:

- responsibility for all quality control (QC) on the project,
- providing means, devices, and safe access to processes where representative samples can be obtained, and
- having certified technicians collect samples when required by the contract specifications.

Quality Assurance (QA) Versus Quality Control (QC)

As stated before, the contractor is responsible for his own quality control on a project, whether it is accomplished by his own forces or by a consultant testing lab. In some cases the Special Provisions will specify additional requirements to this standard by referencing Section 106.04(C).

For quality assurance, the contractor must meet specific sampling and testing requirements to ensure that the product satisfies ADOT contractual specifications. However, if it is permitted by specifications, contractor testing may be used in the acceptance decision. See Appendix B of the Arizona Materials Testing Manual.

Quality assurance verifies that the product met the specifications; quality control helps the contractor manage the process.

Section Two: Sampling Aggregates

Proper sampling is a matter of obtaining material that accurately represents the lot or batch from which it has been taken. When this material is tested the results indicate the characteristics of the materials used on the project.

Regardless of the type of material, the source of the sample, or the tests to be conducted, any sample must be:

- of adequate size for the tests to be conducted (and it is always better to get more than is needed, than to have not enough); [For sample size, refer to *Standard Specifications* and *Arizona Materials Testing Manual*.]
- representative of all of the material by obtaining it from one or more locations and avoiding segregation;
- taken from random locations or portions of the material, rather than the location or portion that is more convenient or looks “good” or “bad,” and
- kept free of contamination by handling the sample properly and using clean sample containers.

Safety Procedures

At the plant, inform the plant manager that you will be sampling materials. Be aware of moving haul trucks and loaders.

In the field, park your vehicle in a safe, out-of-the-way area. Be aware of moving haul trucks and construction equipment.

Sampling Aggregates

(Arizona Test Method 105b)

The equipment and procedures for sampling aggregates from stockpiles, conveyor belts and hot bins are summarized below.

Sampling Aggregates from Stockpiles

The equipment and tools used include:

- a flat wood or metal shield,
- a square-end shovel, and
- sample containers.

The procedures for sampling aggregates from stockpiles are as follows:

1. Plan sampling locations within the stockpile by:
 - a. mentally dividing the stockpile into segments; and
 - b. taking samples from the top, middle and bottom levels of opposite segments, alternately on opposite sides as shown in **Figure 1**.

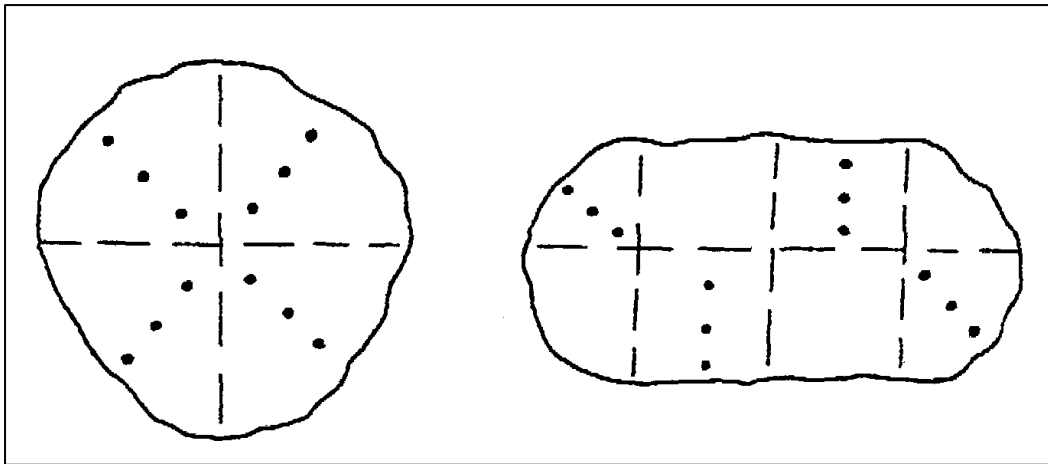


Figure 1: Typical Sampling from Different Stockpile Types

2. Place shield upslope from the area to be sampled to prevent loose aggregate from sliding down into the sampling area.
3. Remove 3 to 6 inches of surface material.
4. Obtain shovel full by:
 - a. pushing straight in with the shovel,
 - b. pushing the shovel handle down, and
 - c. carefully transferring the material into the sample container.
5. Repeat Steps 2, 3 and 4 at each of the other locations within the stockpile, placing each scoop-full into the sample container.
6. Identify the sample, placing the top sheet (the original) of the ticket in with the sample and close the sample container.
7. Repeat Steps 1 through 6 at other stockpiles as needed, placing the material from each stockpile into separate sample containers.

Sampling Aggregates from Conveyor Belts

Aggregates can be sampled from conveyor belts either:

- by stopping the conveyor belt (if the belt is not equipped with a sample diversion device at the end),* or
- by using an approved sample diversion device at the end of the belt (which is usually provided on drum-dryer and other continuous-mix plants where stopping the belt would disrupt production).*

* The “stopped-belt” method is also used as the referee method for approving a mechanical sample-diversion device.

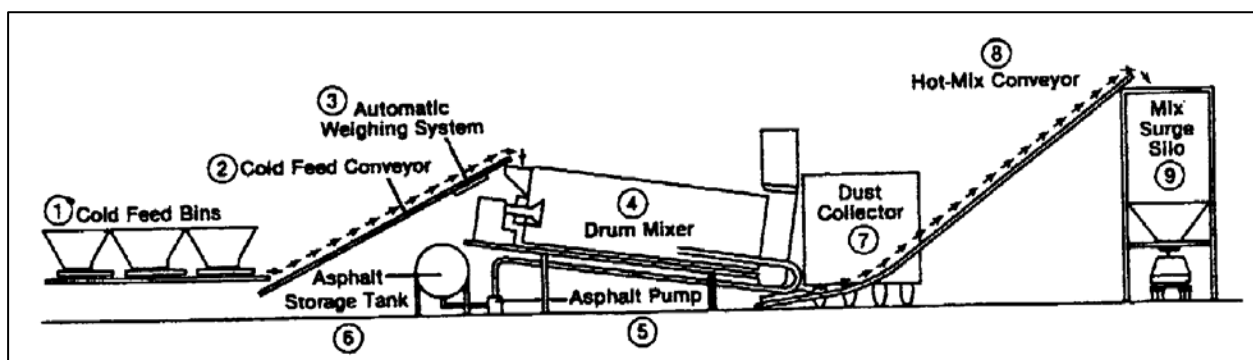


Figure 2 Basic Drum-Mix Plant

Courtesy of Asphalt Institute, MS-22

Sampling From a Stopped Conveyor

The tools and equipment include:

- a special template shaped to the contour of the belt,
- a square-end scoop,
- a brush to remove fines that the scoop cannot get, and
- a sample container.

The procedures for a stopped belt are as follows:

1. Make sure that the plant is operating normally so that the material on the belt is representative.
2. Stop the conveyor belt.
3. Place the template on the belt by pushing down and sawing into the material (but not pushing any material off the belt) until the template is flush with the belt.

4. Remove all the material from within the template to the sample container by:
 - a. scooping out as much as possible, and
 - b. brushing out the remaining fines.
5. Identify the sample, placing the top sheet of the ticket in with the sample and closing the sample container.

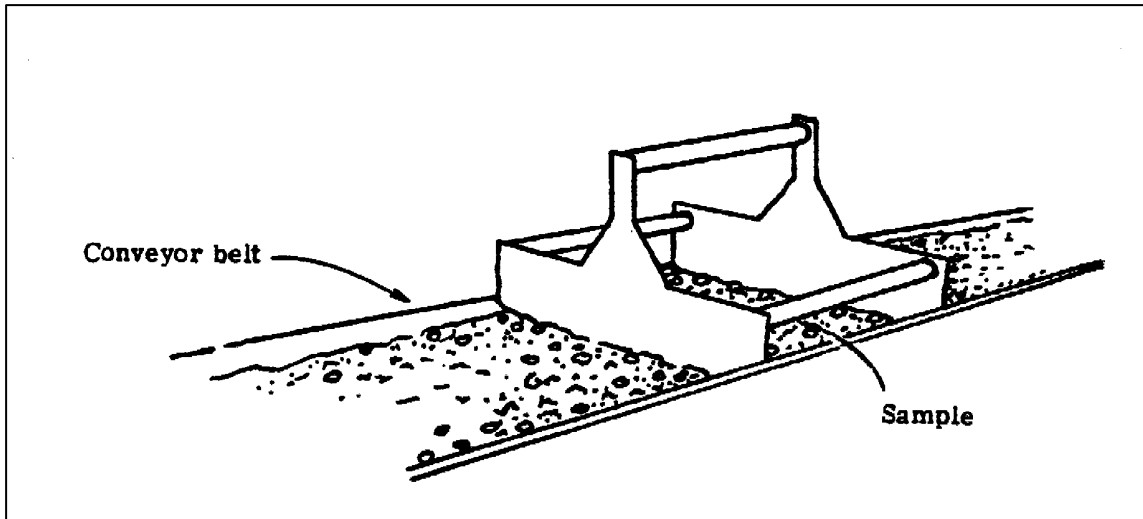


Figure 3: Sampling from a Stopped Conveyor

Sampling From a Mechanical Device on a Moving Conveyor

The equipment needed is:

- an approved mechanical device to divert the aggregate flow at the end of the belt, and
- a sample container.

The procedures for obtaining a sample from a moving conveyor, using a mechanical diversion device, are:

1. Make sure that the plant is operating normally.
2. Place the sample container under the device.
3. Engage the device to divert the material into the sample container.
4. Close the sample container and identify the sample.

Sampling Aggregates from Hot Bins

The tools and equipment needed are:

- a sampling device long enough to interrupt the full flow of the aggregates,
- a sample container for each hot bin, and
- gloves (to protect yourself from burns from the hot aggregate and bins).

The procedures for sampling from hot bins are as follows:

1. As each bin discharges into the weigh box:
 - a. allow some material to pass,
 - b. push the sampling device through the full flow of material, and
 - c. remove the device immediately.
2. Transfer the material from the device to the sample container.
3. Identify the sample and place the original portion of the ticket inside the container.
4. Repeat steps 1, 2, and 3 for each hot bin using a new container for each bin.

Aggregate Sample Identification

Each sample of aggregate must be clearly identified. Below is an example of the Sample Tabulation Card for a sample of mineral aggregate for asphaltic concrete. The key information is listed with the established code designations beginning on page 13.

The inspector is required to keep the middle portion of the ticket after placing the original inside with the sample and taping or otherwise attaching the third copy to the outside of the container.

ARIZONA DEPARTMENT OF TRANSPORTATION SOIL, AGGREGATE, & BITUMINOUS MIXES SAMPLE TABULATION	USE CAPITAL LETTERS												44-9346 R3/92				
	LAB NUMBER			PROJ CODE			ORG NUMBER			MATL		TYPE		PUR-POSE	TEST LAB	SIZE	SIZE %
	TEST NO.			LOT OR SUFFIX		SAMPLED BY				MO	DAY	YEAR	TIME		<input type="checkbox"/> AM	<input type="checkbox"/> PM	
	SAMPLED FROM								LIFT NO.		RDWY		STATION		PLUS		
	ORIGINAL SOURCE				PROJECT ENGINEER / SUPERVISOR				PROJECT NUMBER				TRACS NUMBER				
	REMARKS																

Figure 4: Sample Tabulation Card

FAST Material and Type Codes

Material Code	Material Description	Material Type	Type Description
AA	Arrestor Bed Aggregate		
AB	Aggregate Base	1	Class 1
AB	Aggregate Base	2	Class 2
AB	Aggregate Base	3	Class 3
AC	Asphaltic Concrete	12	1/2" Asphaltic Concrete
AC	Asphaltic Concrete	34	3/4" Asphaltic Concrete
AC	Asphaltic Concrete	BM	Base Mix
AC	Asphaltic Concrete	BB	Bituminous Treated Base
AC	Asphaltic Concrete	FC	ACFC
AC	Asphaltic Concrete	OT	Other
AC	Asphaltic Concrete	RC	Recycled Asphaltic Concrete
AC	Asphaltic Concrete	RD	Asphalt Rubber Asphaltic Concrete
AC	Asphaltic Concrete	RF	Asphalt Rubber A.C. Friction Course
AC	Asphaltic Concrete	RM	Road Mix
AD	Admix		
AG	Aggregate	BB	Bituminous Treated Base
AG	Aggregate	CB	Cement Treated Base
AG	Aggregate	CS	Cement Treated Subgrade
AG	Aggregate	LC	Lean Concrete Base
AG	Aggregate	LS	Lime Treated Subgrade
AG	Aggregate	RM	Road Mix
AG	Aggregate	SC	Soil Cement
AS	Aggregate Subbase	4	Class 4
AS	Aggregate Subbase	5	Class 5
AS	Aggregate Subbase	6	Class 6
BF	Backfill	PP	Pipe
BF	Backfill	SL	Slurry
BF	Backfill	SP	Special
BF	Backfill	TR	Trench
BL	Blotter Material		
BM	Bedding Material	CP	Concrete Pipe
BM	Bedding Material	MP	Corrugated Metal Pipe
BM	Bedding Material	PV	PVC Pipe
BW	Borrow		
CA	Coarse Aggregate	1	Size 1
CA	Coarse Aggregate	10	Size 10
CA	Coarse Aggregate	2	Size 2
CA	Coarse Aggregate	24	Size 24
CA	Coarse Aggregate	3	Size 3
CA	Coarse Aggregate	357	Size 357
CA	Coarse Aggregate	4	Size 4
CA	Coarse Aggregate	467	Size 467
CA	Coarse Aggregate	5	Size 5
CA	Coarse Aggregate	56	Size 56
CA	Coarse Aggregate	57	Size 57

Material Code	Material Description	Material Type	Type Description
CA	Coarse Aggregate	6	Size 6
CA	Coarse Aggregate	67	Size 67
CA	Coarse Aggregate	68	Size 68
CA	Coarse Aggregate	7	Size 7
CA	Coarse Aggregate	78	Size 78
CA	Coarse Aggregate	8	Size 8
CA	Coarse Aggregate	89	Size 89
CA	Coarse Aggregate	9	Size 9
CA	Coarse Aggregate	NA	Composite Samples
CB	Crash Barrel Sand		
CM	Cover Material		
CS	Cement Stabilized Alluvium		
DG	Decomposed Granite		
EM	Embankment		
ET	Entrained Air		
FA	Fine Aggregate		
FF	Flyash		
FM	Filter Material		
GM	Granite Mulch		
GR	Granulated Rubber		
GT	Grout		
HO	Water		
MA	Mineral Aggregate	12	1/2" Asphaltic Concrete
MA	Mineral Aggregate	34	3/4" Asphaltic Concrete
MA	Mineral Aggregate	BM	Base Mix
MA	Mineral Aggregate	FC	ACFC
MA	Mineral Aggregate	OT	Other
MA	Mineral Aggregate	RC	Recycled Rubber Asphaltic Concrete
MA	Mineral Aggregate	RD	Asphalt Rubber Asphaltic Concrete
MA	Mineral Aggregate	RF	Asphalt Rubber A.C. Friction Course
MS	Membrane Seal		
NG	Natural Ground		
NM	Pneumatically Placed Mortar		
OT	Other		
PM	Pipe Plating		
RR	Rip Rap		
SB	Structural Backfill		
SG	Subgrade		
SL	Slurry	38	3/8" Aggregate
SL	Slurry	4	#4 Aggregate
SS	Subgrade Seal		
TS	Top Soil		
WC	Winter Cinders		

Locating Samples Using Random Numbers

Referring to the table of random numbers in Appendix A on page 26 we will work through an exercise to determine the locations of samples so that we can be sure that these locations are random. Note that ASTM also has a referee method for determining random numbers in case any of the standard methods are suspect or where dispute might otherwise be anticipated.

Alternative 1 (5.8.1) or Alternative 2 (5.8.2) are the usual methods used in determining the random numbers that we need; however the most random, unbiased method is given prior to the alternatives as the referee method mentioned above.

Summary

Always be on the lookout for segregation; it is important to know how it can occur. When a contractor has stockpiled aggregates the management of the stockpiles will have a large effect on the potential for segregation. It should also be noted if the contractor runs any track-driven equipment on the aggregate stockpiles. For more on segregation, refer to the *Hot-Mix Asphalt Paving Handbook 2000*.

To recap, samples always must be taken in a fashion that ensures that they will be representative. It is up to the inspector taking the sample to note what quantity and type or condition of material is thereby represented by the sample.

Sampling generally should be random to ensure that there is no bias in the sampling procedure.

Occasionally an additional or judgement sample will be taken at the direction of the Engineer or project supervisor to make a further evaluation of materials or work that appears inconsistent. Although this is not unbiased or random sampling the inspector is still required to obtain a sample that will accurately represent the material in question.

When sampling, always remember that safety is the first priority.

Section Three: Sampling Bituminous Materials

Sampling Bituminous Material

(AASHTO T-40)

Samples of bituminous material are taken from the circulating line of a storage tank or directly from the spray bar on a distributor.

The tools and materials needed include:

- gloves to protect against the heat of the asphalt;
- a large (one gallon, minimum) waste container;
- two new, clean 1-gallon sample containers as follows:
 1. metal cans with friction lids, for asphalt cement or liquid asphalt, or
 2. wide-mouthed glass or plastic jars with screw-on lids for emulsions; and
- a clean, dry cloth.

Safety Procedures

At the plant, inform the plant manager that you will be sampling materials. Use protective equipment (gloves, safety glasses, etc.), and keep a safe distance when opening valves, being alert for splattering. Be aware of moving haul trucks and loaders.

The procedures for sampling asphalt are:

1. Draw off a least one gallon to clear the valve and pull representative material to the spigot. Do not use this material as part of the sample.
2. Fill the first sample container.
3. Close and seal the container.
4. Wipe off any spills or drips with a dry cloth. (Never use solvent.)
5. Repeat Steps 2, 3 and 4 for the second container as a “backup sample.”
6. Identify each sample container.

An example of the identification form for a sample of bituminous material is shown below:

PLEASE PRESS FIRMLY
WHILE FILLING OUT FORM

ARIZONA DEPARTMENT OF TRANSPORTATION 44-4301 R1/94

Name of Material _____

Item No. or Specification Section No. _____

Sample No. _____ Lot No. _____ Test Lab. _____

Sampled by _____ Date _____

Sampled from _____
(Hot Plant, Stockpile, Truck No., Sta. No., Etc.)

Quantity Represented _____

Supplier _____
(Original Source, Manufacturer, Refinery, Etc.)

Project No. _____ TRACS No. _____

Project Code _____ ORG No. _____

Project Engineer/Supervisor _____

Remarks: _____

Figure 5: Bituminous Sample Identification Form

Notice that a slightly different format from the ADOT soils, aggregates, and bituminous mixes is used for bituminous material, but the types of information are similar:

- Name of material (type and grade)
- Identification marks
- Date
- Sampled by or include who witnessed for ADOT
- Sampled from
- Quantity represented
- Supplier (original source)
- Project number, and
- Remarks

Sampling Bituminous Mix

(Arizona Test Method 104)

The equipment and procedures for sampling bituminous mixtures are summarized on the following pages. Samples can be taken from trucks at the plant and from behind the paver in accordance with the following guidelines.

Sampling Mix from Trucks

Samples are taken from the haul trucks for ACFC's and AR-ACFC's, but this method also may be used for miscellaneous AC's or ARAC's. The tools and materials needed include:

- gloves,
- a square-end scoop or shovel,
- a clean pan or other sample container, and
- the sample container should be insulated or placed inside a larger, insulated container to help retain the heat.

The procedure for sampling mix from trucks is:

1. For ACFC, collect the sample at the plant within five minutes after the mix is loaded into the truck. For miscellaneous AC's, the sample is collected just before discharge at the roadway.
2. Remove about 12 inches of the top surface of the mix.
3. Scoop out a portion of the mix and place it in the container.
4. Repeat Steps 2 and 3 at several different, randomly-selected locations within the truck. For sample size, refer to the *Arizona Materials Testing Manual*.
5. Blend the sample so that all portions are mixed together.
6. Identify the sample and close the container.

Sampling Mix at the Roadway

Some asphaltic concrete mixes (not ACFC or AR-ACFC) are usually sampled from behind the paver at the roadway.

The equipment and tools needed include:

- gloves,
- a 4-foot by 1-foot metal plate with wires attached at the corners,
- a square-end shovel,
- a clean 5-gallon sample container that can be closed to keep the sample warm (for sample size, refer to *Standard Specifications* and the *Arizona Materials Testing Manual*), and
- an insulated container that will accommodate the 5-gallon sample bucket.

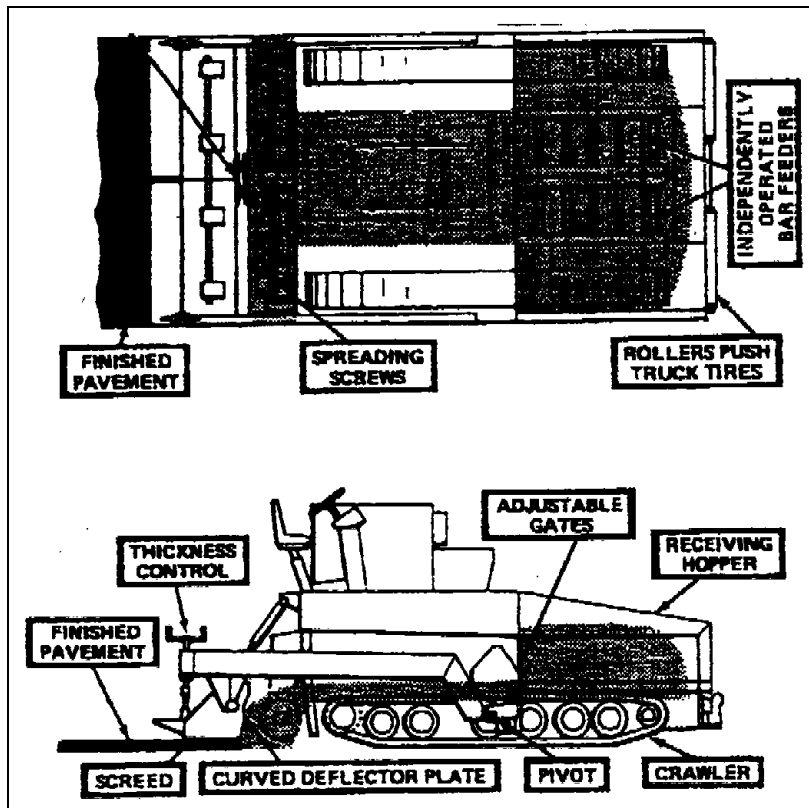


Figure 6: Paver – Top and Side Views
 Courtesy of the Asphalt Institute, MS-22

The procedures for sampling the mix from the roadway are:

1. Place the metal plate:
 - a. in front of the paver, and
 - b. at least one foot in from the edge, or in the center of the mat on wider mats.
2. Allow the paver to lay mix over the plate.
3. Locate the plate by the wires at the corners.
4. Scoop out a strip along the middle of the plate, carefully placing each shovelful in the sample container. Each shovelful must be taken from a previously undisturbed area on the plate.
5. Close the sample container, identify the sample, and transport it to the project lab.

Bituminous Mix Sample Identification

An example of the sample identification for a bituminous mix sample is shown below:

ARIZONA DEPARTMENT OF TRANSPORTATION SAMPLE TABULATION SOIL, AGGREGATE, & BITUMINOUS MIXES	USE CAPITAL LETTERS										44-9346 R3/92									
	LAB NUMBER				PROJ CODE			ORG NUMBER			MATL		TYPE	PUR- POSE	TEST LAB	SIZE	SIZE %			
	TEST NO.				LOT OR SUFFIX		SAMPLED BY				MO	DAY		YEAR		TIME		<input type="checkbox"/> AM	<input type="checkbox"/> PM	
	SAMPLED FROM										LIFT NO.		RDWY		STATION		PLUS		<input type="checkbox"/>	<input type="checkbox"/>
	ORIGINAL SOURCE										PROJECT ENGINEER / SUPERVISOR				PROJECT NUMBER			TRACS NUMBER		
	REMARKS																			

Figure 7: Sample Tabulation Card

Summary

Methods exist for sampling a windrow but generally it is not permitted in most bituminous construction. An exception is found in section 413 ARAC due to the difficulties associated with getting a good finish on hand-worked ARAC caused by obtaining a plate sample. Keep in mind that a truck sample also could be taken as previously discussed. Also remember that our goal is to obtain a sample that is representative of the bituminous mixture as close as possible to its final composition as it is placed.

It is crucial that the sample be representative in order to be valid.

Random numbers are specifically called for to determine the proper location of all end-product sampling points. As described earlier (at the end of Section 2) the table of random numbers found in Appendix A on page 26 or a random number generator may be used. Keep in mind that the referee random number selection process is also available in ASTM D3665. Although ADOT does not specify the details for selection of random numbers it is best to use the ASTM tables and set up a stratified random sampling pattern. This is stated in ATI literature as well.

The bituminous specifications allow for judgement samples when material appears to be inconsistent or otherwise deficient.

Section Four: Standard Specification Types

Using the Materials Sampling Guide Schedule provided by your instructor and the ADOT *Standard Specifications* we will review each of the specifications for bituminous construction currently in use by ADOT.

Summary of Specifications

The information below, summarized from the ADOT *Standard Specifications*, points out the differences with respect to each type of pavement and the corresponding item number. As we study each section of the ADOT *Standard Specifications*, locate all of the places that the section number also appears in the Materials Sampling Guide Schedule.

Std. Spec. Section	Summary
404	This section covers the use of bituminous materials for prime, flush, fog, chip seal, and tack coats. It is also the item under which all bituminous materials are measured and paid for; in this respect it is very important to pay attention to the requirements of Sections 1005 and 1009 depending on the type(s) of material being used on the project. Samples taken of these materials require a Certificate of Compliance or Certificate of Analysis in addition to one or more samples per delivery unit or one per half shift. The exception is asphalt cement used for tack coat (see p.25 in Sampling Guide Schedule) in which case only a Certificate of Compliance is needed.
405	This section addresses Road Mix and is an area of the Specification that is not frequently used. Inspection of the Sampling Guide shows us that samples of the raw aggregate will be taken for moisture content and gradation but all other sampling and testing will be as dictated by the Special Provisions for any particular contract.
406	This section covers the standard asphaltic concrete mix. It was one of the more commonly used specifications. It was originally a method spec but now primary control is almost entirely End-Product making it very similar to the 416 specification. One difference is that only 10 cores are taken for density versus the 20 that are called for in 416 and 417. This specification uses stratified random sampling. We take 4 plate samples and 10 cores for density. The other major difference is that we do not check for spread like we would under 416.

Std. Spec. Section	Summary
407	This was the basic ACFC specification. It is now used less frequently than 414 (see below) due to the popularity of AR mix designs in ADOT. It is also one of the last remaining method specifications. Inspectors are cautioned to watch for a phenomenon known as “draindown” when this type of mix is transported significant distances or allowed to sit in the trucks for excessive lengths of time. Draindown occurs when some of the asphalt cement runs to the lower portions of the load thereby causing undesirable variations in the asphalt content of the mix.
408	This is the only plant recycling specification. Pavement millings (or RAP) is utilized as a part of the aggregate supply. It currently is not being used in ADOT’s pavement preservation program; however, it was recently updated along with the other version 2000 specifications. This specification requires 3 mix (plate) samples and 10 cores again for density.
409	This is the Miscellaneous Structural AC mix. Sampling is left to the discretion of the Engineer. We will usually take one or two samples per day.
411	This specification is used for Misc. Structural Friction Courses and is another specification that is rarely used.
413	This is a rubberized asphalt mix specification used for ADOT’s ARAC. Sampling frequency is a minimum of 4 per day at the plant, from the windrow, or from the mat behind the paver. Viscosity samples also are needed; take one sample per batch. Our responsibility is to observe the contractor’s personnel perform the sampling and nuclear asphalt content gauge operation.
414	This is another friction course and it is the only rubberized one, which makes it an AR-ACFC. Sampling frequency is 4 per day from a loaded truck at the plant. This is due in part to the nature of rubberized mixes being difficult to work by hand and the fact that it is an ACFC as well makes it extra susceptible to degradation in any spots where it is disturbed. Inspectors should watch for draindown again because the asphalt contents of these mixes are quite high (about 7% to 9%). Viscosity samples also are needed; take one sample per batch.
416	End-Product Specification using stratified random sampling. We obtain 20 cores per day and 4 plate samples. The extra 10 cores are saved for 15 days in case of requests by the contractor for retesting the density of the mix (compaction).

Std. Spec. Section	Summary
417	End-Product SHRP specification. This also calls for 20 cores per day along with 4 plate samples. This is associated with the latest testing and design methods for AC pavements in the industry today.
1005	Covers asphalt cements, cutbacks, and emulsions. This specification and the 1009 AR specification are both technical specifications that do not contain a direct payment method. However, they do contain certain provisions for removing or penalizing the contractor if the specification is not met.
1009	This is the specification for the rubberized bituminous material. It is a basic method specification that guides the contractor through the steps to create an approximately 80-20 asphalt rubber blend.

Correction Note: The materials sampling guide schedule reads, “Certificate of Compliance required and one bag per lot per type.” It should read, “Certificate of Compliance required and one sample per bag per lot per type.”

The student is referred to the ADOT *Materials Testing Manual* for information and guidance regarding the lab procedures when dealing with these different methods in detail.

Section Five: Field Operations

Safety is always the first priority. Some project sites experience heavy traffic, as many as 100,000 vehicles per day. In some cases you might have to watch out for an occasional train or airplane passing nearby.

Both pneumatic and steel-wheel rollers are used on most asphalt paving projects. On AR and AR-ACFC specifications only allow the use of steel-wheel rollers. Inspectors should know the difference in roller types so that they can properly document patterns when method specifications are in effect.

Knowing how a paver works and the proper steps a contractor should follow to make a smooth mat are also important items for anyone on an asphalt paving project.

When sampling any bituminous mix look for inconsistencies and uncoated or fractured particles.

We do not direct the contractor's operation. An inspector observes methods, samples to evaluate quality, measures progress and production, and documents facts (including conversations) relevant to the project so that each day's situation can be recreated for review at a later time if needed.

Look for segregation; the contractor is supposed to be "producing" a roadway that is consistent in every respect. This applies to thickness, smoothness, surface texture, along with being well mixed (not segregated). For more on segregation, refer to the *Hot-Mix Asphalt Paving Handbook 2000*.

The supervisor will determine when judgement samples are needed. There are ways to sample the pavement after it has cooled but it is a little more work for the contractor.

Also keep in mind that after results are reported to the Contractor they may be contested if they are unfavorable to the Contractor. In such instances, some re-coring or other resampling would be required unless specifications 416 or 417 (density only) were used to either support or supersede the original test results and evaluation.

Selected Excerpts
From
ADOT Materials Quality
Assurance Program
October 1, 1999 Version
Appendix C
Sampling Guide Schedule

For Use with ADOT Training

Field Sampling & Testing
for Bituminous Construction

(Course Number 301)

Appendix: Table of Random Numbers

	0	1	2	3	4	5	6	7	8	9
1	0.419	0.496	0.313	0.526	0.724	0.163	0.834	0.425	0.719	0.767
2	0.574	0.832	0.137	0.028	0.328	0.113	0.138	0.871	0.511	0.741
3	0.979	0.763	0.439	0.182	0.078	0.572	0.727	0.404	0.963	0.733
4	0.390	0.948	0.261	0.223	0.927	0.451	0.308	0.272	0.909	0.806
5	0.596	0.519	0.683	0.807	0.811	0.897	0.483	0.379	0.944	0.316
6	0.608	0.262	0.517	0.402	0.575	0.993	0.569	0.230	0.451	0.809
7	0.156	0.539	0.013	0.468	0.650	0.067	0.247	0.606	0.367	0.818
8	0.695	0.942	0.362	0.073	0.326	0.809	0.825	0.275	0.354	0.832
9	0.173	0.431	0.317	0.751	0.773	0.803	0.536	0.288	0.573	0.957
10	0.930	0.978	0.230	0.841	0.295	0.232	0.771	0.504	0.968	0.287
11	0.566	0.295	0.882	0.708	0.328	0.998	0.018	0.475	0.080	0.439
12	0.344	0.646	0.704	0.032	0.368	0.978	0.342	0.557	0.002	0.693
13	0.010	0.848	0.207	0.891	0.594	0.056	0.130	0.522	0.612	0.351
14	0.339	0.912	0.868	0.395	0.226	0.729	0.945	0.800	0.406	0.345
15	0.936	0.368	0.903	0.181	0.334	0.633	0.360	0.779	0.172	0.261
16	0.532	0.635	0.857	0.444	0.661	0.002	0.109	0.767	0.092	0.475
17	0.763	0.345	0.176	0.126	0.309	0.506	0.414	0.789	0.585	0.259
18	0.380	0.169	0.534	0.987	0.449	0.148	0.327	0.984	0.740	0.846
19	0.191	0.208	0.748	0.979	0.081	0.204	0.154	0.940	0.687	0.096
20	0.886	0.473	0.589	0.204	0.484	0.221	0.486	0.771	0.849	0.588
21	0.574	0.145	0.934	0.552	0.224	0.170	0.021	0.556	0.207	0.187
22	0.258	0.341	0.682	0.628	0.642	0.212	0.178	0.080	0.132	0.925
23	0.108	0.243	0.342	0.299	0.195	0.625	0.703	0.895	0.105	0.484
24	0.426	0.580	0.734	0.358	0.779	0.956	0.292	0.603	0.597	0.494
25	0.567	0.172	0.341	0.376	0.965	0.297	0.776	0.729	0.162	0.751
26	0.574	0.598	0.072	0.815	0.165	0.451	0.804	0.642	0.926	0.980
27	0.658	0.241	0.351	0.418	0.103	0.084	0.498	0.357	0.973	0.953
28	0.399	0.647	0.932	0.807	0.505	0.240	0.191	0.804	0.655	0.801
29	0.269	0.757	0.847	0.693	0.584	0.663	0.689	0.119	0.992	0.361
30	0.320	0.413	0.473	0.160	0.418	0.747	0.619	0.842	0.224	0.212
31	0.469	0.609	0.321	0.276	0.532	0.939	0.432	0.717	0.119	0.758
32	0.758	0.512	0.625	0.447	0.700	0.776	0.537	0.951	0.607	0.049
33	0.323	0.544	0.900	0.255	0.971	0.889	0.719	0.976	0.154	0.969
34	0.950	0.047	0.119	0.024	0.152	0.316	0.398	0.439	0.364	0.490
35	0.611	0.681	0.724	0.846	0.359	0.082	0.536	0.719	0.148	0.666
36	0.369	0.262	0.480	0.744	0.160	0.084	0.596	0.794	0.059	0.241
37	0.189	0.102	0.750	0.020	0.693	0.894	0.032	0.311	0.557	0.666
38	0.453	0.833	0.423	0.976	0.029	0.039	0.993	0.352	0.828	0.012
39	0.003	0.505	0.644	0.417	0.016	0.385	0.420	0.447	0.250	0.452
40	0.473	0.310	0.971	0.754	0.468	0.025	0.746	0.585	0.760	0.619
41	0.044	0.200	0.726	0.794	0.060	0.932	0.168	0.312	0.866	0.439
42	0.877	0.703	0.377	0.947	0.702	0.708	0.020	0.709	0.658	0.488
43	0.419	0.820	0.493	0.959	0.838	0.071	0.312	0.639	0.755	0.206
44	0.852	0.091	0.078	0.785	0.523	0.837	0.795	0.707	0.615	0.895
45	0.312	0.635	0.011	0.876	0.996	0.676	0.940	0.312	0.765	0.284
46	0.570	0.615	0.703	0.891	0.889	0.593	0.063	0.617	0.999	0.637
47	0.968	0.565	0.973	0.395	0.871	0.241	0.300	0.338	0.431	0.211
48	0.811	0.136	0.545	0.703	0.692	0.188	0.773	0.225	0.277	0.584
49	0.040	0.092	0.900	0.071	0.648	0.796	0.842	0.579	0.056	0.988
50	0.731	0.780	0.141	0.491	0.430	0.434	0.571	0.750	0.713	0.807