

**ARIZONA DEPARTMENT OF TRANSPORTATION**



**MATERIALS QUALITY ASSURANCE  
PROGRAM**

(ADOT Materials Testing Manual – Series 900)

January 17, 2014

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**ADOT MATERIALS QUALITY ASSURANCE PROGRAM**

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## I. SCOPE

The ADOT Materials Quality Assurance Program has been established in accordance with requirements of the *Code of Federal Regulations (23 CFR 637, Subpart B)* - "Quality Assurance Procedure for Construction" (See **Appendix D**). Documented herein are details of the ADOT Materials Quality Assurance Program and applicable policies, procedures, and guidelines.

The Quality Assurance Program represents the Department's commitment to consistently provide our customers with products and services that meet mutually agreed upon requirements. The program is intended to ensure all materials incorporated into ADOT projects satisfy specification requirements and to provide the highest degree of confidence in the reliability of tests performed by laboratories for ADOT projects.

This document has been prepared for utilizing materials acceptance procedures which are now generally employed by ADOT, i.e., acceptance sampling and testing being performed by ADOT or its designated agent(s).

The Quality Assurance Program is administered by the Materials Group Quality Assurance Section. Revisions to this program will be issued by the Quality Assurance Section through the authority of the Assistant State Engineer, Materials Group.

The Materials Quality Assurance Section maintains a website where information regarding its function can be found. Information regarding the "ADOT System for the Evaluation of Testing Laboratories", the ADOT "Directory of Approved Materials Testing Laboratories", the ADOT Laboratory Inspection Program, the ADOT Proficiency Sample Program, and Technician Certification may be obtained from the ADOT Materials Group, Quality Assurance Section website.

The "ADOT System for the Evaluation of Testing Laboratories" has been issued as Materials Policy and Procedure Directive (P.P.D.) No. 19. The ADOT Materials Policy and Procedure Directives Manual, which contains P.P.D. No. 19, can be obtained from the ADOT Materials Group, Materials Manuals website.

**II. LIST OF ABBREVIATIONS**

AAP	AASHTO Accreditation Program
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADOT	Arizona Department of Transportation
AMRL	AASHTO Materials Reference Laboratory
ASTM	American Society for Testing and Materials
ATTI	Arizona Technical Testing Institute
CCRL	Cement and Concrete Reference Laboratory
CFR	Code of Federal Regulations
FAPG	Federal-Aid Policy Guide
FHWA	Federal Highway Administration
I.A.	Independent Assurance Sampling and Testing Program
ITD	Intermodal Transportation Division
NICET	National Institute for Certification in Engineering Technologies
NIST	National Institute of Standards and Technology
PPD	ADOT Materials Policy and Procedure Directive
RME	Regional Materials Engineer
QA	Quality Assurance
QC	Quality Control

### III. GLOSSARY OF TERMS

**Acceptance Program** - All factors used by the State to determine the quality of the product as specified in the contract requirements. These factors include acceptance sampling and testing, and inspection of materials and workmanship.

**Acceptance Sampling and Testing** - Sampling and testing performed to determine the quality and acceptability of the materials and workmanship incorporated in a project.

**Certification Acceptance Projects** - Federal-aid projects which are advertised, awarded, and administered by a Local Public Agency which satisfies the requirements of their ADOT/Local Public Agency certification agreement. See **Appendix A** for information regarding Local Public Agency quality assurance requirements.

**Contractor Testing** - Random sampling and testing and other operational techniques and activities that are performed by the contractor/vendor to fulfill the contract requirements. Contractor testing is normally sampling and testing performed by the contractor for quality control of its materials.

**Correlation Testing Program** - Testing performed to check or establish variability of testing procedures and equipment between testing laboratories. ADOT requires split samples be tested by the Project Laboratory and the Regional or Central Laboratory.

**Independent Assurance Sampling and Testing Program** - Activities that are an unbiased and independent evaluation of sampling and testing used in the acceptance program. Independent Assurance samples and tests or other procedures shall be performed by qualified State personnel, or State designated agents such as qualified consultants, who do not have direct responsibility for contractor or acceptance sampling and testing on a project. The results of independent assurance tests are not used for determining the quality and acceptability of the materials and workmanship. Tests performed by the Materials Group Central Laboratory for use in the acceptance decision are not covered by the Independent Assurance Sampling and Testing Program.

The independent assurance sampling and testing program employed by ADOT is comprised of two different approaches. Those approaches are the "Project Basis" and the "System Basis".

- The "Project Basis" is used for the majority of construction materials and consists of evaluating laboratories' testing equipment and personnel by inspections, I.A. split samples, and proficiency samples. Use of the "Project Basis" for independent assurance sampling and testing is described in **Sections V(B)(1) and V(B)(2)**.

- The “System Basis” is an alternate method which is used to satisfy the independent assurance sampling and testing requirements for certain items. Currently, those items are concrete mixture properties (other than compressive strength) and field density of compacted soil and aggregate materials. The “System Basis” approach is based on observing and verifying satisfactory performance by the individuals performing acceptance sampling and testing, and the equipment utilized, for a particular period of time, rather than performing independent assurance sampling and testing at specified frequencies for a specific project. Use of the “System Basis” for independent assurance sampling and testing is described in **Section V(B)(3)**.

**Inspection** - The process of observing, measuring, examining, testing, gauging, or otherwise evaluating materials, products, services, testing activities, and equipment.

**Laboratory Technician** - An employee of the laboratory who is assigned to perform the actual testing operations primarily conducted in the laboratory. Certain specifications may require technicians who are certified through appropriate certification programs determined by the Department.

**Proficiency Sample Program** - Homogeneous samples that are distributed and tested by two or more laboratories. The test results are compared to assure that the laboratories are obtaining results within prescribed limits of variability.

**Qualified Laboratories** - Laboratories which have been approved to perform testing activities for ADOT. These laboratories have met the requirements of the “ADOT System for the Evaluation of Testing Laboratories” (PPD No. 19). The ADOT “Directory of Approved Materials Testing Laboratories” lists laboratories meeting this criteria.

**Qualified Sampling and Testing Personnel** - Personnel who meet the requirements as established by ADOT.

**Quality** - Consistently conforming to mutually agreed upon requirements.

**Quality Assurance** - All those planned and systematic activities necessary to provide adequate confidence that a product or service satisfies given requirements for quality.

**Quality Assurance Program** - The organizational structure, policies, responsibilities, procedures, processes, and resources utilized for implementing quality assurance activities and ensuring continued compliance with applicable standards.

**Random Sample** - A sample drawn from a lot in which each increment in the lot has an equal probability of being chosen. All samples used for contractor or acceptance sampling and testing shall be random samples.



**Testing Laboratory** - An organization that measures, examines, performs tests; or otherwise determines the characteristics, properties, and performance of materials or products. ADOT issues the “Directory of Approved Materials Testing Laboratories” which lists testing laboratories approved to perform testing activities on ADOT projects.

**Vendor** - A supplier of project-produced material that is not the contractor.

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## V. QUALITY ASSURANCE

### A. MATERIALS ACCEPTANCE

The quality of materials and construction incorporated into ADOT construction projects are controlled by sampling and testing, and accepted based on specification compliance. Compliance with specifications is determined by acceptance sampling and testing. All materials shall be randomly sampled at prescribed frequencies as given in the Sampling Guide Schedule, **Appendix C**. Sampling and testing shall be performed by qualified laboratories and by qualified sampling and testing personnel.

Reliance should not be placed wholly on the results of sampling and testing in determining the acceptability of materials and construction work. The sampling and testing should be supplemented by sufficient visual inspection of the materials to determine whether the samples and tests are reasonably representative. In addition, there should be sufficient observation of the construction operations and processes to assure uniformly satisfactory results.

#### 1. Acceptance Sampling and Testing

The Sampling Guide Schedule (**Appendix C**) applies to sampling frequencies only for acceptance sampling and testing. It gives the material type to be sampled, the frequency of sampling, location of samples, and testing to be performed. Acceptance samples must be obtained randomly by ADOT technicians or ADOT designated agents.

In some cases, ADOT technicians or ADOT designated agents may not be allowed to physically perform the sampling of materials due to liability issues or safety and health regulations.

When directing and witnessing the sampling, both the name of the person physically performing the sampling and the name of the ADOT technician or ADOT designated agent directing and witnessing the sampling shall be noted on the sampling ticket.

After samples are taken, they shall be in the immediate custody of the ADOT technician or ADOT designated agent. Thereafter, the samples shall remain in ADOT's "chain of custody" until they are delivered to the appropriate laboratory for testing.

Note: During their initial cure, concrete cylinders may not be in ADOT's continual "chain of custody". If this is the case, appropriate measures shall be taken to ensure the integrity of the samples.

It is the intent of the Sampling Guide Schedule to provide guidance to personnel responsible for sampling and testing materials, yet allow reasonable latitude for adapting to specific project needs. The frequency may vary for individual projects or

phases of projects in accordance with job conditions, such as, the uniformity of materials at the source, the methods and equipment used, and weather conditions. The number of samples and locations from which they are taken should adequately assure or verify that the materials incorporated and construction produced are acceptable in accordance with the plans and specifications. The Engineer may direct that less acceptance sampling and testing be accomplished in particular cases he deems necessary provided concurrence from Materials Group is obtained. Conversely, the Engineer may direct that an amount of acceptance testing greater than the required minimum be done when he deems necessary.

The recommended number of acceptance samples is listed on a materials sample checklist [see **Section V(E)(1)**] issued for each project by the Quality Assurance Section. The number of samples given on the materials sample checklist is the recommended minimum derived from the project special provisions bidding schedule. For materials that are sampled on a time designated lot basis, an estimated lot quantity is used to determine the recommended number of acceptance samples.

## **2. Acceptance of Materials by Certification or Other Means**

- Acceptance of materials by “Certificate of Compliance” or “Certificate of Analysis” will be in accordance with Subsection 106.05 of the specifications, Section 1000 of the ADOT Materials Testing Manual, and applicable ADOT Materials Policy and Procedure Directives.
- Small quantities may be accepted on the basis of certification or based upon visual observations of the Engineer. Small quantities may be considered to be approximately 500 cubic yards or less of processed aggregate material or approximately 20 tons of bituminous material, portland cement, or fly ash. A small quantity of portland cement concrete should be considered to be 5 cubic yards or less. The Engineer should exercise careful judgment in the acceptance of small quantities. Considerations must include the significance of the product to the construction as well as the quantity. The recommended sizes of small quantities are to be considered approximate, not maximums.
- Some materials are pre-sampled at the supplier’s yard by the Regional or Central Laboratory, tested, and, if specifications are met, tagged with an ADOT green sticker showing the project number, lab number, lot number, individual approving material, and date of approval. Such materials include, but not are limited to, concrete curing compounds, precast concrete pipes, and glass beads. For materials that are “green tagged”, it may not be necessary to do any further sampling and testing. However, the proper laboratory should be contacted for verification of the materials acceptability.

- Some materials approved for use are shown on the Department's Approved Products List (APL). This list includes products that have been pre-tested and found acceptable for Department use; however, when such products are used they must also meet the requirements of the Sampling Guide Schedule (**Appendix C**) and/or the requirements of the specifications. Copies of the most current version of the APL are available on the internet from the ADOT Research Center, through its Product Evaluation Program.

## **B. INDEPENDENT ASSURANCE SAMPLING AND TESTING**

The Code of Federal Regulations (23 CFR 637, Subpart B) (See **Appendix D**) requires the implementation of an Independent Assurance Program. Its definition of an independent assurance program is as follows:

*“Activities that are an unbiased and independent evaluation of all the sampling and testing procedures used in the acceptance program.”*

The independent assurance program evaluates the sampling/testing personnel and testing equipment used in acceptance of materials. The Code of Federal Regulations allows observations, split sample results, and proficiency sample results as means of evaluating testing personnel within a State's independent assurance program. Calibration checks, split sample results, and proficiency sample results are permissible inclusions to the I.A. program for evaluating acceptance testing equipment. The independent assurance program does not directly determine the acceptability of materials.

For the majority of construction materials used for ADOT projects, the independent assurance sampling and testing requirements are satisfied using the “Project Basis”, as described in **Sections V(B)(1) and V(B)(2)**. Using the “Project Basis”, ADOT evaluates laboratories' testing equipment and personnel by obtaining and testing I.A. samples and splits of those samples.

The Regional Materials Engineers are responsible for administering the “Project Basis” independent assurance program; they provide personnel and equipment to obtain the independent assurance samples. Communication shall be maintained between project and regional lab personnel to assure timely independent assurance sampling and testing is accomplished commensurate with project progress.

A “System Basis” is used to satisfy the independent assurance sampling and testing requirements for certain items. Currently, those items are concrete mixture properties (other than compressive strength) and field density of compacted soil and aggregate materials. The “System Basis” is described in **Section V(B)(3)**.

Materials requiring independent assurance sampling and testing are outlined in the Sampling Guide Schedule (**Appendix C**).

**1. Frequency of Independent Assurance Sampling and Testing when the “Project Basis” is used**

For independent assurance sampling and testing administered under the “Project Basis”, the frequency of sampling for independent assurance is a function of the number of samples used for acceptance on a project basis. Unless a material is represented by a small quantity, at least one I.A. sample is required for each qualifying material type on each project.

Independent assurance samples shall be of sufficient quantity for a split to be tested by the project laboratory.

Independent assurance (I.A.) sampling and testing shall be performed as early as possible after production or placement of the material begins.

I.A. sampling shall be performed by the individual(s) designated by the respective Regional Materials Engineer.

I.A. testing shall be performed by the laboratory/individual(s) designated by the respective Regional Materials Engineer.

The minimum frequency of independent assurance sampling and testing is given below.

- For asphaltic concrete produced under Specifications 415, 416, or 417:
  - One independent assurance bituminous mixture sample shall be taken for every 5 acceptance lots. The I.A. sample shall be taken at a different location than any acceptance sample, and split with the laboratory performing acceptance testing. At least one I.A. bituminous mixture sample is required for each project having less than 5 acceptance lots.
  - Independent assurance sampling and testing, other than gradation, shall be performed on mineral aggregate for the bituminous mixture at the rate of one I.A. sample for every 40 acceptance samples.
  - I.A. samples for compaction (separate cores) will not be taken.
- For asphaltic concrete produced under Specifications 407, 413, or 414:
  - Independent assurance sampling and testing for the bituminous mixture shall consist of observing the acceptance sampling and testing at a rate of one I.A. sample for every 20 acceptance samples.

- Independent assurance sampling and testing shall be performed on mineral aggregate for the bituminous mixture at the rate of one I.A. sample for every 40 acceptance samples.
- For Class P portland cement concrete:
  - One independent assurance concrete mixture sample for compressive strength shall be taken for every 5 acceptance lots. The I.A. sample shall be taken at a different location than any acceptance sample, and split with the laboratory performing acceptance testing. At least one I.A. concrete mixture sample for compressive strength is required for each project having less than 5 acceptance lots.
  - Independent assurance sampling and testing of the concrete mixture, other than for compressive strength, shall consist of meeting the requirements for the “system basis” described in **Section V(B)(3)**.
  - Independent assurance sampling and testing shall be performed on aggregate for the concrete mixture at the rate of one I.A. sample for every 40 acceptance samples.
- For Class S or B portland cement concrete:
  - Independent assurance sampling and testing for compressive strength of the concrete mixture shall be performed at the following rate: for Class S concrete, one I.A. sample for every 25 acceptance samples; for Class B concrete, one I.A. sample for every 40 acceptance samples. For I.A. split comparison results, duplicate sets of samples shall be taken, prepared, and tested.
  - Independent assurance sampling and testing of the concrete mixture, other than for compressive strength, shall consist of meeting the requirements for the “system basis” described in **Section V(B)(3)**.
  - Independent assurance sampling and testing shall be performed on aggregate for the concrete mixture at the rate of one I.A. sample for every 40 acceptance samples.
- For all other materials subject to I.A. sampling and testing (as indicated in the Sampling Guide Schedule, **Appendix C**):
  - One I.A. sample shall be taken for every 40 acceptance samples.

## 2. Comparison and Reporting of Independent Assurance Sampling and Testing when the “Project Basis” is used

For independent assurance sampling and testing administered under the “Project Basis”, each I.A. sample will normally have an I.A. split run by the ADOT acceptance

lab, with some exceptions as noted below. I.A. sample results shall be promptly compared to I.A. split sample results.

- For asphaltic concrete produced under Specifications 415, 416, or 417:
  - I.A. samples of bituminous mixture are split with the acceptance lab. **The I.A. and the acceptance lab split test results are used only for evaluating the equipment and personnel. They are not to be used in the statistical acceptance of the respective lot from which the I.A. sample was taken.**
  - Each I.A. test result for samples of mineral aggregate for the bituminous mixture, other than gradation, is compared to its I.A. split result.
  
- For asphaltic concrete produced under Specifications 407, 413, or 414:
  - Each observation performed for independent assurance sampling and testing of the bituminous mixture shall be documented by recording the date of each observation, name of the test operator performing the acceptance sampling and testing, and the acceptability of the sampling and testing performed.
  - Each I.A. test result for samples of mineral aggregate for the bituminous mixture is compared to its I.A. split result.
  
- For Class P portland cement concrete:
  - I.A. samples for compressive strength of the concrete mixture are split with the acceptance lab. **The I.A. and the acceptance lab split test results are used only for evaluating the equipment and personnel. They are not to be used in the statistical acceptance of the respective lot from which the I.A. sample was taken.**
  - Each I.A. test result for samples of aggregate for the concrete mixture is compared to its I.A. split result.
  
- For Class S or B portland cement concrete:
  - Each I.A. test result for compressive strength of the concrete mixture is compared to its I.A. split result.
  - Each I.A. test result for samples of aggregate for the concrete mixture is compared to its I.A. split result.

- For all other materials subject to I.A. sampling and testing (as indicated in the Sampling Guide Schedule, **Appendix C**):
  - Each I.A. test result is compared to its I.A. split result.

For a favorable comparison, each specified test characteristic must be within the allowable variation listed in **Figure 1** for “SAMPLE RESULT vs. SPLIT RESULT”.

The Regional Materials Engineer is responsible to determine allowable variations for test characteristics not listed in **Figure 1**.

An example of the comparison of test results and the report of Independent Assurance Sampling and Testing performed is given in **Figure 2**.

If there are no unfavorable comparisons, the results of the independent assurance testing shall be reported by the Regional Materials Engineer to the Resident Engineer/Project Lab within five working days of receiving the sample in the I.A. testing laboratory.

If there are any unfavorable comparisons, an investigation shall be initiated to determine the cause of the discrepancy. The investigation may include a check of the test data, calculations, and results; an inspection of the equipment used to perform the testing; a discussion with the test operators regarding their knowledge of the procedure in question; retesting of samples; exchanging samples; and observation of each other's techniques. When the problem is isolated, the steps taken to resolve it shall be documented. The results of the I.A. testing, comparisons, findings, and resolutions shall be reported by the Regional Materials Engineer to the Resident Engineer/Project Lab in a prompt and timely manner.

When Central Lab performs testing of independent assurance samples:

- If there are no unfavorable comparisons, the results will be communicated to the Regional Materials Engineer who will notify the Resident Engineer/Project Lab within five working days of receipt of the sample by Central Lab.
- If there are any unfavorable comparisons, they shall be investigated as described above and a report of the results of the I.A. testing, comparisons, findings, and resolutions shall be communicated to the Regional Materials Engineer, who will notify the Resident Engineer/Project Lab in a prompt and timely manner.

When an I.A. split is used as an acceptance sample, it is recorded as an acceptance test on the project Materials Sample Checklist.



**INDEPENDENT ASSURANCE AND CORRELATION TESTING ALLOWABLE VARIATIONS (±)**  
(See Notes 1 and 2 below.)

PORTLAND CEMENT CONCRETE		SOILS AND AGGREGATES	
TEST	SAMPLE RESULT vs. SPLIT RESULT (See Note 3 below.)	TEST	SAMPLE RESULT vs. SPLIT RESULT (See Note 3 below.)
Coarse Aggregate Gradation:		Gradation, except for Portland Cement Concrete and Bituminous Mixtures:	
+1"	4	+1"	4
1"	4	1"	4
3/4"	4	3/4"	4
1/2"	4	1/2"	4
3/8"	4	3/8"	4
1/4"	4	1/4"	4
No. 4	4	No. 4	4
No. 8	4	No. 8	4
Fine Aggregate Gradation:		No. 16	4
No. 4	4	No. 40	3
No. 16	3	No. 200	1.5
No. 50	3	Sand Equivalent	6
No. 100	3	Flakiness Index	3
No. 200	1.5	Uncompacted Void Content	1.0
28-Day Compressive Strength: (Class P, S, and B) (See Note 4 below.)	15% of the mix design strength	pH	0.4
		Optimum Moisture, percent	2.0
		Proctor Density, pounds/cu. ft.	4.0
		Fractured Coarse Aggregate Particles (See Note 5 below.)	15% of the mean of the results
		Plasticity Index: (See Note 5 below.)	
		Liquid Limit (LL)	13% of the mean of the results
		Plastic Limit (PL)	18% of the mean of the results
BITUMINOUS MIXTURES			
TEST	SAMPLE RESULT vs. SPLIT RESULT (See Note 3 below.)		
Mineral Aggregate Gradation:			
+3/4"	4		
3/4"	4		
1/2"	4		
3/8"	4		
No. 4	4		
No. 8	4		
No. 30	2		
No. 40	2		
No. 200	1.0		
Percent Asphalt	0.4		
Bulk Density, pounds/cu. ft.	2.0		
Rice Density, pounds/cu. ft.	2.0		
Voids, percent	1.5		
Marshall Stability, pounds	1200		

Note 1: Use applicable test characteristics specified for material being tested.  
 Note 2: Regional Materials Engineer to determine allowable variations for test characteristics not shown.  
 Note 3: Allowable variations apply for both independent assurance testing and correlation testing comparisons.  
 Note 4: Allowable variations based on a percentage of the mix design strength shall be rounded if necessary to the nearest whole number.  
 Note 5: Allowable variations based on a percentage of the mean of the results shall be rounded if necessary to the nearest whole number.

**Figure 1**

## Arizona Department of Transportation Report of Independent Assurance Sampling and Testing

Project #: F-99-B(100)T	Resident Engineer: George Washington
TRACS #: H888801C	Contractor: DESERT CONSTRUCTION
Project Name: RED RIVER VALLEY- GREEN GORGE	District: Holbrook
Material Type: Aggregate Base Class 2	Sample Date: 05/14/2013 Sample Received: 05/15/2013 12:00 am
Sample Location: Rdwy/windrow 1' rt of CL	Sampled By: Ronald Reagan
Location of Supply: Dunlap Plant #117	I.A. Sample ID#: 6 Tested By (Lab): Flagstaff Regional Lab
	I.A. Split ID#: 6 Tested By (Lab): Flagstaff Area

	3"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#8	#16	#40	#200	Opt Mst %	Proc Den	PL	LL	PI	FF	FF2	SE	pH	Res
I.A. Test Results	100	100	100	100	100	95	78	70	58	51	35	22	11	5.0					NP	100				
I.A. Split Test Results	100	100	100	100	100	97	81	71	59	52	35	22	12	5.0					NP	99				
Variation (I.A. vs. Split)	0	0	0	0	0	2	3	1	1	1	0	0	1	0.0						1				
Allowable Variation (+/-)				4	4	4	4	4	4	4	4	4	3	1.5						15				
Unfavorable Comparison (X):																								
Avg. Acceptance Results	100	100	100	100	100	96	81	72	61	54	37	24	13	5.8	17.4	118.7				99				
Variation (I.A. vs. Avg.)	0	0	0	0	0	1	3	2	3	3	2	2	2	0.8						1				

Favorable Comparison  Yes  No

I.A. Sample is Complete  Yes  No a7198 05/17/2013 12:31 pm

I.A. Split is Complete  Yes  No a1871 05/17/2013 12:15 pm

Individual Contacted and Date/Time Acceptance Lab Notified: Ronald Reagan 05/17/13 12:25 PM

Action Taken:

Remarks:

Regional Materials Engineer: Thomas Jefferson 05/20/13 08:11 am

EXAMPLE REPORT OF INDEPENDENT ASSURANCE SAMPLING AND TESTING

Figure 2

### **3. Use of the “System Basis” for Independent Assurance Sampling and Testing Requirements for Certain Materials**

The “system basis” outlined below is an alternate I.A. method which is based on observing and verifying satisfactory performance by the individuals performing acceptance sampling and testing, and the equipment utilized, for a particular period of time, rather than performing independent assurance sampling and testing at specified frequencies for a specific project.

The “system basis” is used to satisfy the requirements for independent assurance sampling and testing only for certain materials. Currently, the materials for which the “system basis” is applicable are concrete mixture properties (other than compressive strength) and field density of compacted soil and aggregate materials.

The objective of the “system basis” is to observe and verify that the the individuals performing acceptance sampling and testing, and the equipment utilized, are qualified for a twelve month period. Ideally, all individuals who are performing such sampling and testing, and the equipment utilized, in a given twelve month period would be covered by this verification. It is recognized that this may not be possible in all cases. In the first 12 months of this program, a target of 75 percent of all technicians performing acceptance sampling and testing on ADOT projects for concrete mixture properties (other than compressive strength) and field density of compacted soil and aggregate materials will be identified, observed, and verified. In subsequent 12-month periods, it is anticipated that the target percentage will be increased.

The “system basis” is a more effective means of performing independent assurance sampling and testing than performing independent assurance sampling and testing at specified frequencies for a specific project since it ensures that most of the individuals performing acceptance sampling and testing are reviewed and that the same individuals are not continually reviewed.

ADOT Materials Group has implemented a system by which the majority of individuals performing acceptance sampling and testing, and the equipment utilized, are identified, observed, and verified for each twelve month period. The Regional Materials Engineers and the Materials Quality Assurance Section will administer the I.A. “System Basis” program.

For each twelve month period, the Assistant State Engineer, Materials Group, will submit a report to the FHWA documenting activities of the I.A. “System Basis” program. The report will include the following information:

1. Names and number of technicians performing acceptance sampling and testing of concrete mixture properties (other than compressive strength) and field density of compacted soil and aggregate materials on ADOT projects.
2. Number of such technicians evaluated by the program.
3. Number of such technicians that had deviations, as determined by the evaluation.
4. Summary of how the deviations were addressed, along with any potential systematic solutions to recurring deficiencies.
5. Goals for the upcoming twelve month period.

### **C. CORRELATION TESTING**

Correlation testing is a quality assurance activity conducted to supplement independent assurance sampling and testing. Correlation testing provides a method to isolate problems that originate from sample splitting or testing error. Correlation samples are taken by Project Lab personnel and are split with the Regional Lab unless otherwise directed by the Regional Materials Engineer.

#### **1. Frequency of Correlation Testing**

At the prescribed frequency given below, a representative split of acceptance samples taken on the project is obtained for correlation testing. The correlation split samples shall be properly identified and promptly submitted to the Regional Lab for testing. The correlation split will be of sufficient size for the Regional Lab to duplicate the testing that is performed at the Project Lab.

Correlation testing shall be performed at a minimum frequency of one correlation sample split for every five acceptance samples. Every effort should be made to obtain a correlation split sample from the first acceptance sample. If favorable comparisons are achieved on three consecutive correlation splits for a given material, the Regional Materials Engineer may revise the correlation frequency for that material to a minimum of one correlation sample split for every ten acceptance samples.

- For asphaltic concrete produced under Specifications 415, 416, or 417:
  - Correlation testing is not performed on the bituminous mixture.
  - Correlation testing, other than gradation, shall be performed at the frequency described above on mineral aggregate materials for the bituminous mixture.
  
- For asphaltic concrete produced under Specifications 407, 413, or 414:
  - Correlation testing is not performed on the bituminous mixture.
  - Correlation testing shall be performed at the frequency described above on mineral aggregate materials for the bituminous mixture.
  
- For Class P, S, or B portland cement concrete:
  - Correlation testing is not performed on portland cement concrete mixtures.
  - Correlation testing shall be performed at the frequency described above on the aggregate materials for the concrete mixture.
  
- For all other materials subject to correlation testing:
  - Correlation testing shall be performed at the frequency described above.

## 2. Comparison and Reporting of Correlation Testing

The Regional Materials Engineer or their designated representative will compare the results of tests performed on the acceptance sample and the correlation split. For a favorable comparison, each specified test characteristic must be within the allowable variation listed in **Figure 1** for “SAMPLE RESULT vs. SPLIT RESULT”.

The Regional Materials Engineer is responsible to determine allowable variations for test characteristics not listed in **Figure 1**.

An example of the comparison of test results and the report of Correlation Sampling and Testing performed is given in **Figure 3**.

If there are no unfavorable comparisons, the results of the correlation testing shall be reported by the Regional Materials Engineer to the Resident Engineer/Project Lab within five working days of receiving the sample in the correlation testing laboratory.

## Arizona Department of Transportation Report of Correlation Sampling and Testing

Project #: 007-A-STA TRACS #: H999901C Project Name: ARIZONA STATE PARK Material Type: Mineral Aggregate Sample Location: Cold Feed Location of Supply: Cactus Plant #111	Resident Engineer: George Bush Contractor: HAMMERD ENGINEERING CONSTRUCTION District: Globe Sample Date: 04/04/2013 Sampled By: Bill Clinton Correlation Sample ID#: 3 Acceptance ID #: 3
Sample Received: 04/16/2013 12:05 pm Tested By (Lab): Tucson Regional Lab Tested By (Lab): Globe Lab	

	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#8	#10	#16	#30	#40	#50	#100	#200	FF	FF2	FI	SE	UV
Correlation Split Test Results	100	100	100	100	93	83	67	56	39	36	27	18	15	11	6	3.8	79				81
Acceptance Sample Test Results	100	100	100	100	92	82	67	57	41	38	30	21	17	13	8	4.9	78				76
Variation (Split vs. Acceptance)	0	0	0	0	1	1	0	1	2	2	3	3	2	2	2	1.1	1				5
Allowable Variation (+/-)	4	4	4	4	4	4	4	4	4	4	4	4	3			1.5	12				6
Unfavorable Comparison (X):																					
Avg. Acceptance Results	100	100	100	100	92	82	67	57	41	38	30	21	17	13	8	4.9	78				76
Variation (Split vs. Avg.)	0	0	0	0	1	1	0	1	2	2	3	3	2	2	2	1.1	1				5

Favorable Comparison     Yes     No  
 Correlation Split Sample is Complete     Yes     No    B4713    04/18/2013 01:36 pm  
 Acceptance Sample is Complete     Yes     No    b3330    04/08/2013 06:21 am

Individual Contacted and Date/Time Acceptance Lab Notified: Bill Clinton    04/18/13 01:36 PM

Action Taken:

Remarks:

Regional Materials Engineer: Abe Lincoln    04/18/2013 1:40 pm

**EXAMPLE REPORT OF CORRELATION SAMPLING AND TESTING**

**Figure 3**

If there are any unfavorable comparisons, an investigation shall be initiated to determine the cause of the discrepancy. The investigation may include a check of the test data, calculations, and results; an inspection of the equipment used to perform the testing; a discussion with the test operators regarding their knowledge of the procedure in question; retesting of samples; exchanging samples; and observation of each other's techniques. When the problem is isolated, the steps taken to resolve it shall be documented. The results of the correlation testing, comparisons, findings, and resolutions shall be reported by the Regional Materials Engineer to the Resident Engineer/Project Lab in a prompt and timely manner.

When Central Lab performs testing of correlation samples:

- If there are no unfavorable comparisons, the results will be communicated to the Regional Materials Engineer who will notify the Resident Engineer/Project Lab within five working days of receipt of the sample by Central Lab.
- If there are any unfavorable comparisons, they shall be investigated as described above and a report of the results of the correlation testing, comparisons, findings, and resolutions shall be communicated to the Regional Materials Engineer, who will notify the Resident Engineer/Project Lab in a prompt and timely manner.

#### **D. CONTRACTOR TESTING**

When specified by Standard Specifications or Special Provisions, the contractor is required to perform specific sampling, testing, and other related activities. The primary purpose of contractor sampling and testing is to assure the contractor that their process is in control and producing a product satisfying ADOT contractual specifications.

Contractor sampling and testing shall be performed by qualified technicians and testing laboratories. Laboratory and technician qualification requirements are presented in the "ADOT System for the Evaluation of Testing Laboratories" (PPD No. 19). Laboratories satisfying the "ADOT System for the Evaluation of Testing Laboratories" are listed in the ADOT "Directory of Approved Materials Testing Laboratories", which is updated monthly. Information on accessing/obtaining the "ADOT System for the Evaluation of Testing Laboratories" and the ADOT "Directory of Approved Materials Testing Laboratories" is given in **Section I**.

The Resident Engineer has the responsibility and authority to review and approve contractor sampling and testing activities. Project personnel are also responsible for monitoring the contractor's performance and compliance with specification requirements. When requested by the Project or District, Materials Quality Assurance Section will perform an inspection of the contractor's testing laboratory in accordance with **Section VI (A)**.

## **E. FINAL CERTIFICATION OF MATERIALS INCORPORATED IN THE WORK**

The following information outlines the procedure to be followed in certifying that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications.

A "Final Materials Certification Flow Chart" is given in **Figure 9**. This flow chart provides a brief illustration of the Materials Certification requirements described herein.

For Local Public Agency projects, the final certification of materials incorporated in the work is described in **Appendix A**.

For Consultant Administered Projects, the final certification of materials incorporated in the work is described in **Appendix B**.

### **1. Materials Sample Checklist**

Materials Group, Quality Assurance Section, will originate the project "Materials Sample Checklist" recommending the number of acceptance, independent assurance, and correlation samples to be taken for each material. Materials that are not listed, but are accepted by testing shall be added to the sample checklist by the project. "As-Built" quantities that are substantially different from plans quantities shall be noted on the sample checklist and the Quality Assurance Section contacted for revised sampling and testing requirements. A blank sample checklist and cover letter are given in **Figures 4 through 6**. Upon completion of each project, the sample checklist shall be completed and signed by the Resident Engineer, and submitted to the Regional Materials Engineer for review.

### **2. Materials Certificate Log**

A "Materials Certificate Log" shall be maintained in accordance with Series 1000 of the Materials Testing Manual. Upon completion of each project, the Materials Certificate Log shall be signed by the Resident Engineer. A copy of the log shall be attached to the Materials Sample Checklist and submitted to the Regional Materials Engineer for review.





Intermodal Transportation

**MEMORANDUM**

**TO: (Name)**  
Construction Supervisor  
(District Name) (Mail Drop)

**FROM: (Name)**  
Quality Assurance Engineer  
Materials Group (068-R)

**CC: (Name)**  
Regional Materials Engineer  
(Name) Regional Materials Lab

**DATE:** (Mon. Day, Year)

**RE: PROJECT NO.**  
PROJECT NAME  
(Project Location)

Materials Group has prepared the following checklist of the materials to be used in constructing this project which require testing for approval. The number of recommended samples for acceptance (ACCP), independent assurance (IAS), and correlation (CORR) testing are derived from the "Materials Quality Assurance Program" (Series 900 of the Materials Testing Manual) which includes the Sampling Guide Schedule (Appendix C). The recommendations are estimates for the plan quantity and may change due to actual material production rates. Documentation must be provided in the Materials Exception Report if the required testing detailed in the Sampling Guide Schedule is not performed. All materials used on the project which require testing should be listed. Materials used which were not originally listed should be added.

Acceptance samples taken by the project are to be recorded under the ACCP SAMPLES TAKEN BY PROJECT column, regardless of where the tests are performed. The number of samples tested shall be recorded in the appropriate column. Acceptance testing performed by the project is to be recorded under the ACCP SAMPLES TESTED BY PROJECT column, acceptance testing performed by the Regional Lab is to be recorded under the REGIONAL ACCP column, and acceptance testing performed by the Central Lab is to be recorded under the CENTRAL ACCP column. Independent assurance sample splits used for acceptance testing are to be recorded under the ACCP column for the lab performing the acceptance testing. Correlation testing performed by the Regional Lab is to be recorded in the REGIONAL CORR column. Independent assurance sample testing is to be recorded under the column for the lab performing the testing, i.e., REGIONAL IAS or CENTRAL IAS columns.

Upon completion of the project, the Materials Sample Checklist shall be signed and submitted to the Regional Materials Engineer for review and signature. A copy of the completed and signed Certificate Log(s) shall be attached to the Materials Sample Checklist. These documents shall be forwarded to the District Engineer for review and approval. The District Engineer will then forward the Sample Checklist, Certificate Log, Exception Report (if needed) and Certification Letter to the Quality Assurance Engineer, Materials Group.

Glass Beads, Concrete Curing Compound, Geosynthetics, and Paint should be pre-approved by Central Lab prior to use. If not pre-approved by Central Lab, obtain samples for testing by the Central Lab as detailed in the applicable Policy and Procedures Directive (PPD). Water utilized for concrete batching does not require sampling if obtained from a potable source. See Section 900 appendix C – Sampling Guide Schedule of the Materials Testing Manual if there are questions on sampling

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**MATERIALS SAMPLE CHECKLIST (COVER SHEET)**

**Figure 4**

ARIZONA DEPARTMENT OF TRANSPORTATION  
MATERIALS SAMPLE CHECKLIST

PROJECT LOCATION: \_\_\_\_\_ PROJECT NUMBER: \_\_\_\_\_

ITEM NUMBER	MATERIAL	PLAN QUANTITY	ACTUAL QUANTITY IF VARIES FROM PLAN QUANTITY	NUMBER OF SAMPLES				NUMBER OF SAMPLES TESTED						
				RECOMMENDED			PROJECT	REGIONAL			CENTRAL			
				A	I	C	ACCP SAMPLES TAKEN BY PROJECT	ACCP SAMPLES TESTED BY PROJECT	A	I	C	A	I	

\* Small quantity, no samples required.

MATERIALS SAMPLE CHECKLIST (FIRST PAGE)

Figure 5

ARIZONA DEPARTMENT OF TRANSPORTATION  
MATERIALS SAMPLE CHECKLIST

PROJECT NUMBER: \_\_\_\_\_

ITEM NUMBER	MATERIAL	ADDITIONAL COMMENTS

- NOTE:
- A. One acceptance sample every other day of production. Minimum one IAS per 40 acceptance and one Correlation per 5 acceptance.
  - B. Class B and Class S with design compressive strength below 4000 psi - One acceptance sample per 100 CY. Class S with design compressive strength of 4000 psi or greater, one acceptance per 50 CY. Minimum one IAS per 40 acceptance samples.
  - C. Class P - Five samples per lot for acceptance. Minimum one IAS per 25 acceptance samples.
  - D. Minimum one acceptance sample per shift. Minimum one IAS per 40 acceptance samples.
  - E. One sample per delivery unit. (per PPD No. 8)

REMARKS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

This is to certify that all materials, except those materials accepted by certification and those where no samples are required, were properly sampled and tested.

Report prepared by \_\_\_\_\_ Date \_\_\_\_\_

\_\_\_\_\_  
Resident Engineer (Signature and Date) Reviewed by: \_\_\_\_\_  
Regional Materials Engineer (Signature and Date)

**MATERIALS SAMPLE CHECKLIST (LAST PAGE)**  
**Figure 6**

### **3. Materials Certification / Exception Report**

The materials records for each project shall be reviewed by the Resident Engineer. A "Materials Certification / Exception Report" shall then be prepared by the Resident Engineer. The Materials Certification / Exception Report must include at a minimum the following statement:

"I certify that I have reviewed the materials records for the above referenced project. The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications. In addition, all material sampling and testing was performed in accordance with the ADOT Materials Quality Assurance Program."

Any exceptions to the certification shall be detailed in the report. Exceptions may include, but are not limited to, the following: material represented by failing tests which has been incorporated into the work, inadequate certificates, insufficient sampling and testing, and other deficiencies in meeting the requirements of the Materials Quality Assurance Program. Each exception, including exceptions that are covered by supplemental agreements, must be listed and explained in the report. The explanation shall include the corrective action taken to remedy the exception, including references to any supplemental agreements that provided for changes in specifications and/or acceptance of the material.

The Materials Certification / Exception Report shall be signed by the Resident Engineer and be submitted with the Materials Sample Checklist to the Regional Materials Engineer for review.

An example Materials Certification / Exception Report is given in **Figure 7**.

### **4. Regional Material Engineer's Responsibilities**

The Regional Materials Engineer shall review the completed Materials Sample Checklist, Materials Certificate Log, and Materials Certification / Exception Report. If necessary, they shall be returned to the Resident Engineer for correction. The Regional Materials Engineer shall also review the results of correlation and independent assurance sampling and testing for the project.



**MEMORANDUM**

TO: (Name)  
 (District Name) District Engineer (Mail Drop)

THRU: (Name)  
 (Region Name) Regional Materials Engineer (Mail Drop)

FROM: (Name)  
 Resident Engineer (Mail Drop)

DATE: (Month, Day, Year)

RE: **MATERIALS CERTIFICATION / EXCEPTION REPORT**

Fed. Proj. No: ( \_\_\_\_\_ )  
 TRACS No: ( \_\_\_\_\_ )  
 PROJECT NAME/DESCRIPTION:  
 ( \_\_\_\_\_ )  
 ( \_\_\_\_\_ )

I certify that I have reviewed the materials records for the above referenced project. The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications. In addition, all material sampling and testing was performed in accordance with the ADOT Materials Quality Assurance Program.

Exceptions to the above certification are as follows:

1. Lots #1 and #2 of section 416 Asphaltic Concrete (End Product) paving, were in reject, but were allowed to remain in place at the maximum negative penalty (see Memo from Materials Group dated March 8, 2013).
2. Two-point barbed wire was installed rather than the 4-point barbed wire required in the project plans. This change was initiated by the State Game and Fish Department and is documented in Change Order #7.
3. An insufficient number of Aggregate Base correlation samples were obtained. Correlation frequency requirements have been reviewed with the proper personnel to ensure an adequate number of samples are obtained in the future.

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**EXAMPLE MATERIALS CERTIFICATION/EXCEPTION REPORT**

**Figure 7 (Continued on next page)**

MATERIALS CERTIFICATION / EXCEPTION REPORT

Date (Month, Day, Year)

Fed. Proj. No: ( \_\_\_\_\_ )

Page 2

TRACS No. ( \_\_\_\_\_ )

PROJECT NAME/DESCRIPTION:

( \_\_\_\_\_ )

( \_\_\_\_\_ )

4. Concrete Curing Compound: The contractor did not supply an acceptable Certificate of Compliance for curing compound that was used on the project. The project personnel were advised to review the Materials Certification requirements to prevent recurrence.

5. One of seventeen cover material acceptance tests failed on the #4 screen at 12% passing vs. 10% passing specification. Results of the other 16 acceptance tests met specification. The material was judged to be in substantial conformance by the Resident Engineer and was left in place with no penalties.

6. Concrete cylinders for the sidewalk at station 15+10 failed to meet the required compressive strength of 3000 psi. The strength average was 2850 psi. A penalty of 6% was applied to the contract unit price for the sidewalk represented by the testing results.

7. The slump of the first load of concrete for the box culvert at station 67+45 was measured at 2.75 inches. The submitted mix design required a slump of 3 to 5 inches. The slump was adjusted at the batch plant and all future loads had the required slump. All concrete met compressive strength requirements.

8. It was found that Joe Tester, who performed acceptance testing on concrete, did not have a current "ACI Concrete Field Testing Technician Grade I" certification. The project will monitor technician certifications more closely on future projects.

\_\_\_\_\_  
 (Name)  
 Resident Engineer

**EXAMPLE MATERIALS CERTIFICATION/EXCEPTION REPORT**

**Figure 7 (Continued from previous page))**

The Regional Materials Engineer shall then prepare a “Final Materials Certification” on behalf of the District Engineer. The Final Materials Certification must include at a minimum the following statement:

“The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications. In addition, all material sampling and testing was performed in accordance with the ADOT Materials Quality Assurance Program. ”

If there are exceptions, the Final Materials Certification shall also state, “**See exceptions listed in the attached Materials Certification / Exception Report.**”

If independent assurance or correlation testing were required, the Final Materials Certification must also include the following statement:

“Independent assurance sampling and testing, and correlation testing, were performed in accordance with the ADOT Materials Quality Assurance Program. Results of this testing compared favorably with the results of acceptance sample testing.”

If independent assurance or correlation testing were not required, the above statement shall be modified accordingly.

Significant deviations in the required independent assurance sampling and testing or correlation testing shall be noted in the Final Materials Certification as exceptions.

The Final Materials Certification shall be signed by the Regional Materials Engineer and forwarded, along with the Materials Sample Checklist, Materials Certificate Log, and Materials Certification / Exception Report, to the District Engineer for review and signature.

An example Final Materials Certification is given in **Figure 8**.



**MEMORANDUM**

TO: (Name)  
Assistant State Engineer  
Materials Group (MD 068R)

FROM: (Name)  
(District Name) District Engineer (Mail Drop)

FROM: (Name)  
(Region Name) Regional Materials Engineer (Mail Drop)

DATE: (Month, Day, Year)

RE: **FINAL MATERIALS CERTIFICATION**

Fed. Proj. No: (\_\_\_\_\_)

TRACS No: (\_\_\_\_\_)

PROJECT NAME/DESCRIPTION:

(\_\_\_\_\_)

(\_\_\_\_\_)

Attached are the Materials Sample Checklist, Materials Certificate Log, and Materials Certification / Exception Report for this project.

The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications. In addition, all material sampling and testing was performed in accordance with the ADOT Materials Quality Assurance Program. **See exceptions listed in the attached Materials Certification / Exception Report.**

Independent assurance sampling and testing, and correlation testing, were performed in accordance with the ADOT Materials Quality Assurance Program. Results of the IA and Correlation testing compared favorably with the results of acceptance sample testing.

\_\_\_\_\_  
(District Name) District Engineer

\_\_\_\_\_  
(Region Name) Regional Materials Engineer

Attachments: Materials Sample Checklist  
Materials Certificate Log  
Materials Certification / Exception Report

**EXAMPLE FINAL MATERIALS CERTIFICATION**

**Figure 8**



### **5. Certification of Materials for Federal-Aid Projects**

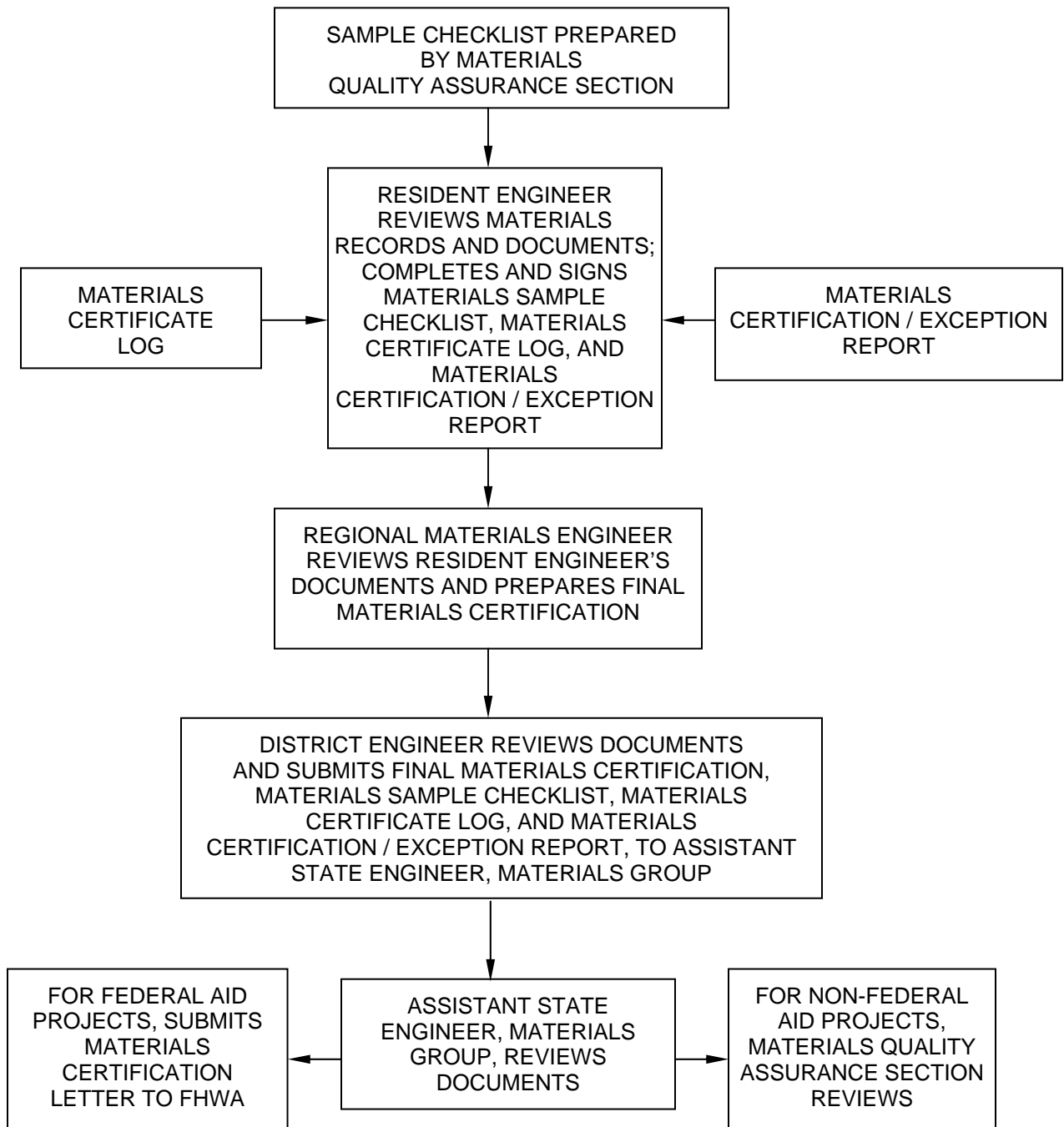
The Final Materials Certification, including attachments (Materials Sample Checklist, Materials Certificate Log, and Materials Certification / Exception Report), shall be sent to the Assistant State Engineer, Materials Group. The Assistant State Engineer, Materials Group, will review the documentation furnished by the District Engineer. Based on this documentation, the Assistant State Engineer, Materials Group, will prepare and submit a certification letter to the Federal Highway Administration. Accompanying that certification letter will be a copy of the Materials Certification / Exception Report. A copy of the certification letter and supporting documentation will be maintained on file by the Materials Group Quality Assurance Section.

### **6. Certification of Materials for Non Federal-Aid Projects**

The Final Materials Certification, including attachments (Materials Sample Checklist, Materials Certificate Log, and Materials Certification / Exception Report), shall be sent to the Assistant State Engineer, Materials Group. The Materials Group, Quality Assurance Section, will review the documentation furnished by the District Engineer. Based on this documentation, the Materials Group, Quality Assurance Section, will prepare a certification letter. The certification letter and supporting documentation will be maintained on file by the Materials Group Quality Assurance Section.

## **VI. LABORATORY QUALIFICATIONS**

The “ADOT System for the Evaluation of Testing Laboratories” (PPD No. 19) details the requirements that laboratories must satisfy to be approved for performing testing activities for ADOT. In addition to being AASHTO certified through the AASHTO Accreditation Program (AAP), laboratories must participate in the ADOT Laboratory Inspection Program and the ADOT Proficiency Sample Program. AAP accreditation and ADOT approval must be received for all test methods that are to be performed on ADOT projects. Laboratories which have been approved to perform testing activities on ADOT projects are listed in the ADOT “Directory of Approved Materials Testing Laboratories”. Included in that directory are the individual tests for which a laboratory has been approved.



**FINAL MATERIALS CERTIFICATION FLOW CHART**

**Figure 9**

## **A. ADOT LABORATORY INSPECTION PROGRAM**

The Quality Assurance Section of Materials Group administers an inspection program of all materials testing laboratories performing testing activities for the Department. Compliance to test procedures and equipment requirements are included in the inspection. All laboratories performing Acceptance or Referee testing are inspected on a frequency not to exceed 18 months. Information regarding the ADOT Laboratory Inspection Program is also available on the ADOT Materials Group, Quality Assurance Section website.

### **1. Participation**

All independent, contractor, materials supplier, government, and other testing laboratories desiring to perform testing activities for ADOT must submit to an inspection as specified in the “ADOT System for the Evaluation of Testing Laboratories” (PPD No. 19). The inspection considers those elements of service that the respective laboratory proposes to offer to the Department. This requirement includes laboratories submitting asphaltic concrete mix designs and those performing acceptance and referee testing for the Department.

The Quality Assurance Section will inspect only laboratories that are involved, or seeking involvement, in an activity related to the design or construction of an ADOT project.

### **2. Equipment Inspection**

The laboratory equipment inspection will consist of checking dimensional, calibration, and specification conformance of all apparatus and equipment required by the test procedures contained in the Materials Testing Manual or other applicable specifications. Equipment related documentation, required by AASHTO R18, is also checked during this inspection. This inspection is not a calibration service for non-ADOT laboratories. Any equipment found unacceptable must be repaired, properly calibrated, or removed from service at the expense of the owner laboratory. Laboratory facilities will also be checked for compliance with applicable standards, such as, proper temperature and humidity control.

Documentation of the calibration and verification of equipment used in field testing which is not available during the inspection will be reviewed for compliance with applicable requirements.

### **3. Procedural Inspection**

The procedural inspection serves as a tool to evaluate the performance of laboratory technicians when performing tests in accordance with the ADOT Materials Testing Manual or other applicable specifications. Arizona, AASHTO, and ASTM test methods referenced in the Materials Testing Manual will be observed. In the event that Arizona Test Methods deviate from those given in a similar AASHTO or ASTM procedure, the Materials Testing Manual will govern.

### **4. Procedure and Report**

The equipment and procedural inspections are normally conducted simultaneously; however, circumstances may dictate independent inspections. The inspection formats will generally conform to the techniques employed by AMRL and CCRL, as appropriate. When a departure from the requirements of a test method is observed by the inspectors, they will point it out to the laboratory personnel so that immediate corrections can be made if possible. The inspectors will present a summary of their findings and identify deficiencies requiring corrective action at an informal exit review where any deficiencies discovered can be discussed openly. It is requested that the Laboratory Manager and Supervising Engineer be present at the exit review.

A written inspection report will be issued by the Quality Assurance Section to the laboratory that has been inspected. The laboratory must provide the Quality Assurance Engineer with satisfactory responses to the noted deficiencies within 30 days of the report issuance. The responses must provide satisfactory evidence that all significant deficiencies were corrected or that corrective action is in progress. The laboratory's inspection and responses will be considered when evaluating ADOT eligibility.

## **B. ADOT PROFICIENCY SAMPLE PROGRAM**

The Quality Assurance Section administers the ADOT Materials Proficiency Sample Program. The program allows participants to evaluate the reliability of their testing by comparing their test results to a population of test data generated by all participants. Specified routine tests are performed in accordance with standard Arizona and AASHTO test methods by each participating laboratory on carefully prepared samples of highway construction materials and the test results reported to ADOT for review and analysis. Information regarding the ADOT Proficiency Sample Program is also available on the ADOT Materials Group, Quality Assurance Section website.

### **1. Participation**

Participation in the ADOT Proficiency Sample Program is required for all laboratories performing Acceptance or Referee testing activities for the Department, as specified in

the ADOT “System for the Evaluation of Testing Laboratories” (PPD No. 19). Participation by government agency laboratories not performing testing activities for the Department is voluntary.

## 2. Proficiency Samples

Proficiency samples are carefully prepared to be as homogeneous as possible to minimize the effect of material variability in evaluating the results. Each sample is sequentially numbered and, using random numbers, a set of samples is allocated to each participant. To permit an estimate of single-operator precision, instructions are given for a single test operator to conduct all repetitions of an individual test method; however, it is not required that the same person conduct all test methods prescribed for a set of proficiency samples.

The program generally provides 8 to 10 proficiency samples per year. Typically, the material types and routine tests performed are:

- **Soil** - Gradation, Atterberg limits (PI), pH, resistivity, and moisture-density relations.
- **Fine Aggregate** - Gradation, sand equivalent, fine specific gravity, absorption, and uncompacted void content.
- **Coarse Aggregate** - Gradation, specific gravity, absorption, L.A. Abrasion, unit weight, fractured coarse aggregate particles, flakiness index, and percent carbonates.
- **Asphaltic Concrete** - Asphalt content, maximum theoretical specific gravity/density (Rice), Marshall stability/flow, Marshall compaction/density, gyratory compaction/density, moisture content, and gradation of mineral aggregate.
- **Portland Cement Concrete** - 7-day and 28-day compressive strengths of prepared cylinders.
- **Asphalt Cement/Binder** - Rotational viscosity, pressurized aging, bending beam rheometer, and dynamic shear rheometer.
- **Emulsified Asphalt** - Saybolt-Furol viscosity, % residue, % uncoated particles, absolute viscosity, and sieve test.

### 3. Analysis/Reporting of Proficiency Sample Results

Proficiency sample test results are required to be submitted promptly upon completion of testing to the Quality Assurance Section no later than a specified date. All test data submitted is analyzed similar to the method presented in the paper: *“Statistical Evaluation of Interlaboratory Cement Tests”* by J. R. Crandall and R. L. Blaine, Volume 59 (1959) of the Proceedings of the American Society for Testing and Materials. A final report summarizing the results of the analysis is issued for each proficiency sample. The final report presents a statistical summary of results for the population of test data and a tabulation of each laboratory's individual data. Statistical characteristics presented are averages, standard deviations, coefficients of variation, z-scores, and performance ratings. The z-score is equal to the number of standard deviations the data departs from the population mean. A laboratory's performance ratings are based on the following scale:

Rating	Standard Deviations from Mean (z-score)
5	0 to $\leq 1.0$
4	$> 1.0$ to $\leq 1.5$
3	$> 1.5$ to $\leq 2.0$
2	$> 2.0$ to $\leq 2.5$
1	$> 2.5$ to $\leq 3.0$
0	$> 3.0$ ; eliminated from analysis
N	No data received

All data submitted is initially reviewed and analyzed. Invalid data is eliminated, then the remaining data is reanalyzed and presented in the proficiency sample final report. A single low rating, or a pair of low ratings, is not considered significant. A continuing trend of low ratings for a test characteristic should cause a laboratory to investigate its equipment and test methodology.

The “History of Z – Scores” charts accompany each proficiency sample final report. These charts show a laboratory's performance trend for each test characteristic. In addition, scatter diagrams are included in each proficiency sample report for each test characteristic. A scatter diagram shows each laboratory's reported results as a point on the graph, relative to the population averages for that test.

Participating laboratories are required to investigate the reason for discrepancies when their results are 2 or more standard deviations from the population average values (rating of 2 and less). The laboratories must report findings and corrective actions to the Quality Assurance Section within 30 days of the final report issuance. The

performance and adequacy of the laboratory’s responses will be considered when evaluating the eligibility of the laboratory to conduct testing activities for ADOT.

**C. CONFLICT OF INTEREST**

In order to avoid a conflict of interest, any qualified laboratory shall perform only one of the following types of testing on the same project: Acceptance testing, contractor testing, Independent Assurance testing, or dispute resolution (referee) testing. Independent assurance testing and correlation testing are performed as described herein.

**VII. SAMPLING AND TESTING PERSONNEL QUALIFICATION REQUIREMENTS**

All personnel supervising or performing sampling and testing activities for ADOT must meet the qualification requirements given in the table below.

<b>Soils and Aggregate</b>	
<u>Field</u>	<u>Laboratory</u>
Arizona Technical Testing Institute (ATTI) “Field” certification.	Arizona Technical Testing Institute (ATTI) “Laboratory Soils/Aggregate” certification.
<b>Asphaltic Concrete</b>	
<u>Field</u>	<u>Laboratory</u>
Arizona Technical Testing Institute (ATTI) “Field” certification.	Arizona Technical Testing Institute (ATTI) “Asphalt” certification.
<b>Concrete</b>	
<u>Field</u>	<u>Laboratory</u>
American Concrete Institute (ACI) “Concrete Field Testing Technician Grade I” certification.	American Concrete Institute (ACI) “Concrete Strength Testing Technician” certification.

Information regarding requirements for the qualification of sampling and testing personnel is also available on the ADOT Materials Group, Quality Assurance Section website.

Individuals performing sampling and testing activities for ADOT who are not employed by ADOT or who are not associated with a laboratory which has met the requirements of the “ADOT System for the Evaluation of Testing Laboratories” must, in addition to meeting the qualification requirements specified in the above paragraph, utilize equipment and apparatus which has been inspected and found acceptable. Inspection of equipment and apparatus must be performed at the intervals specified

in Appendix A3 of the ADOT Materials Testing Manual. Documentation of equipment and apparatus inspection(s) shall be properly maintained. Upon request by the Department, that documentation shall be made available for review. All equipment and apparatus shall be maintained in good working order. Inspection of equipment and apparatus shall be performed by either:

- An AASHTO accredited laboratory that has been approved by ADOT.
- An individual or company who, as a business, performs inspection and calibration of sampling and testing equipment.

Inspections and calibrations must be performed in accordance with established ADOT, AASHTO, ASTM, and *National Institute of Standards and Technology* (NIST) specifications. Proper calibration equipment that is traceable to NIST standards shall be used.