

## **PART V**

### **5.00 MATERIALS CONTROL**

#### **5.01 GENERAL**

##### **5.01.01 ORGANIZATION AND FUNCTION OF THE BUREAU OF MATERIALS AND RESEARCH**

The Bureau of Materials and Research has responsibility for the establishment and administration of the materials portion of the Department's Quality Control/Quality Assurance (QC/QA) Program.

The Bureau develops standards and specifications for materials, establishes sampling procedures and frequencies, and establishes testing procedures that are used in the laboratory and the field in order to assure compliance with specifications. It performs materials testing to assist the districts in administering quality assurance functions of the QC/QA Program. Such testing includes tests on materials purchased by contractors or the State for use in maintenance or construction activities. The bureau also conducts tests on soils, concrete, bituminous mixtures and numerous other specialized materials, the results of which are used by others.

The responsibility of the Bureau extends to all materials used or proposed for use in State and Federal-aid highway construction and maintenance.

On "full oversight" and "certification acceptance" projects involving Federal funds, the Bureau of Materials and Research must certify to the Federal Highway Administration as to the quality of each type of material used on each project before the State is completely reimbursed by the Federal Government. On all other projects the bureau reviews project materials records and advises the District Engineer of materials status prior to contract finalization.

To accomplish its various objectives, duties and responsibilities, the Bureau organization consists of the Headquarters Administration office, the Materials and Research Center (MRC), and Regional Laboratories. It also has the assistance of a District Laboratory in each District.

##### **5.01.02 REASONS FOR QUALITY CONTROL/QUALITY ASSURANCE (QC/QA)**

- (a) Compliance with Specifications.

The primary reason for requiring inspection, sampling and testing of materials is to ensure that all materials incorporated into the work will meet the requirements of the contract documents (plans, specifications, special provisions and other supplemental documents).

Specifications and plans have been prepared to require the use of materials that will perform satisfactorily with a minimum of maintenance throughout the life of the facility. Any material that deviates appreciably from specification or plan limits will not perform as expected, and, in all probability, will shorten the life of the facility or add appreciably to the cost of its maintenance. In addition, the General Clauses and Covenants of the Standard Specifications require that only material meeting specification requirements be used in the work. It is recommended that all inspectors review all the applicable clauses and covenants of the Standard Specifications at regular intervals.

An adequate and effective QC/QA system for materials used in a project is absolutely essential to ensure that materials furnished and completed work produced by the contractor conform to requirements of the contract documents.

(b) Uniform Relations With Contractors and Producers.

The contract documents provide an equitable basis for bidding by contractors since they define the requirements that are to be met. The contractor commits to furnishing materials and completed work that will equal or exceed such requirements.

The Engineer must determine, through quality assurance measures, that the State is receiving what is specified under the contract. He should accept nothing less. To do so, would not only be a disservice to the State, but would be giving undue advantage to the contractor. Other contractors who had bid on the same work could contend that they would have offered a lower bid had they been able to anticipate that materials or work outside of specifications would be accepted.

It is essential that quality assurance be applied uniformly by all engineers and inspectors from project to project so that all contractors and suppliers are treated alike. To begin with, the contract documents should be so prepared that there will be the least possible difference of interpretation, both on the part of the contractor and on the part of the engineering personnel. Beyond that, this manual provides guidance to the Engineer and inspector on interpretation of the specifications and the application of quality assurance.

(c) Documentation of Expenditure of Public Funds.

When payment is to be made to the contractor for materials furnished and work performed, the duly designated state official must authorize disbursement of public funds for this purpose. The disbursing officer must depend upon others for evidence to support the expenditure. Through the materials quality assurance system, the Field Engineer will acquire substantiating data in the form of test results, inspection records and measurements to justify acceptance of the contractor's work. Thus the Engineer can assure and furnish documentation to the officials responsible for authorizing payment that the contractor has fulfilled his obligation and is entitled to full or adjusted payment as provided for in the contract documents.

In case of failure to meet the minimum requirements, quality assurance data will constitute the basis for rejection of work deemed unfit for acceptance.

Complete records, including test and inspection reports covering acceptance or rejection, should be maintained in the Engineer's project files while the necessary copies should be furnished to the appropriate headquarters personnel as needed for verification and as supporting evidence for payment documents.

### **5.01.03**      **PROCEDURES FOR QUALITY ASSURANCE**

#### (a)      General

KDOT has two procedures for assuring quality on project produced materials. The two Sampling and Testing Frequency Charts in Appendix A and B help clarify some of the differences between the two procedures.

(1)      The older of the two is “Method Specs”. Under this procedure, KDOT’s test results are used as the basis of acceptance for project produced materials, and the contractor is not required to conduct quality control testing, although they may choose to do so.

(2)      A more current procedure is “QC/QA” specifications. Under this method of quality assurance, the contractor conducts quality control testing, and these test results can be used as a basis of acceptance, provided KDOT’s quality assurance verifies the results.

#### (b)      Authorized Personnel.

(1)      Under a “method spec”, all inspection, sampling and testing for acceptance must be performed by an authorized representative of the Kansas Department of Transportation. The representative may be an employee of the Kansas Department of Transportation, an employee of another highway agency or an employee of a commercial testing laboratory or inspection agency. The contractor's/producer's process control test results may be used for partial acceptance when allowed by the contract documents. (See basis of acceptance.)

Arrangements for inspection and sampling of materials by agencies other than the Department are made by the Chief, Bureau of Materials and Research.

Samples submitted to the laboratory for tests by unauthorized individuals or agencies will not be tested except by authorization of the Chief, Bureau of Materials and Research.

(2)      Under “QC/QA” specifications, all technicians must demonstrate qualifications for each Test Group in which they wish to conduct materials sampling and testing. These qualifications include some type of certificate for the completion of a training program or a combination of demonstration of the test procedures and completion of written exams covering the group of test methods. For a list of Test Groups, see Appendix C. Acceptable certifications include KDOT training and testing, training conducted at KSU-Salina or Manhattan, American

Concrete Institute certification, or a certificate of completion for a program similar to those described and issued or approved by another state's DOT. KDOT has final judgment on a technician's qualifications.

Certification in one group may be required before attendance in the certification course of another group. For example, both Aggregate Field and Aggregate Lab will eventually be required before a technician may attend the Bituminous Mix QC/QA training. Currently the one day Aggregate Course at KSU-Salina is a prerequisite for the Bituminous Mix QC/QA training.

All contractors conducting QC/QA sampling and testing for KDOT projects are responsible for the annual calibration and verification of their equipment by an AASHTO Accredited Laboratory using NIST traceable equipment, or by some other NIST traceable source (see Appendix C for calibration and verification frequencies). Calibrations and verifications required more often than every 12 months may be conducted by the contractor if the equipment is checked annually by an AASHTO Accredited Laboratory. Equipment will be made available to the District Materials Engineer for spot checks of the calibrations when necessary.

(3) All technicians conducting sampling and testing for the State of Kansas projects are given a unique number for tracking in the Contract Management System (CMS). The system also lists the group of tests that the technician is authorized or qualified to conduct.

The contractor and KDOT Construction Offices must submit a list of qualified technicians that will be conducting sampling and testing on a project to the District Materials Engineer before work begins on the project. Include each technician's CMS identification number and the possible group of tests to be conducted by the technician on the list. The District Materials Engineer will run a sort against CMS to determine if Independent Assurance requirements have been completed for each technician during that calendar year. They will make an attempt to schedule such activity during the course of the project if required.

(c) Inspection and Sampling Procedures.

(1) Contract Requirements: The first activity in the inspection and sampling of a product is to determine the specified requirements for the material. The project listing issued by the Bureau of Materials and Research and the contract documents should be reviewed to determine if there are special provisions covering the product. If there are none, then the plans and Standard Specifications are applicable. If dimensions and other details are not covered by the Standard Specifications and special provisions, then the necessary information must be obtained from the plans.

When reviewing contract requirements for a product, the following statement from the Standard Specifications should be kept in mind: "In case of discrepancy, calculated dimensions will govern over scaled dimensions; Plans will govern over Standard Specifications; Special Provisions will govern over Plans; and Project Special Provisions will govern over Special Provisions."

The applicable specifications, special provisions and plans must be carefully studied and notes outlining pertinent requirements should be made for reference during the actual inspection procedure.

(2) Visual Inspection: To prevent incorporation of "out of specification" material into the work and to prevent an injustice to the producer or the supplier by rejecting "specification material," it is essential that each sample truly represent the material being inspected. Therefore, before most material is sampled, it must be subjected to a careful visual inspection. If the material to be sampled involves many individual units such as concrete blocks, culvert pipe, bolts and nuts, castings, etc., the entire lot offered for inspection must be carefully examined for workmanship, defects, dimensions if specified, finish and uniformity.

Any units which visual inspection shows to be outside specified limits should be immediately rejected and not sampled. It is emphasized that the Department is not a "culling" agency and if it is found that more than 10 to 15 percent of the units in a lot fall outside the specified limits, the entire lot should be rejected. If the producer or supplier elects to cull the lot and remove all non-specification units, the new lot may be re-inspected and sampled.

(3) Sampling: When sampling materials, refer to section **5.16** for specific instructions on sampling procedures for specific materials. In situations not covered by section **5.16**, contact the District Materials Engineer for assistance.

(4) Identification of Materials: It is essential that all material be properly marked for identification when the material is inspected and sampled. The identification must be such that the Field Engineer can readily associate the material with the inspection and/or test report for the lot of material covered by the inspection.

If the number of units is not too large, each unit must be tagged or stenciled with a laboratory or other number assigned by the inspector. When a large number of units are involved in a lot, identification is placed on a number of units on a random basis.

(5) Identification of Samples: Properly executed Contract Management System (CMS) Sample ID screens or information sheets must be prepared for each sample or group of samples submitted to the laboratory for test. All appropriate items on the sheet or screen must be filled out so that the sample will be identified with the lot of material that it represents. It is especially important that the quantity of material represented by each sample be shown in order for the Field Engineer to account for all materials received on the project. Further details are set forth in section **5.20** of this manual.

(6) Inspection at Destination: All materials that arrive on the project are to be inspected by the Engineer prior to being incorporated into the work and all such inspections should be carefully documented. It must be understood that the final acceptance or rejection of all materials should be made at the project site just prior to incorporation of the material in the work.

Subject items that have previously been inspected, tested and accepted to visual inspection to ascertain possible damage during shipment, laboratory numbers or other identification assigned during the initial inspection and general conformance with dimensional requirements.

Visually examine all items accepted by certification at destination to ensure conformance with dimensional and/or other requirements, to ensure that the identification on the material correspond with the identification on the certifications, and to ensure that the material was not damaged during shipment.

#### **5.01.04      QUALITY CONTROL/QUALITY ASSURANCE (QC/QA) TESTS**

(a)    General

This section establishes terminology and procedures for the various test that are included in the QC/QA system.

(b)    Definitions

(1)    Acceptance Program All factors that comprise the State's determination of the degree of compliance with contract requirements and value of a product. These factors include the State's sampling, testing and inspection, and validated results of contractor sampling and testing.

(2)    Assurance Sampling and Testing Split or replicate samples used as an independent check of the sampling and testing procedures and equipment. These samples are to assure testing is being performed properly by both the contractor's and the State's personnel. The results of assurance tests are not to be used as a basis of material acceptance.

(3)    Dispute Resolution The procedure used to resolve conflicts resulting from discrepancies between the State's verification results and the Contractor's quality control results of sufficient magnitude to impact payment. Any laboratory used for dispute resolution must be accredited by the AASHTO Accreditation program for the tests to be performed.

(4)    Independent Assurance (IA) IA is an unbiased and independent verification of the Quality Assurance system used and of the reliability of the test results obtained in the regular sampling and testing activities. KDOT's IA will consist of observations by independent personnel to assure that specified procedures are followed (witnessing), and split or replicate sampling and testing.

(5)    Quality Assurance (QA) All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality. QA activities include: acceptance, independent assurance, verification, and prequalification sampling and testing; inspection; reporting of results; and any follow up that may be necessary due to test failure. Without these actions, it would be impossible for the Engineer to accurately

verify compliance or in many cases the level of compliance with the requirements of the contract documents.

(6) Quality Control (QC) The sum total of activities performed by the contractor or producer to make sure that a product meets contract specification requirements. QC activities generally are outlined in a contractor's process control plan which lists such items as types of tests to be performed, sampling locations, sampling frequencies, equipment calibration procedures and frequencies, and documentation procedures.

(7) Qualified Laboratories Laboratories used for sampling and testing of materials are those approved through appropriate programs as determined by KDOT.

(8) Qualified Technician Personnel who are certified through appropriate programs defined by KDOT.

(9) Replicate Tests - Tests performed by independent assurance personnel using equipment other than that used by project personnel, but performed on a portion of the sample used by project personnel.

(10) Split Samples - Sampling and splitting of the material conducted under the observation of independent assurance personnel. Tests on separate portions are performed by KDOT designated independent assurance personnel using equipment other than that used by project personnel.

(11) Verification Sampling and Testing Sampling and testing performed to validate the quality of the product or to check the adequacy of mix designs. If quality control sampling and testing is used in the acceptance program, verification sampling and testing will also be used to validate the quality control sampling and testing. Verification samples are independent samples obtained by KDOT.

11.1 Class I and Class II aggregate Production Samples - Sampling and testing procedures utilized to verify that the production of Class I and Class II limestone aggregates for PCCP or other uses complies with the specification quality requirements. These test results will also be utilized to determine if the quality characteristics of the individual beds in the geologic formation have significantly changed from those obtained in initial prequalification of each bed.

(12) Other - sampling and testing by the District Materials laboratories not otherwise designated in this instruction or specified in the Sampling and Testing Frequency Chart, such as determination of asphalt content in maintenance mixes, or a Marshall design.

(c) Independent Assurance

KDOT uses a systems wide approach to Independent Assurance Sampling and Testing of project produced materials. Each test is included in one of the following Groups according to the type of material: Aggregates, Concrete, Bituminous Mixes, and Soils. A breakdown of requirements for each Group is provided in Appendix C. Independent assurance will be conducted once per calendar year per technician per group of tests performed by that technician during that year. It may not be possible to witness all the tests within a group during the assurance process. There are, however, critical Core Tests within each group that must be witnessed before annual Independent Assurance requirements are completed by a technician for that group of tests. These Core Tests are marked with a double asterisk (\*\*) on the list in Appendix C.

KDOT's MRC at 2300 Van Buren is AASHTO Accredited. District Materials personnel are responsible for conducting the independent assurance witnessing and testing. The equipment that the Districts use to conduct independent assurance testing is calibrated or verified annually by the MRC personnel, by another AASHTO Accredited Laboratory, or by outside NIST traceable sources.

Independent Assurance consists of witnessing the technician properly conduct the test, and split or replicate samples. The District conducts the split or replicate testing whenever possible during the independent assurance process. KDOT may hire, train, and evaluate personnel from independent laboratories to conduct independent assurance witnessing for KDOT. KDOT will still conduct the split sample testing. The independent laboratory need not be AASHTO Accredited since the personnel would be acting on behalf of KDOT.

(d) Comparison Procedures

(1) Assurance Samples. Acceptable variations for between laboratory reproducibility are listed in Appendix C. Precision statements from ASTM or AASHTO test procedures are used when available, and these statements are included in the KT Methods. Where precision statements are not available the standard deviations from the last 10 AMRL Proficiency Samples are used to calculate the 95% reproducibility limit (between laboratories) - D2S as defined in ASTM E-177. These calculated values are reviewed annually for applicability and may be adjusted when warranted. Where precision statements and AMRL Samples are not available, the Engineer will use his discretion to determine acceptable variations. The comparison are made by personnel who are knowledgeable of testing variation and who have the authority to resolve any problems in equipment, procedures, etc.

(2) Under a "method spec" the numerical results obtained on Verification Samples are compared promptly with the specifications, or certified results, as applicable. Appropriate action is taken by the person responsible for making comparisons in each case. In the case of verification sample test results obtained at the MRC, the Engineer of Tests informs the district of any test results which do not comply with specifications and retain the reports pending receipt of information from the district regarding its investigation of circumstances for non-compliance and corrective action taken, if needed, resulting from its investigation.

Under QC/QA specifications, Verification test results are statistically compared to the contractor's test results by the use of the F and T tests outlined in Section 5.17.08 or some other statistically valid practice. Use F & T tests only when enough verification results are available. KDOT prefers results from at least 3 to 5 verification tests for statistical comparisons. If the data passes the T test, use the contractor's numbers to calculate pay quantities. If the data fails the T test, use KDOT's numbers to calculate pay quantities.

(3) Reports of Verification Samples shall show sufficient information to facilitate comparison with the corresponding Acceptance Test, related certifications, or producer's test results.

3.1 When statistical comparisons are made, include a comment in the report similar to one of the following:

3.1.1 "Statistical comparison of results indicates it is reasonable to assume all associated samples came from the same population."

3.1.2 "Statistical comparison of results indicates it is reasonable to assume all associated samples did not come from the same population (or lot)."

3.2 When no statistical comparison can be made, include a comment in the report similar to one of the following:

3.2.1 "The results of this test appear to agree reasonably well with data reported previously for this project."

3.2.2 "Comparison of these data with data reported previously for this product indicates that further monitoring or corrective action is merited."

(e) Dispute resolution

If a dispute exists between the Engineer and the contractor about the validity of the others test results the KDOT Materials Research Center will perform referee testing. If one of the disputed Department test results was generated at the MRC, then an Independent AASHTO Accredited Laboratory agreeable to both parties will be selected. If referee testing indicates that the department's test results are correct then the contractor pays for the additional testing, including referee testing performed at the MRC. If the referee testing indicates that the contractor's test results are correct then the Department pays for the additional testing.

(f) Sampling and Testing Frequency

(1) The 2 Sampling and Testing Frequency Charts (Appendix A and Appendix B) reflect the minimum rate for sampling and testing. It is understood that if a problem occurs, more samples or tests may be necessary.

- 1.1 It is also intended that Verification and Assurance Samples may be used for items other than those required by the Sample and Testing Frequency Chart. However, Assurance Samples will never be used for Acceptance.

(g) Reporting Procedures

(1) Report Assurance Samples not reported in CMS on **DOT Form 684** or **685**. If the forms are not appropriate for the types of tests to be reported, use the backside of either form, or use other DOT forms as appropriate. Assurance Samples are reported in CMS on the data input screen appropriate for the item being tested. Identify the individual tests by CMS ID nos. or by the Assurance Sample Number (assigned by the District Materials Engineer), the name of the person requesting the sample, and the appropriate sample number used by the group performing the test or a notation as to which group performed each test.

When entering split and replicate samples into CMS the contractor's or field personnel's results are entered as Sample A and the District's or MRC's results are entered as Sample B under the same CMS sample ID number.

(2) Contractors do not currently have access to CMS. District or field personnel are responsible for entering Acceptance and Verification test results into CMS. When test results on Acceptance Samples fall outside of the specification limits, underline or circle in red the points of noncompliance. This option is not available in CMS.

(3) Number of copies and distributions:

Non CMS

Bureau of Materials and Research - 1 copy  
Bureau of Construction and Maintenance - 1 copy  
District Engineer - 1 copy  
Field Engineer - 1 copy

CMS

In CMS it is the users responsibility to identify the need for information and obtain such information. Information can be obtained using on-line service or ordering reports.

(h) Responsibility

The Chief of Materials and Research will maintain a complete file of non-CMS reports on Assurance Samples, Acceptance Samples, Verification Samples and other tests. District Materials Engineers are responsible for forwarding these reports to the Bureau of Materials and Research.

(1) The District Materials Engineer is responsible for reporting the results on all Assurance Samples performed in the District and may be required to perform Acceptance Tests

shown on the Sampling and Testing Frequency Chart in Appendix A or Verification Tests shown in Appendix B. In addition, performance of additional tests such as, but not limited to, Marshall Designs, Soil Compaction Standards, and Asphalt Extractions will be required.

(2) The Engineer of Tests is responsible for reporting results on samples that are submitted to the Materials and Research Center for Test.

(3) The Field Engineer is normally responsible for the Acceptance Tests shown on the Sample and Testing Frequency Chart in Appendix A or the Verification Tests shown in Appendix B.