

5.2.7.4 CONCRETE: CONTRACTOR'S QUALITY CONTROL PLAN

NOTE: This document is generally written in the imperative mood. The subject, "the *Contractor*" is implied. Also implied in this language are "*shall*", "*shall be*", or similar words and phrases. The word "*will*" generally pertains to decisions or actions of the Kansas Department of Transportation.

1. GENERAL

Provide qualified personnel and sufficient equipment meeting the requirements listed in the Department's Construction Manual to conduct quality control testing which conforms with the Sampling and Testing Frequency Chart for Portland Cement Concrete Pavement for Quality Control/Quality Assurance Projects in Appendix B of this Manual.

Calibrate and correlate the testing equipment with prescribed procedures and conduct tests in conformance with specified testing procedures as listed in the Department's Construction Manual. As a minimum, meet the calibration schedule as outlined in **Table 1, Concrete Materials Test Equipment**.

Maintain control charts on an ongoing basis.

File all reports, records, and diaries developed during the progress of construction activities as directed by the Engineer. Files become the property of the Engineer.

Provide the following:

- Make copies of all test results and control charts readily available to the Engineer at the project site.
- Copies of all failing test results (based on a moving average of four tests, when appropriate) and summary sheet sent by facsimile on a daily basis to the Construction Engineer.

2. QUALITY CONTROL ORGANIZATION

Submit a listing of the names and phone numbers of individuals and alternates responsible for quality control administration and inspection along with the proposed mix design data. Provide an organizational chart that shows the specified lines of authority relating both to mix design and quality control operations during production. Post a copy of the organizational chart in the Contractor's test facility.

The Contractor's quality control organization or private testing firms representing the Contractor must include individuals who are certified by ACI, or a State approved equivalent, for the appropriate test methods. Only technicians certified in accordance with KDOT requirements may perform process control testing on the project.

3. QUALITY CONTROL PLAN

Prepare a Quality Control Plan detailing the type and frequency of inspection, sampling and testing deemed necessary to measure and control the various properties of materials and construction governed by the Specifications. As a minimum, detail sampling location and techniques, and test frequency to be utilized in the sampling and testing plan. The Department may utilize quality control sampling and testing performed by the Contractor for acceptance. Submit the Quality Control Plan to the Engineer in writing a minimum of 30 days before work begins.

3.1. Identify the personnel responsible for the Contractor's quality control in the plan. This should include the company official who will act as liaison with Department personnel, as well as the Certified Technician who will direct the inspection program. The class or classes of concrete involved will be listed separately. If existing mix designs are to be utilized, list the mix design numbers. Quality control sampling, testing, and inspection should be an integral part of the Contractor's quality control system. In addition to the above requirements, the Contractor's quality control system should document the quality control requirements considered to be normal activities necessary to control the production and placing of a given product or material at an acceptable quality level. Retain the latest ten gradation samples for use by the Engineer. It is intended that sampling and testing be in accordance with standard methods and procedures, and that measuring and testing equipment be standard, properly calibrated and documented in the Quality Manual. Detail in the Quality Control Plan any alternative sampling method, procedure and inspection equipment to be used.

3.1.1. Elements of the Plan. Include all elements that affect the quality of the PCCP including, but not limited to the following:

- Mix Designs
- Aggregate Production
- Quality of Components
- Stockpile Management
- Proportioning, including added water
- Mixing and transportation, including time from batching to completion of delivery
- Initial mix properties, including temperature, air content, and consistency
- Placement and consolidation, including a schedule for calibrating and checking vibrators
- Concrete yield versus Plan quantity records
- Compressive strength
- Finishing and curing

3.1.2. Personnel Requirements:

Detail in the Plan:

- The frequency of sampling and testing, coordination of activities, corrective actions to be taken, and documentation.
- How the duties and responsibilities are to be accomplished and documented, and whether more than one Certified Technician is required.
- The criteria utilized by the Technician to correct or reject unsatisfactory materials.

Certified Technicians required duties:

- Perform and utilize quality control tests and other quality control practices to assure that delivered materials and proportioning meet the requirements of the mix designs, including temperature, slump, air content, and strength. Be available on the project site whenever concrete is being produced for use on or being placed on the project site.
- Periodically inspect all equipment utilized in transporting, proportioning, mixing, placing, consolidating, finishing, and curing to assure it is operating properly and that placement, consolidation, finishing, and curing conform to the mix design and other Contract requirements.

4. DOCUMENTATION

Maintain adequate records of all inspections and tests. Indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken as appropriate in the records. The Contractor's documentation procedures will be subject to approval of the Engineer before the start of the work and to compliance checks during the progress of the work.

Charts and Forms.

Keep all conforming and non-conforming inspections and test results complete and available at all times to the Engineer during the performance of the work. Provide forms on a computer-acceptable medium where required. Document batch tickets and gradation data in accordance with Department requirements.

Chart test data for portland cement concrete, including gradation, in accordance with the applicable requirements.

The Contractor may use other types of control charts as deemed appropriate. It is normally expected that testing and charting will be completed within 24 hours after sampling.

All charts and records documenting the Contractor's quality control inspections and tests become property of the Department upon completion of the work.

5. CORRECTIVE ACTION

Notify the Engineer when the moving average test result trend line for any property approaches the specification limits. Cease operations if two consecutive moving average points fall outside the Specification limits. Ceasing operations is the Contractor's responsibility. Quality control tests for this determination includes aggregate gradation, compliance with the mix design band, entrained air content, concrete unit mass, and density of fresh concrete in place. Production will be suspended pending the satisfactory results of a pre-production sample, unless waived by the District Materials Engineer.

Failure to cease operations for the conditions cited above will subject all subsequent material to rejection by the Engineer, or acceptance at a reduced price, as determined by the Engineer.

The Engineer may examine materials represented by individual test results which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor's test results or the Department's test results. The information from additional testing (including testing of in place pavement) may be used to define unacceptable work according to **Standard Specifications For State Road And Bridge Construction Subsection 106.10**, and apply appropriate price reductions or initiate corrective action as determined by the Engineer.

For any test, if a dispute exists between the Engineer and the Contractor about the validity of the others' test results, the KDOT Materials and Research Center (MRC) will perform referee testing. If one of the disputed Department test result was generated at the MRC, then an Independent Laboratory agreeable to both parties will be selected. The selected Laboratory must be approved by the AASHTO Accreditation Program for the appropriate test procedure. If referee testing indicates that the departments 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.

6. Non-Conforming Materials. Establish and maintain an effective and positive system for controlling non-conforming material, including procedures for its identification, isolation and disposition. Reclaim or rework non-conforming materials in accordance with procedures acceptable to the Engineer.

Positively identify all non-conforming materials and products to prevent use, shipment, and intermingling with conforming materials and products. Provide holding areas, mutually agreeable to the Engineer and the Contractor.

7. Testing Facilities. Locate the Contractor's testing facility at the plant site or at the project site. Obtain approval of the facility by the Engineer before the commencement of mixture production. Any other laboratory location requires approval by the District Materials Engineer. Provide suitable space and specified testing equipment for use by the Contractor's quality control personnel to perform tests as required.

KDOT's Materials and Research Center is Accredited through the AASHTO Accreditation Program (AAP). If the contractor's QC laboratory is not participating in the AAP, then the contractor shall have an AAP approved laboratory inspect the QC laboratory's equipment annually. The inspection shall include all equipment necessary to perform testing on specified types of material related to this contract; base and grading, aggregate, bituminous and concrete.

Maintain a Quality Manual showing all calibrations performed on all test equipment and when next calibration is due for that equipment. As a minimum, follow the calibration/verification interval established in **Table 1, Concrete Materials Test Equipment**.

To facilitate communication between the Contractor and the Engineer regarding quality control, equip the Contractor's testing facility with the following:

- A telephone with a private line for the exclusive use of the testing facility's quality control personnel.
- A copying machine.
- A facsimile machine for use by contractor personnel and the Engineer.

Table 1, Concrete Materials Test Equipment

Equipment – Test Method	Requirements	Interval (months)
Mechanical Shakers – KT-2	Check Sieving Thoroughness.	12
General Purpose Balances, Scales and Masses – AASHTO M 231	Calibrate	12
Test Thermometers – KT-17, KT-22 & AASHTO T 231	Standardize	6
Compression Testing Machine – KT-22, KT-23 & AASHTO T 22	Standardize	12
Sieves – AASHTO M 92	Check Physical Conditions.	6
Water tanks – AASHTO M 201	Cleaned and refilled with 3 g/L of hydrated lime (calcium hydroxide).	24
	Verify recording thermometer.	6
Pressure Meter – KT-18	Standardize	3
Volumetric Meter – KT-19	Standardize	12
Slump Cones- KT-21	Check Critical Dimensions.	12
Unit Mass – KT-20	Standardize	12
Capping Material – AASHTO T 231	Check Strength.	3
Reusable Molds – KT-23	Check Critical Dimensions.	12
Nuclear Density Gauge – KT-36 & 38	Check for Uniformity	12

8. Testing Requirements. Take all samples for tests at random locations, selected as specified in the Contractors quality control plan and at the rates specified in the Sampling and Testing Frequency Chart for Portland Cement Concrete Pavement for Quality Control/Quality Assurance Projects in Appendix B of Part V of this manual. Record and document all test results and calculations on data sheets that are acceptable to the Engineer. Record specific test results on a daily summary sheet approved by the Engineer to facilitate the computation of moving test averages. Base moving averages on 4 consecutive test results. Include a description of quality control actions taken (adjustment of aggregate or additive proportions in the mix, moisture adjustments, etc.) in the Daily Quality Control Summary Sheet. Post quality control charts and keep current, show both individual test results and moving average values. As a minimum, plot the single test values and the 4 test moving average values on approved control charts for the following properties:

- Percent air in concrete mixture.
- Slump of concrete mixture.
- Concrete unit mass.
- In place concrete density on plastic concrete as a percentage of determined unit mass.
- Gradation of individual aggregates.

Plot individual test results in black for each test point. Connect points with a solid black line. Plot the moving average for each test variable in red starting with the fourth test. Connect the points with a dashed red line. Plot the Department's verification test results with green asterisks. Do not include the Department's verification tests in the moving average.

Indicate specification working range limits for single test results on the control charts using a dotted green line and for four point moving average results with a solid green line.

NOTE: Section 5.2.7.5 of this manual, Example of a Laboratories Quality Manual, will provide examples of equipment procedures to verify that equipment is in proper condition. Also, examples of records for calibrating/verifying equipment are presented.