

SUPPLEMENTAL SPECIFICATION 106 - CONTROL OF MATERIAL, MARSHALL QC/QA

106.03A BITUMINOUS CONCRETE PAVEMENT SAMPLES AND TESTS - MARSHALL QC / QA.
All materials will be inspected, sampled, tested or accepted by the Engineer as incorporated into the work. Under any applicable QC/QA specifications, the Contractor shall perform all Process Quality Control testing with the Engineer performing all Quality Acceptance testing. Any work in which untested and/or unaccepted materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Any work determined to be unacceptable and unauthorized will not be paid for. All testing will conform to the most recent cited standard methods of AASHTO or ASTM, including AASHTO Interim Specifications or the ASTM Tentative Specifications that are current on the date of the advertisement for bids, unless otherwise specified. In the case of conflict between the ASTM and the AASHTO methods of sampling and testing, the AASHTO method shall govern. When modified AASHTO or ASTM test methods or Vermont Agency of Transportation test methods are designated, the test method will be available at the office of the Agency's Materials and Research Section. Tests for compliance with specification requirements will be made by and at the expense of the Agency.

Samples will be taken by authorized representatives of the Agency in accordance with the requirements of the latest edition of the Agency's Materials Sampling Manual. The Contractor shall provide such facilities, as specified in these Specifications, or as the Engineer may require, for collecting and/or forwarding samples. In all cases, the Contractor shall furnish the required samples without charge.

All materials used are subject to inspection, testing, and acceptance / rejection at any time during the Contract period. Materials contaminated by the Contractor's operations shall be removed. No work or materials shall be deemed approved until accepted by the Engineer. Copies of all test results will be furnished to the Contractor's representative upon request.

In lieu of testing, the Agency may approve the use of certain materials based upon the receipt of a certification from the manufacturer stating that such material is in compliance with these Specification. The requirements for such certifications are specified in Subsection 700.02, Materials Certification.

Items designated for acceptance under Quality Acceptance (QA) provisions will be randomly sampled and tested in accordance with the recommended acceptance guidelines specified for those items. Samples may also be taken any time the material appears defective or when the Engineer determines that a change in the process or product has occurred. Acceptance tests will govern in all cases for determination of pay factors without regard to quality control tests.

- (a) The Contractor shall provide Process Quality Control adequate to produce work of acceptable quality. The Contractor shall perform Process Quality Control sampling, testing, and inspection during all phases of the work at a rate sufficient to assure that the work conforms to the contract requirements and the minimum guidelines specified.

The Engineer will not sample or test for Process Quality Control or assist in controlling the Contractor's production operations.

The Contractor shall provide personnel and testing equipment capable of providing a product which conforms to specified requirements. Continual production of non-conforming work at a reduced price, in lieu of adjustments to bring work into conformance, shall not be allowed.

1. The Contractor shall provide and maintain a Process Quality Control Plan, hereinafter referred to as the "Plan", including all the personnel, equipment, supplies, and facilities necessary to obtain samples, perform tests, and otherwise control the quality of the product to meet specified requirements.

The Contractor shall be prepared to present and discuss, at the preconstruction conference, quality control responsibilities for the specific items indicated in the contract. The Contractor shall submit the Plan to the Engineer for approval / rejection, at least ten (10) working days prior to the start of related work. The Contractor shall not start work on the subject items without an approved Plan.

The approval process for the Contractor's Plan may include inspection of testing equipment and a sampling and testing demonstration by the Contractor's technician(s) to assure an acceptable level of performance.

2. All Contractor Process Quality Control testing under the Plan shall be performed by qualified technicians in laboratories approved by the Materials and Research Engineer. Technician qualifications shall be as described in the specifications for the item being accepted.

Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect and review the Contractor's laboratory facility. The Engineer will advise the Contractor of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. Deficiencies shall be grounds for the Engineer to order an immediate stop to incorporating materials into the work until deficiencies are corrected.

3. The Plan shall be administered by a qualified individual. Administrator qualifications shall be as described in the specifications for the item(s) being accepted.

The individual administering the Plan must be a full-time employee of, or a consultant engaged by, the Contractor. The individual shall have full authority to institute any and all actions necessary for the successful operation of the Plan.

4. The Plan shall contain a system for sampling that assures all material being produced has an equal chance of being selected for testing. The Engineer shall be provided the opportunity to witness all sampling.

When directed by the Engineer, the Contractor shall sample and test any material which appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or the resulting deficiency otherwise corrected by the Contractor. All sampling and testing shall be in accordance with Agency, AASHTO, or ASTM procedures.

5. All testing shall be performed in accordance with the acceptance test procedures applicable to the specified Contract items or other methods set forth in the approved Plan. Should acceptance test procedures not be applicable to quality control tests, the Plan shall stipulate the test procedures to be utilized. Upon request the Contractor shall provide copies of all test results on forms meeting the approval of the Engineer.
6. The Contractor shall maintain complete records of all Process Quality Control tests and inspections. The records shall be available to the Engineer for review and copies furnished upon request. A complete set of all such documents shall be provided upon completion of the Contract.

Control Charts acceptable to the Engineer shall be maintained and kept current at a location satisfactory to the Engineer. At a minimum, the Control Charts shall identify the project number, the contract item number, the test number, each test parameter, the upper and lower specification limit applicable to each test parameter and the Contractor's test results.

The Contractor shall include the Control Charts as part of a Process Quality Control System. The charts shall be used for identifying production and equipment problems and for identifying aspects which could result in pay factor reductions before they occur. Trigger mechanisms for corrective action and suspension of operations must be identified.

7. The Engineer may suspend associated construction or production operations at any time that the Plan is not being followed by the Contractor.

8. Under such conditions where two subplot test results indicate that the lot will result in a sub-par Percent Within Limits (PWL), the Contractor may request that a third test, herein termed a "lot/day termination test", be taken. After performing a lot/day termination test, all production operations shall immediately be terminated for that day. The Contractor shall secure the Engineer's approval and concurrence prior to performing said test. This test shall not be cause for switching to "low production activities" as defined under 106.03 (a)9.
9. Upon 24 hours advance request and subsequent approval by the Engineer, the Contractor may perform production activities outside of the requirements of the Plan in the instance those activities involve "low production activities". For the purpose of this section, low production activities are defined as those not associated with mainline activities and up to a maximum daily production of 300 Metric Tons (Tons) of bituminous mixture.

Materials being produced for low production activities will be tested under the provisions of the latest edition of the Standard Specifications For Construction as modified by the latest version of the General Special Provisions for all Projects, Subsection 406.03 (d) and shall comply with all applicable specifications for the mix type being produced.

- (b) Items specified to be sampled and tested for Quality Acceptance (QA) will be evaluated for acceptance in accordance with the guidelines specified for those items. All acceptance test results for a lot, as defined in the specification, will be analyzed collectively and statistically by the Quality Level Analysis - "Percent Within Limits" Method using the procedures listed to determine the total estimated percent of the lot that is within specification limits. Quality Level Analysis - "Percent Within Limits" is a statistical procedure for estimating the percent compliance with a \bar{x} specification and is affected by shifts in the arithmetic mean (\bar{X}) of the test results and by the sample standard deviation (s).

1. A lot containing non-specification material, at or below the Rejectable Quality Level (RQL), will be rejected. In concert with and notwithstanding other provisions of Subsection 406.03 (e) 5, the Contractor may submit a written request for acceptance of the material at a reduced price or propose other corrective action for approval by the Engineer. Such requests shall include an engineering analysis showing expected effects on performance. The Engineer will determine if the proposed course of action is acceptable.
2. If less than three samples have been obtained at the time a lot is terminated, the material in the shortened lot will be included as a part of an adjacent lot and a pay factor computed for the combined lots. Generally, this involves combining the shortened day's results with a subsequent day's test results.

However, if this occurs on the last day of production, these results will be combined with the most recent day's lot results for a revised determination.

3. The Engineer may reject material which appears to be obviously defective based on visual inspection. Such rejected material shall not be used in the work.
4. Quality Level Analysis - "Percent Within Limits" procedures are defined as follows:

- a. Compute the upper quality index (Q_u):

$$Q_u = \frac{USL - \bar{X}}{s}$$

Where USL = upper specification limit

\bar{X} = arithmetic mean of the test results

s = sample standard deviation

- b. Compute the lower quality index (Q_L):

$$Q_L = \frac{\bar{X} - LSL}{s}$$

Where LSL = lower specification limit

- c. Determine PWL_U (percent within the upper specification limit which corresponds to a given Q_U) from references available through the Engineer.

Note: If a USL is not specified, PWL_U will be 100.

- d. Determine PWL_L (percent within the lower specification limit which corresponds to a given Q_L) from references available through the Engineer.

Note: If a LSL is not specified, PWL_L will be 100.

- e. Determine the PWL (total percent within specification limits).

$$PWL = PWL_U + PWL_L - 100$$

- f. Determine the Pay Factor (PF) for the lot from the process or equation applicable to the specific Contract item.

Note: Numbers used in the above calculations shall be carried to significant figures and rounded according to AASHTO Standard Recommended Practice R-11.