**Page 106-3 thru -5: Delete subsection 106.05 and replace with the following (revert back to 2019 version, this replaced in the error in 2021):**

**106.05 Sampling and Testing of Hot Mix Asphalt.** All HMA, Item 403, except HMA (Patching) and temporary pavement shall be tested in accordance with the following program of process control testing and acceptance testing:

1. *Process Control Testing*. The Contractor shall be responsible for process control testing on all elements listed in Table 106-1. Process control testing shall be performed at the expense of the Contractor. The Contractor shall develop a process control plan (PCP) in accordance with the following:

1. Process Control Plan. For each element listed in Table 106-1, the PCP must provide adequate details to ensure that the Contractor will perform process control. The Contractor shall submit the PCP to the Engineer at the Pre-construction Conference. The Contractor shall not start any work on the project until the Engineer has approved the PCP in writing.

* + - 1. Frequency of Tests or Measurements. The PCP shall indicate a random sampling frequency, which shall not be less than that shown in Table 106-1. The process control tests shall be independent of acceptance tests.
			2. Worksheets, Forms, and Charts. The Contractor shall submit examples of worksheets, test result forms, and test results charts in accordance with CP 12 as part of the PCP.
			3. Test Result Chart. Each process control test result, the appropriate tonnage and the tolerance limits shall be plotted. For in place density tests, only results after final compaction shall be shown. The chart shall be posted daily at a location convenient for viewing by the Engineer.
			4. Quality Level Chart. The Quality Level (QL) for each element used to calculate incentive or disincentive in Table

106-1 and each required sieve size shall be plotted. The QL will be calculated in accordance with the procedure in CP 71 for Determining Quality Level (QL). The QL will be calculated on tests 1 through 3, then tests 1 through 4, then tests 1 through 5, then thereafter the last five consecutive test results. The tonnage of material represented by the last test result shall correspond to the QL. For in place density tests, only results after final compaction shall be shown. The chart shall be posted daily at a location convenient for viewing by the Engineer.

* + 1. Elements Not Conforming to Process Control. The QL of each discrete group of five test results, beginning with the first group of five test results, shall be a standard for evaluating material not conforming to process control. When the group QL is below 65, the process shall be considered as not conforming to the PCP. In this case, the Contractor shall take immediate action to bring the process back into control. Except where the cause of the problem is readily apparent and corrected without delay, production shall be suspended until the source of the problem is determined and corrected. A written explanation of actions taken to correct control problems shall accompany the test data and be submitted to the Engineer on the day the actions are taken.
		2. Point of Sampling. The material for process control testing shall be sampled by the Contractor using approved procedures. Acceptable procedures are Colorado Procedures, AASHTO and ASTM. The order of precedence is Colorado Procedures, AASHTO procedures and then ASTM procedures. The location where material samples will be taken shall be indicated in the PCP.
		3. Testing Standards. The PCP shall indicate which testing standards will be followed. Acceptable standards are Colorado Procedures, AASHTO and ASTM. The order of precedence is Colorado Procedures, AASHTO procedures and then ASTM procedures.
		4. Testing Supervisor Qualifications. The person responsible for the process control sampling and testing shall be identified in the PCP and be qualified according to the requirements of CP 10
		5. Technician Qualifications. Technicians taking samples and performing tests must be qualified according to the requirements of CP 10.
		6. Testing Equipment. All of the testing equipment used to conduct process control testing shall conform to the standards specified in the test procedures and be in good working order. Nuclear testing devices used for process control testing of in-place density do not have to be calibrated on the Department’s calibration blocks.
		7. Reporting and Record Keeping. The Contractor shall report the results of the process control tests to the Engineer in writing at least once per day. The Contractor shall assemble a process control (PC) notebook and update it daily. This notebook shall contain all worksheets, test results forms, test results charts and quality level charts for each of the elements listed in Table 106-1. The Contractor shall submit the PC notebook to the Engineer for review once a month on the date agreed to at the Pre-Paving Conference. The PC notebook will be returned to the Contractor within one working day after submittal. The Engineer will notify the Contractor in writing of any deficiencies in the PC notebook, including the failure to submit the notebook on time or an absence of the required reports. Upon the second failure to submit the complete PC notebook on time or with an absence of the required reports, the Engineer will notify the Contractor, and the pay estimate will be withheld until the Contractor submits, in writing, a report detailing the cause for the failure to submit the complete PC notebook on time or the cause for the absence of required reports. The report shall include how the Contractor plans to resolve the failures. Additional failures to submit the PC notebook on time or absent the required reports will result in a delay of the pay estimate until the Contractor has identified and resolved the failure along with revising and

resubmitting his PCP to address these issues. Once the Engineer has reviewed and approved the revised PCP the estimate may be paid. Upon submittal of the PC notebook for the semi-final estimate, the PC notebook shall become the property of the Department. The Contractor shall make provisions such that the Engineer can inspect process control work in progress, including PC notebook, sampling, testing, plants, and the Contractor’s testing facilities at any time.

1. *Acceptance Testing.*  Acceptance testing is the responsibility of the Department and shall not be addressed in the PCP. The Department will determine the locations where samples or measurements are to be taken. The maximum quantity of material represented by each test result and the minimum number of test results will be in accordance with Table 106-1. The location or time of sampling will be based on a stratified random procedure as described in CP 75. Acceptance sampling and testing procedures will be in accordance with the Schedule for Minimum Materials Sampling, Testing and Inspection in the

Department’s Field Materials Manual. Samples for project acceptance testing shall be taken by the Contractor in accordance with the designated method. The samples shall be taken in the presence of the Engineer. Where appropriate, the Contractor shall reduce each sample to the size designated by the Engineer. The Contractor may retain a split of each sample which cannot be included as part of the PCP.

If the Contractor elects to question the Hot Mix Asphalt (HMA) acceptance test results, the steps outlined in CP 17 shall be followed. The results from the CP 17 resolution process shall be binding on both the Department and the Contractor. Requests for CP 17 process for all elements except density shall be submitted in writing to the Engineer within five work days from the date the Contractor receives acceptance test data from the Engineer. The specific element questioned shall be identified in writing. All requests for the CP 17 process for the density element shall be submitted in writing to the Engineer within 24 hours of receiving test data from the Engineer.

The Contractor shall choose either the CDOT Materials and Geotechnical Branch or a consultant laboratory not associated with the project to perform the third party testing. The Contractor shall document his choice in writing at the Pre-Paving Conference. If a consultant laboratory is chosen, the CDOT Materials and Geotechnical Branch will determine the consultant that will be used from a pre-established list and ensure there is no conflict of interest.

If third party testing is required, the responsibility for the testing expenses shall be assigned in accordance with CP 17. The costs for testing are shown in CP 17, Table 17-2.

All materials being used are subject to inspection and testing at any time prior to, during, or after incorporation into work. Acceptance tests will be made by and at the expense of the Department, except when otherwise provided.

1. *Check Testing Program (CTP).* Prior to, or in conjunction with, placing the first 500 tons of asphalt pavement, under the direction of the Engineer, a CTP will be conducted between acceptance testing and process control testing programs. The CTP will consist of testing for asphalt content, theoretical maximum specific gravity, HMA 4.75 mm (#4) sieve, HMA 2.36 mm (#8) sieve, HMA 0.075 mm (#200) sieve, in-place density, and joint density in accordance with CP 13. If the Contractor intends to test to determine air voids and VMA, check testing for these tests is recommended. The CTP will be continued until the acceptance and process control tests are within the acceptable limits shown in Table 13-1 of CP 13. For joint density, the initial check test will be a comparison of the seven cores tested by CDOT and the seven cores tested by the Contractor. These are the cores from the compaction test section used for nuclear gauge calibration and test section payment.

During production, a split sample check will be conducted at the frequency shown in Table 106-1. Except for joint density, the split samples will be from an acceptance sample obtained in accordance with subsection 106.05(b). The acceptance test result will be compared to the process control test result obtained by the Contractor using the acceptable limits shown in Table 13-1 of CP 13. For joint density, the comparison sample for testing by the Contractor will be obtained by taking a second core adjacent to the joint density acceptance core. The acceptance test result will be compared to the process control test result obtained by the Contractor using the acceptable limits as shown in Table 13-1 of CP 13 and following the check testing procedure given in CP 13.

If production has been suspended and then resumed, the Engineer may order a CTP between process control and acceptance testing persons to assure the test results are within the acceptable limits shown in Table 13-1 of CP 13. Check test results shall not be included in process control testing. The Region Materials Engineer shall be called upon to resolve differences if a CTP shows unresolved differences beyond the values shown in Table 13-1 of CP 13.

1. *Stability Verification Testing.* After the mix design has been approved and production commences, the Department will perform a minimum of three stability verification tests to verify that the field produced HMA conforms to the approved mix design:

The test frequency shall be one per day unless otherwise directed by the Engineer.

The test results will be evaluated and the Contractor shall make adjustments if required in accordance with the following:

* 1. The minimum value for stability will be the minimum specified in Table 403-1 of the specifications. There will be no tolerance limit.
	2. Quality Level. Calculate a QL for stability.

If the QL for stability is less than 65, then production shall be halted and the Contractor shall submit a written proposal for a mix design revision to the Engineer. The Engineer shall give written approval to the proposed mix design revision before production continues.

After a new or revised mix design is approved, three additional stability tests will be performed on asphalt produced with the new or revised mix design. The test frequency shall be one per day unless altered by the Engineer.

If the stability QL is less than 65, then production shall be halted until a new mix design has been completed and approved using plant produced material or the Contractor shall submit a written proposal for a mix design revision to the Engineer. The Engineer shall give written approval to the proposed mix design revision before production continues.

* 1. New or Revised Mix Design. Whenever a new or revised mix design is used and production resumes, three additional

stability field verification tests shall be performed and the test results evaluated in accordance with the above requirements. The test frequency shall be one per day unless altered by the Engineer.

* 1. Field Verification Process Complete. When the field verification process described above is complete and production continues, the sample frequency will revert back to 1 per 10,000 tons.
1. *Mix Verification Testing.* After the mix design has been approved and production commences, the Department will perform a minimum of three volumetric verification tests for each of the following elements to verify that the field produced Hot Mix Asphalt (HMA) conforms to the approved mix design:
	* 1. Air Voids.
		2. Voids in Mineral Aggregate (VMA).
		3. Asphalt Content (AC).

 The test frequency shall be one per day unless altered by the Engineer.

The test results will be evaluated and the Contractor shall make adjustments if required in accordance with the following:

* + 1. Target Values. The target value for VMA will be the average of the first three volumetric field test results on project produced hot mix asphalt or the target value specified in Table 403-1 and Table 403-2 of the specifications, whichever is higher. The target value for VMA will be set no lower than 0.5 percent below the VMA target on Form 43 prior to production. The target values for the test element of air voids and AC shall be the mix design air voids and mix design AC as shown on Form 43.
		2. Tolerance Limits. The tolerance limits for each test element shall be:

 AC ± 0.3 percent

 Air Voids ± 1.2 percent

 VMA ± 1.2 percent

* + 1. Quality Levels. Calculate an individual QL for each of the elements using the volumetric field verification test results. If the QL for VMA or AC is less than 65 or if the QL for air voids is less than 70, the production shall be halted and the Contractor shall submit a written proposal for a mix design revision to the Engineer. Production shall only commence upon receipt of written approval from the Engineer of the proposed mix design revision.

After a new or revised mix design is approved, three additional volumetric field verification tests will be performed on asphalt produced with the new or revised mix design. The test frequency shall be one per day unless altered by the Engineer.

If the QL for VMA or AC is less than 65 or the QL for the test element of air voids is less than 70, then production shall be halted until a new mix design has been completed in accordance with CP 52 or CP 54, a new Form 43 issued, and the Contractor demonstrates that he is capable of producing a mixture meeting the verification requirements in accordance with A or B below:

* + - 1. The Contractor shall produce test material at a site other than a CDOT project. The Contractor shall notify the Engineer a minimum of 48 hours notice prior to the requested test. The location and time of the test are subject to the approval of the Engineer, prior to placement. Three samples will be tested for volumetric properties. If the QL for VMA or AC is equal or greater than 65 and the QL for the element of air voids is equal or greater than 70, full production may resume or;
			2. The Contractor may construct a 500 ton test strip on the project. Three samples in the last 200 tons will be tested for volumetric properties. After construction of the test section, production shall be halted until the testing is complete and element QLs are calculated. If the QL for VMA or AC is equal to or greater than 65 or the QL for the element of air voids is equal to or greater than 70, full production may resume. If the QL for VMA or AC is less than 65 or the QL for the element of air voids is less than 70, the material shall be removed and replaced at no cost to the Department. The time count will continue, and any delay to the project will be considered to have been caused by the Contractor and will not be compensable.

The costs associated with mix designs shall be solely at the Contractor’s expense.

If the Contractor fails to verify the new mix design in accordance with A or B, then production shall be halted until a new mix design has been completed in accordance with CP 52 or CP 54, a new Form 43 issued, and the Contractor demonstrates they are capable of producing a mixture meeting the verification requirements in accordance with A or B.

* 1. New or Revised Mix Design. Whenever a new or revised mix design is used and production resumes, three additional volumetric field verification tests shall be performed and the test results evaluated in accordance with the above requirements. The test frequency shall be one per day unless altered by the Engineer.
	2. Field Verification Process Complete. When the field verification process described above is complete and production continues, the sample frequency will revert back to a minimum of 1/10,000 tons. The Engineer has the discretion to conduct additional verification tests at any time.
1. *Testing Schedule***.** Process control and project acceptance testing frequency shall be in accordance with Table 106-1.
2. *Reference Conditions.*Three reference conditions can exist determined by the Moving Quality Level (MQL). The MQL will be calculated in accordance with the procedure in CP 71 for Determining Quality Level (QL). The MQL will be calculated using only acceptance tests. The MQL will be calculated on tests 1 through 3, then tests 1 through 4, then tests 1 through 5, then thereafter on the last five consecutive test results. The MQL will not be used to determine pay factors. The three reference conditions and actions that will be taken are described as follows:
	1. Condition green will exist for an element when an MQL of 90 or greater is reached, or maintained, and the past five consecutive test results are within the specification limits.
	2. Condition yellow will exist for all elements at the beginning of production or when a new process is established because of changes in materials or the job-mix formula, following an extended suspension of work, or when the MQL is less than 90 and equal to or greater than 65. Once an element is at condition green, if the MQL falls below 90 or a test result falls outside the specification limits, the condition will revert to yellow or red as appropriate.
	3. Condition red will exist for any element when the MQL is less than 65. The Contractor shall be notified immediately in writing and the process control sampling and testing frequency increased to a minimum rate of 1 per250 tons for that element. The process control sampling and testing frequency shall remain at 1 per 250 tons until the process control QL reaches or exceeds 78. If the QL for the next five process control tests is below 65, production will be suspended.

If gradation is the element with MQL less than 65, the Department will test one randomly selected sample in the first 1250 tons produced in condition red. If this test result is outside the tolerance limits, production will be suspended. (This test result will not be included as an acceptance test.)

After condition red exists, a new MQL will be started. Acceptance testing will stay at the frequency shown in Table 106-1. After three acceptance tests, if the MQL is less than 65, production will be suspended.

Production will remain suspended until the source of the problem is identified and corrected. Each time production is suspended, corrective actions shall be proposed in writing by the Contractor and approved in writing by the Engineer before production may resume.

Upon resuming production, the process control sampling and testing frequency for the elements causing the condition red shall remain at 1 per 250 tons. If the QL for the next five process control tests is below 65, production will be suspended again. If gradation is the element with MQL less than 65, the Department will test one randomly selected sample in the first 1250 tons produced in condition red. If this test result is outside the tolerance limits, production will be suspended.

**Table 106-1**

**SCHEDULE FOR MINIMUM SAMPLING**

 **AND TESTING FOR HMA**

|  |  |  |  |
| --- | --- | --- | --- |
| **Element**  | **Process Control**  | **Acceptance1,2**  | **Check (CTP)**  |
| Asphalt Content  | 1/500 tons  | 1/1000 tons  | 1/10,000 tons  |
| Gradation  | 1/Day  | 1/2000 tons  | 1/20,000 tons  |
| Theoretical Maximum Specific Gravity  | 1/1000 tons, minimum 1/Day  | 1/1000 tons, minimum 1/Day  | 1/10,000 tons  |
| In-place Density  | 1/500 tons  | 1/500 tons  | 1/5000 tons  |
| Joint Density  | 1 core/2500 linear feet of joint  | 1 core/5000 linear feet of joint  | 1 core/50,000 linear feet of joint  |
| Aggregate Percent Moisture 3  | 1/2000 tons, minimum 1/Day  | 1/2000 tons  | Not applicable  |
| Percent Lime 3,4  | 1/Day  | Not applicable  | Not applicable  |
| 1. The minimum number of acceptance tests will be: 5 asphalt content, 3 gradation, 10 in-place density and 5 joint density for all projects.
2. When unscheduled job mix formula changes are made (Form 43) acceptance of the elements, except for in-place density, will be based on the actual number of samples that have been selected up to that time, even if the number is below the minimum listed in the schedule. At the Engineer’s discretion, additional random in-place density tests may be taken in order to meet scheduled minimums, provided the applicable pavement layer is available for testing under safe conditions. Beginning with the new job mix formula, the quantity it will represent shall be estimated. A revised schedule of acceptance tests will be based on that estimate.
3. Not to be used for incentive or disincentive pay. Test according to CP-33 and report results from Form 106 or Form 565 on Form 6.
4. Verified per Contractor’s PC Plan
 |