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| REVIEW OF NEW SPECIFICATION OR SPECIFICATION CHANGE  | 106-29 |
| **Specification Section No.:** 105 and 106 | **Item:** Revision of Sections 105 and 106Conformity to the Contract of Hot Mix Asphalt(Voids Acceptance) |
| **Originating Office:** Materials & Geotechnical | **By:** Gallegos/Standford |
| **Date Sent For Review:** August 29, 2017 | **Date Comments Due: September 26, 2017** |
| Submit response to: STANDARDS AND SPECIFICATIONS UNIT, DIVISION OF PROJECT SUPPORT 4TH FLOOR, CDOT HEADQUARTERS |
| **Vote****/N** | **Concurrent Reviews – Others Commenting** | The attached Draft Specification is submitted for your review and comments. If not returned by Date Comments Due, the draft specification will be considered to be approved unless the Standards and Specifications Unit of the Project Development Branch [(303) 757-9474, (303) 757-9402] is advised otherwise.**REMARKS:** If these proposed changes are approved, our unit will issue these in a revised standard special provision. The proposed changes apply to the 2017 edition of the Standard Specifications. |
|  | **Spec Committee Members:** |  **✓** |
|  | Co-Chairman: Lacey |  |
|  | Region 1: Quirk |  |
|  | Region 1: Lucerna |  |
|  | Region 2: Phillips |  |
|  | Region 3: Jean |  |
|  | Region 4: Boespflug |  |
|  | Region 5: Valentinelli |  |
|  | Project Development: Vacant |  |
|  | Specifications: Brinck |  |
|  | Bridge: Hasan |  |
|  | Contracts & Market Analysis: Eddy |  |
|  | Materials: Schiebel |  |
|  | Traffic Engineering: Matthews |  | REVIEWER COMMENTS:( ) Approved ( ) Disapproved ( ) ModifiedIf disapproved or modified, give reason why and show any modifications on the attached draft copy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ Name/Signature Date |
|  | Maintenance: Weldon |  |
|  | FHWA: Larson |  |
|  | Attorney General: Milan |  |
|  |  |  |
|  | **Others:** |  |
|  | Colorado Contractors Assoc.: Moody |  |
|  |  |  |
|  | **Technical Committees:** |  |
|  | PDAC |  |
|  | Drainage Advisory Committee (DAC) |  |
|  | Water Quality Advisory Committee (WQAC) |  |

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| **COLORADO DEPARTMENT OF TRANSPORTATION****SUBMITTAL OF NEW SPECIFICATION OR SPECIFICATION CHANGE** | Log No. (Assigned by Standards and Specifications Unit)106-29 |
| TO: Standards & Specifications Unit Project Development Branch | FROM:Region 1(Region, Branch or Technical Committee) |
| SPECIFICATION SECTION NO.Presented below | ITEM106.05 Sampling and Testing of Hot Mix Asphalt. | Priority XRoutine Fast |
| Reason for this new or changed specification:To clearly identify in the specification as to when a target value VMA adjustment is applicable.These changes are applicable to ensure production processes are controlled so the product placed on the roadway is of the highest percent of quality.This revision was accepted by the MAC in November of 2016 and was to be proposed for inclusion to the 2017 standard specifications. Formal submittal of these changes in November 2016 were inadvertently overlooked. |
| New or Revised Specification:See Attached. |
| NOTE: See Procedural Directive 513.1 for a description of appropriate specification development procedures. |

CDOT Form #1215 1/15

~~January 15, 2015~~

 Revised, November 17, 2016

REVISION OF SECTIONS 105 AND 106

CONFORMITY TO THE CONTRACT OF HOT MIX ASPHALT

(VOIDS ACCEPTANCE)

# NOTICE

This is a standard special provision that revises or modifies CDOT’s *Standard Specifications for Road and Bridge Construction*. It has gone through a formal review and approval process and has been issued by CDOT’s Project Development Branch with formal instructions regarding its use on CDOT construction projects. It is to be used as written without change. Do not use modified versions of this special provision on CDOT construction projects, and do not use this special provision on CDOT projects in a manner other than that specified in the instructions unless such use is first approved by the Standards and Specifications Unit of the Project Development Branch. The instructions for use on CDOT construction projects appear below.

Other agencies that use the *Standard Specifications for Road and Bridge Construction* to administer construction projects may use this special provision as appropriate and at their own risk.

**Instructions for use on CDOT construction projects:**

Use this standard special provision on projects with 2000 or more tons of hot mix asphalt or as directed by the RME when acceptance is based on air voids, and other elements.

REVISION OF SECTIONS 105 AND 106

CONFORMITY TO THE CONTRACT OF HOT MIX ASPHALT

(VOIDS ACCEPTANCE)

Sections 105 and 106 of the Standard Specifications are hereby revised for this project as follows:

Delete subsection 105.05 and replace with the following:

**105.05 Conformity to the Contract of Hot Mix Asphalt.** Conformity to the Contract of all Hot Mix Asphalt, Item 403, except Hot Mix Asphalt (Patching) and temporary pavement will be determined by tests and evaluations of elements that include asphalt content, voids in the mineral aggregate, air voids, in-place density, and joint density in accordance with the following:

All work performed and all materials furnished shall conform to the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown in the Contract.

For those items of work where working tolerances are not specified, the Contractor shall perform the work in a manner consistent with reasonable and customary manufacturing and construction practices.

When the Engineer finds the materials or work furnished, work performed, or the finished product are not in conformity with the Contract and has resulted in an inferior or unsatisfactory product, the work or material shall be removed and replaced or otherwise corrected at the expense of the Contractor.

Materials will be sampled randomly and tested by the Department in accordance with subsection 106.05 and with the applicable procedures contained in the Department’s Field Materials Manual. The approximate maximum quantity represented by each sample will be as set forth in subsection 106.05. Additional samples may be selected and tested at the Engineer’s discretion.

A process will consist of either a test value or a series of test values resulting from related tests of an element of the Contractor’s work and materials. An element is a material and/or workmanship property that can be tested and evaluated for quality level by the Department approved sampling, testing, and analytical procedures. All materials produced will be assigned to a process of each element being tested and evaluated. A change in process is defined as a change that affects the element involved. A process for any element normally will include all produced materials associated with that element prior to a change in the job mix formula (Form 43) with the exception of the process for joint density element. For joint density, a new process will be established for each new layer of pavement or for changes in joint construction. In-place density measurements taken within each compaction test section will be a separate process. The Engineer may separate a process in order to accommodate small quantities or unusual variations.

Evaluation of materials for pay factors (PF) will be done using only the Department’s acceptance test results. Each process will have a PF computed in accordance with the requirements of this Section. Test results determined to have sampling or testing errors will not be used.

Except for in-place density measurements taken within a compaction test section, any test result for the asphalt content, in-place density and/or joint density element greater than the distance 2 x V (see Table 105‑2) outside the tolerance limits will be designated as a separate process and the quantity it represents will be evaluated in accordance with subsection 105.05(a). An element pay factor less than zero shall be zero. The calculated PF will be used to determine the Incentive/Disincentive Payment (I/DP) for the process in accordance with 105.05(e) Evaluation of Work.

Any test result for the air voids or VMA elements greater than the distance 2 x V (see Table 105-2) outside the tolerance limits will be designated as a separate process and the quantity it represents shall be removed and replaced with specification material at the Contractor’s expense.

In the case of in‑place density or joint density, the Contractor will be allowed to core the exact location (or immediately adjacent location for joint density) of a test result more than 2 x V outside the tolerance limit. The core must be taken and furnished to the Engineer within eight hours after notification by the Engineer of the test result. The result of this core will be used in lieu of the previous test result. Cores not taken within eight hours after notification by the Engineer will not be used in lieu of the test result. All costs associated with coring will be at the Contractor’s expense.

1. *Representing Small Quantities.* When it is necessary to represent a process by only one or two test results, PF will be the average of PFs resulting from the following:

If the test result is within the tolerance limits then PF = 1.00. If the test result is above the maximum specified limit, then

 PF = 1.00 – [0.25(T0 ‑ TU)/V]

 If the test result is below the minimum specified limit, then

 PF = 1.00 – [0.25(TL ‑ T0)/V]

 Where: PF = pay factor.

 V = V factor from Table 105‑2.

 T0 = the individual test result.

 TU = upper specification limit.

 TL = lower specification limit.

If the pay factor of any of the above calculations is less than 0.75 for any element, the acceptance of the work will be evaluated according to subsection 105.05(e).

1. *Determining Quality Level.* Each process with three or more test results will be evaluated for a quality level (QL) in accordance with Colorado Procedure 71.
2. *Joint Density Element.* Joint density will be tested according to subsection 401.17.
3. *Process Pay Factor.* Using the calculated QL for the process, compute the PF as follows: The final number of random samples (Pn) in each process will determine the final pay factor. As test values are accumulated for each process, Pn will change accordingly. When the process has *been* completed, the number of random samples it contains will determine the computation of PF, based on Table 105-3 and formula (1) below. When Pn is from 3 to 9, or greater than 200, PF will be computed using the formulas designated in Table 105-3. Where Pn is equal to or greater than 10 and less than 201, PF will be computed by formula (1):



 Where, when referring to Table 105-3:

PF1= PF determined at the next lowest Pn formula using process QL

 PF2 = PF determined using the Pn formula shown for the process QL

 PF3= PF determined at the next highest Pn formula using process QL

 Pn2= the lowest Pn in the spread of values listed for the process Pn formula

 Pn3= the lowest Pn in the spread of values listed for the next highest Pn formula

 PnX = the actual number of test values in the process

When evaluating the item of Furnish Hot mix asphalt, the PF for the element of In-Place Density shall be 1.0.

Regardless of QL, the maximum PF in relation to Pn is limited in accordance with Table 105-3.

As test results become available, they will be used to calculate QL and PF numbers for each process. The process I/DP’s will then be calculated and accumulated for each element and for the item. The test results and the accumulated calculations will be made available to the Contractor upon request.

Numbers from the calculations will be carried to significant figures and rounded according to AASHTO Standard Recommended Practice R‑11, Rounding Method.

1. *Evaluation of Work.* When the PF of a process is 0.75 or greater, the finished quantity of work represented by the process will be accepted at the appropriate pay factor. If the PFfor the air voids or VMA elements within *any* process is less than 0.75, the Contractor shall remove and replace the material with specification material at the Contractor’s expense. If PF for any other element within any process is less than 0.75, the Engineer may:
	1. Require complete removal and replacement with specification material at the Contractor’s expense,

or

* 1. Where the finished product is found to be capable of performing the intended purpose and the value of the finished product is not affected, permit the Contractor to leave the material in place. If the material is permitted to remain in place, the PF for the process shall not be greater than 0.75. The Region Materials Engineer (RME) will be consulted prior to determining the material will be allowed to remain in place. The RME will also be consulted to assist in determining an appropriate pay factor.

When condition red, as described in subsection 106.05(g), exists for any element, resolution and correction will be in accordance with subsection 106.05(g). Material that the Engineer determines is defective may be isolated and rejected without regard to sampling sequence or location within a process.

If removal and replacement is required because the joint density PF for a process is below 0.75, the Contractor shall remove and replace the full lane width adjacent to and including at least six inches beyond the visible joint line for the entire length of joint representing the process. If the lane removed is adjacent to another joint, that joint shall also be removed to a point six inches beyond the visible joint line. When a single joint density core is more than 2V outside the tolerance limits, the removal and replacement limits shall be identified by coring the failing joint at 25 foot intervals until two successive cores are found to be 1V or less.below the minimum tolerance limit. If removal and replacement is required, the Contractor shall submit documentation identifying the process to be used to correct the area in question. The process will be approved by the Engineer before commencing the corrective work

**Table 105‑2**

**“W” and “V” Factors For Various Elements**

|  |  |  |
| --- | --- | --- |
| **Element** | **V Factor** | **W Factor** |
| Asphalt Content | 0.20 | 10 |
| Voids in the Mineral Aggregate | 0.60 | 10 |
| Air Voids | 0.60 |  30 |
| In-place Density | 1.10 |  35 |
| Joint Density | 1.60 | 15 |

## Table 105-3

**Formulas For Calculating PF Based on Pn**

|  |  |  |
| --- | --- | --- |
| **Pn** | **When Pn as shown at left is 3 to 9, or greater than 200, use designated formula below to calculate Pay Factor, PF = ...,****when Pn is 10 to 200, use formula (1) above:** | **Maximum PF** |
| 3 | 0.31177 + 1.57878 (QL/100) - 0.84862 (QL/100)2 | 1.025 |
| 4 | 0.27890 + 1.51471 (QL/100) - 0.73553 (QL/100)2 | 1.030 |
| 5 | 0.25529 + 1.48268 (QL/100) - 0.67759 (QL/100)2 | 1.030 |
| 6 | 0.19468 + 1.56729 (QL/100) - 0.70239 (QL/100)2 | 1.035 |
| 7 | 0.16709 + 1.58245 (QL/100) - 0.68705 (QL/100)2 | 1.035 |
| 8 | 0.16394 + 1.55070 (QL/100) - 0.65270 (QL/100)2 | 1.040 |
| 9 | 0.11412 + 1.63532 (QL/100) - 0.68786 (QL/100)2 | 1.040 |
| 10 to 11 | 0.15344 + 1.50104 (QL/100) - 0.58896 (QL/100)2 | 1.045 |
| 12 to 14 | 0.07278 + 1.64285 (QL/100) - 0.65033 (QL/100)2 | 1.045 |
| 15 to 18 | 0.07826 + 1.55649 (QL/100) - 0.56616 (QL/100)2 | 1.050 |
| 19 to 25 | 0.09907 + 1.43088 (QL/100) - 0.45550 (QL/100)2 | 1.050 |
| 26 to 37 | 0.07373 + 1.41851 (QL/100) - 0.41777 (QL/100)2 | 1.055 |
| 38 to 69 | 0.10586 + 1.26473 (QL/100) - 0.29660 (QL/100)2 | 1.055 |
| 70 to 200 | 0.21611 + 0.86111 (QL/100) | 1.060 |
| > 201 | 0.15221 + 0.92171 (QL/100) | 1.060 |

1. *Process I/DP Computation.*

I/DP = (PF - 1)(QR)(UP)(W/100)

 Where: I/DP= Incentive/Disincentive Payment

 PF = Pay Factor

 QR = Quantity in Tons of HMA Represented by the Process

 UP = Unit Bid Price of Asphalt Mix

 W = Element Factor from Table 105-2

When AC is paid for separately UP shall be:

 UP = [(TonHMA)(UPHMA) + (TonAC)(UPAC)]/TonHMA

Where: TonHMA = Tons of Asphalt Mix

 UPHMA = Unit Bid Price of Asphalt Mix

TonAC = Tons of Asphalt Cement

 UPAC = Unit Bid Price of Asphalt Cement

For the Joint Density element:

 UP = UPHMA

 Where: UPHMA  is as defined above.

When AC is paid for separately UP shall be:

UP = [(BTonHMA)(BUPHMA) + (BTonAC)(BUPAC)]/BTonHMA

Where: BTonHMA = Bid Tons of Asphalt Mix

 BUPHMA = Unit Bid Price of Asphalt Mix

BTonAC = Bid Tons of Asphalt Cement

 BUPAC = Unit Bid Price of Asphalt Cement

1. *Element I/DP.* The I/DP for an element shall be computed by accumulating the process I/DP for that element.
2. *I/DP for a Mix Design.* The I/DP for a mix design shall be computed by accumulating the process I/DP’s for the asphalt content, voids in the mineral aggregate, air voids, and in-place density elements for that mix design. The accumulated quantities of materials for each element must be the same at the end of I/DP calculations for a mix design.
3. *Project I/DP.* The I/DP for the project shall be computed by accumulating the mix design I/DP’s and the joint density I/DP’s. The accumulated quantities of materials for each element must be the same at the end of I/DP calculations for the project.

Delete subsection 106.05 and replace with the following:

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:

(a) *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 quality control plan (QCP) in accordance with the following:

1. Quality Control Plan. For each element listed in Table 106‑1, the QCP must provide adequate details to ensure that the Contractor will perform process control. The Contractor shall submit the QCP to the Engineer at the preconstruction conference. The Contractor shall not start any work on the project until the Engineer has approved the QCP in writing.

A. Frequency of Tests or Measurements. The QCP 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.

B. 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 QCP.

C. 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.

D. 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.

2. 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 QCP. 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.

3. 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 QCP.

4. Testing Standards. The QCP 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.

5. Testing Supervisor Qualifications. The person responsible for the process control sampling and testing shall be identified in the QCP and be qualified according to the requirements of CP 10

6. Technician Qualifications. Technicians taking samples and performing tests must be qualified according to the requirements of CP 10.

7. 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.

8. 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 Quality Control (QC) 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 QC notebook to the Engineer for review once a month on the date agreed to at the Pre-Paving Conference. The QC 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 QC 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 QC 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 QC 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 QC 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 QCP to address these issues. Once the Engineer has reviewed and approved the revised QCP the estimate may be paid. Upon submittal of the QC notebook for the semi-final estimate, the QC 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 QC 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 QCP. The Department will determine the locations where samples or measurements are to be taken and as designated in Section 403. 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. 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 QCP.

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 working 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, voids in the mineral aggregate, air voids, in-place density, and joint density in accordance with CP 13 of the Department’s Field Materials Manual. The CTP will be continued until the acceptance and process control test results 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. The split samples will be from an acceptance sample obtained in accordance with subsection 106.05(b). 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 material 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 shown in the above table 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 Hot mix asphalt conforms to the approved mix design:

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. 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.

3. 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.

4. Field Verification Process Complete. When the field verification process described above is complete and production continues, the sample frequency will revert back to 1/10,000 tons.

1. *Target Values for VMA.* After the mix design has been approved and production commences, the first three volumetric *acceptance* tests conforming to the tolerances set forth in the original Form #43 for asphalt content, air voids and voids in mineral aggregate (VMA) will be analyzed to verify and establish a target value for VMA. The Contractor shall make adjustments if required in accordance with the following: The target value for VMA will be the average of the first three volumetric acceptance test results conforming to the tolerances set forth in the original Form #43 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 1.0 percent below the VMA target on original Form 43.

Whenever a new or revised mix design is used and production resumes, the next three acceptance tests will be evaluated and a target value for VMA will be established in accordance with the above requirements.

1. *Independent Assurance Testing.*Independent assurance testing for Asphalt Content and In-Place Density will be in accordance with the Department’s Field Materials Manual. Independent assurance testing for *Voids* in the Mineral Aggregate and Air Voids will be performed by the Department’s Flexible Pavement laboratory on samples sent from the field at a frequency of one per 10 000 tons.
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 1/250 tons for that element. The process control sampling and testing frequency shall remain at 1/250 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.

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 1/250 tons. If the QL for the next five process control tests is below 65, production will be suspended again.

1. *Correction Factor.* In determining the air voids and VMA in the materials compacted with the SuperPave Gyratory *Compactor* (SGC), the following correction for bulk specific gravity shall be performed during the CTP:

1. The difference in the average value of bulk specific gravity between the process control testing SGC and acceptance testing SGC will be determined and used as a correction factor for the process control bulk specific gravity.

2. This correction factor shall be used to correlate the process control SGC to the acceptance testing SGC for comparison of air voids and VMA during the CTP and full project production. Values in Table 13-1 of CP 13 apply to SGC comparison after correction factor has been applied.

3. This correction factor shall be applied in correlating the SGC’s air voids and VMA test results from process control and acceptance testing to produce comparable data. Any changes in SGC equipment or in the mix design properties, specifically the number of gyrations, asphalt binder grade, aggregate gradation, combination of aggregates, and aggregate sources shall require a new correction factor to be determined under a CTP.

Example: If for the five CTP tests on split samples the process control SGC averages bulk specific gravity of 2.391 and the acceptance SGC averages 2.382, the correction factor would be –0.009 (2.382-2.391) to the process control bulk specific gravities. Each of the five process control CTP bulks would be decreased by 0.009 before CTP result comparison of voids and VMA is made. If the volumetric results satisfy Table 13-1 of CP 13, use corrected bulks to calculate voids and VMA for process control testing program.

If process control and acceptance SGCs are not from the same equipment manufacturer, project-specific material shall be used to perform the CTP and generate the correction factor.

**Table 106‑1**

**SCHEDULE FOR MINIMUM SAMPLING AND TESTING**

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Process Control** | **Acceptance**3 | **Check (CTP)** |
| Determining Asphalt Content of Hot Bituminous Mixtures | 1/500 tons | 1/1000 tons1 | 1/10,000 tons |
| Theorectical Maximum Specific Gravity | 1/1000 tons, minimum 1/day | 1/1000 tons, minimum 1/day | 1/10,000 tons |
| Voids in the Mineral Aggregate | 1/1000 tons | 1/1000 tons1 | 1/10,000 tons |
| Air Voids | 1/1000 tons | 1/1000 tons1 | 1/10,000 tons |
| Hveem Stability | 1/10,000 tons | 1/10,000 tons2 | Not applicable. |
| Resistance to Moisture Damage (Lottman) | 1/10,000 tons | According to subsection 401.02 | Not applicable. |
| Gradation | 1/10,000 tons | 1/10 000 tons2 | Not applicable. |
| Determining Percent Relative Compaction of Bituminous Pavement | 1/500 tons1 | 1/500 tons1 | 1/5000 tons |
| Joint Density | 1 core/2500 linear feet of joint | 1 core/5000 linear feet of joint1 | 1 core/50,000 linear feet of joint |
| Aggregate Percent Moisture (4) | 1/2000 T or 1/Day if less than 2000 T | 1/2000 T | Not applicable |
| Percent Lime (4) (5) | 1/Day | Not applicable | Not applicable |
| Notes for Table 106-1:1. The minimum number of acceptance tests will be at least 5 asphalt content, 5 voids in the mineral aggregate, 5 air voids, 10-in‑place density and 5 joint densities for all projects.
2. For information only. These elements are not used to calculate pay factors.
3. 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 Table 106-1. At the Engineer’s discretion, additional random in-place density test 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.
4. Not to be used for incentive/disincentive pay. Test according to CP-60B and report results from Form 106, Form 565 or Form 6.
5. Verified per Contractor’s QC Plan.
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