Initial/Final Report
Special Experimental Project No. 14 (SEP-14)

Utah Department of Transportation
Quality Bid Factor
September 2016

Purpose
To determine the feasibility of giving a competitive advantage to suppliers who demonstrate the ability to provide product that meets requirements.

Introduction
In 2015, UDOT received approval to utilize a Quality Bid Factor (QBF) for two projects. The hope was that the QBF further would encourage suppliers towards receiving incentive (on average) by giving bidding consideration based on past performance. Ensuring a consistent product requires more QC effort and cost often putting quality suppliers at a disadvantage.

This effort was designed to provide an advantage to win work based on previous history of the contractor (supplier) supplying products that meet contract requirements.

The Quality Bid Factor (QBF) adjusted a proposer's bid amount for a specific bid item (SMA) based on historic quality performance data related to that bid item.

This program was tested on two projects in Region 4:

Project F-0018(56)6 – PIN 013355.
Project F-0006(177)291 – PIN 12510

Contract Information
The specialized contract documents for these projects can be found in the appendix to this document. These consist of the following project specifications:

00120S - Bidding Requirements and Conditions
00223S - Asphalt Quality
00515M – Contract Award and Execution
02744S – Stone Matrix Asphalt (SMA)

Project Overview
Prior to placing the projects out for bid, the materials database was queried to produce a file containing all test data for every supplier in the southern region of Utah (Region 4) over the last three years. This data was provided to each supplier who were asked to review their data and ensure it was correct. A list of QBFs was produced from that data for use in the pre-bid meetings (see Table 1 below). The QBF represents the number of dollars to be added per ton of SMA for bidding purposes only. Initially this factor was to be an addition of up to $5.00 per ton however, limitations in the bidding system required only positive factors. As a result, the factors were "slid" along the number line resulting in an addition of from $0.00 to $10.00 per ton. The better the quality of the supplier, the lower the addition will be, resulting in a lower overall price.

Table 1

Region 4

SMA-Asphalt Quality Factor Table

January 2016

Asphalt Mix Plant	Q Factor
Granite Portable	5.57
Granite Construction	5.00
Legrand Johnson @Moab Plant	5.57
Nielson Construction	5.57
Staker Parsons Centerfield	3.00
Staker Parsons Portable Plant	3.00
Staker & Parson Keigley Hot Plant	5.57
Western Rock Portable	5.00
Western Rock @ Cedar City	6.32
Western Rock @Ft. Pierce	7.05
W.W. Clyde Portable	8.52
WWClyde At Cedar Plant	5.00
Sunroc at Ft. Pierce	5.57

Mandatory pre-bid meetings were required for each project in order to fully explain the QBF and answer any questions the suppliers or contractors may have. The method of calculating the QBF was explained through a power point presentation and each supplier in attendance was provided with a table containing the QBFs for Region 4. They were also afforded another opportunity to review the data the Department had and offer any corrections they felt were needed. At the pre-bid meeting it was made clear to each supplier that they must send an e-mail designating their proposed supply source and QBF to be considered responsive. The details of the requirements are contained in the project documents, more specifically in the specifications 00120S and 00223S which are included in the appendix.

Methodology

Region 4 had performed a review of data on SMA which showed that over 50% of the SMA placed in the Region for 2014 was in some form of disincentive or reject. The quality department worked with regional representatives to device a method to further incentivize quality for SMA. Numerous discussions centered around what “level” to base the factor on. Should the factor be based upon the pit that is used, the plant, or maybe the QC manager? The more granular the data is analyzed, the more difference there was between suppliers. As the data was conglomerated further up the supplier chain (for example very large contractors/suppliers own numerous smaller companies and pits) the more the factors began to cancel out. The decision was made to calculate the QBF on the supplier’s plant. If a plant did not have prior data that could be used, it was decided to give them effectively a zero (no benefit or disadvantage). If a mobile plant was moved and no data existed for it in the new location, it was also given a zero.

The QBF was based on the concept of incentive and disincentive as currently in place in our standard specifications. The Standard specifications give incentives and disincentives according to three metrics in place density, gradation, and oil content. It was determined that the QBF would include a weighted average of all these factors in order to provide the most representative example of overall quality for a given supplier.

Project Development

Prior to bid opening, each contractor had to submit an e-mail designating the supplier they would use for SMA to be considered responsive. Each bid was opened and the calculations to include the QBF were

made by the Quality Department and checked by Construction Department representatives. There were two bidders for each project. The results for each project are included in Table 2 and Table 3 below.

Table 2

Asphalt Quality Factor Bid Evaluation
PIN 13355
February 9, 2016

Contractor Name	Proposed Supplier	Quality Bid Factor	SMA Quantity Bid	Total to be added	Bid Total "P + T" Section	Bid Total "P +T + Q" Section	Rank
From Bid	*From Email*	*From QBF Table*	*From Engr. Est.*	*Calculated*	*From Bid*	*Calculated*	*Calculated*
Western Rock	Western Rock @ Ft. Pierce	$7.05	11,043	$77,853.15	$1,500,981.00	$1,578,834.15	1
Sunroc	Sunroc @ Ft. Pierce	$5.57	11,043	$61,509.51	$1,677,877.91	$1,739.387.42	2

Table 3

Asphalt Quality Factor Bid Evaluation
PIN 12510
March 15, 2016

Contractor Name	Proposed Supplier	Quality Bid Factor	SMA Quantity Bid	Total to be added	Bid Total "P + T" Section	Bid Total "P +T + Q" Section	Rank
From Bid	*From Email*	*From QBF Table*	*From Engr. Est.*	*Calculated*	*From Bid*	*Calculated*	*Calculated*
Staker & Parsons Cos DBA Nielson Cos	Nielson Construction Portable Plant	$5.00	19, 580	$97,900.00	$3,531,108.10	$3,629,008.10	1
Kilgore Companies, a Delaware LLC	LeGrande – Portable Cedar Rapids Plant	$5.00	19, 580	$97,900.00	$3,720,697.85	$3,818,597.85	2

As can be seen in Table 2, the supplier with a lower QBF did reduce his bid price. This was probably done in response to his competitor having an advantage. The QBF was not enough to overcome the difference in un-factored bids and resulted in Western Rock winning the work. By the time the second project had gone to bid, contractors knew more of how the QBF worked and what to expect. For the two responsive bidders on that project the QBFs were equal. This is due to the fact that portable plants were used and in the absence of data to determine a QBF, each received a QBF of 5 as discussed in the project specifications.

After project completion, the testing data collected during the project was evaluated and a post-project QBF was determined for each contractor. These are provided in Tables 4 and 5 below.

Table 4

PIN 13355
SMA – Asphalt Quality Factor Table
July 2016

Asphalt Mix Plant	Q Factor
Western Rock @ Ft. Pierce	7.05

Table 5

PIN 12510

SMA – Asphalt Quality Factor Table

July 2016

Asphalt Mix Plant	Q Factor
Green River Hot Plant	5.00

It can be seen from Table 4 that the suppliers QBF for the project performed under SEP-14 improved from 7.05 to 5.57. The factor for the other project remained constant at 5.00 (Table 5). It is important to note that the Mix Plant shown in Table 5 is the same plant that was designated in the pre-bid meeting. The plant was moved to be closer to the work and as a result had a new name. The fact that the QBF improved or stayed constant is encouraging and seems to support the idea that basing future opportunities on past performance warrants further investigation.

Industry Reaction

It was very evident at each pre-bid meeting that the QBF and the concept that past performance will have an effect on the ability to win future work had a major impact on the contracting community. Numerous comments were made at the pre-bid meetings stating that there had been major efforts on quality in the last year and that the previous years should not be considered. The Department told the contracting community that if this concept was to move forward, new data would start to be collected and QBFs would be determined from this data. This seemed to alleviate fears on unfair treatment and foster a general acceptance of the new concept.

The quality department met with representatives from the local chapter to the Association of General Contractors (AGC) to gain their perspective on the QBF after both projects had completed construction. The representatives felt that our specification was already very strict and that the contracting community is already sufficiently motivated to produce a quality project. They also felt that the QBF would unnecessarily complicate the bidding environment. Further they mentioned that they would review projects much more closely and would likely not bid on projects that had the potential of impacting their QBF. There are always projects that have difficulties inherent in them and these may end up with less competition in the bidding environment because of the potential of having a contractor's QBF impacted.

Lessons Learned

Conversations with the Resident Engineers (RE) on the projects revealed that they did see an increase in quality and in the "willingness" to work out issues. One RE went on to mention that work by the same contractor on other projects has improved. It is felt by a number of department personnel that the amount of the QBF was not sufficient to have the desired effect on the bid outcome. The amount should be reviewed and modified as necessary.

Future Steps

If the Department decides to further investigate the QBF the following are some options and issues that have been discussed.

For future phases of this concept the definition of "supplier" and "plant" must be fine-tuned. The "loop hole" of a portable plant being relocated or a supplier without data being given a null or zero factor was possibly exploited during the second project and could feasibly be used in the future to offset a supplier with poor quality data.

The amount of impact the QBF has needs to be reviewed and modified. The amount the factor contributes to the bid of a contractor with a history of less quality does not currently seem to be enough to

overcome that of a higher quality one to make much of a difference. This becomes even more of an issue as the difference between contractors QBFs become less numerically. Large differences in quality resulting in large differences in QBFs will, of course, result in more competitive advantage. The concept of QBFs for multiple materials and bid items was discussed, but this would be more difficult because some incentives are given for items of work performed by the contractor and some by the supplier. This would also result in numerous factors that need to be tracked and calculated.

In light of the AGCs comments the concept of awarding suppliers with different levels of quality and advertising it has been suggested. Currently the Department does this with pre-cast suppliers with good results. The pre-cast suppliers are awarded with Gold or Silver class suppliers and that information is listed on our website next to their information and a qualified suppler. They are also awarded a plaque on an annual basis if they are successful in gaining either Gold or Silver class. It is felt that the prestige of being awarded might be sufficient to produce the desired extra effort in the area of product quality.

Appendix

PROJECT #
PIN #

SECTION 00120M

BIDDING REQUIREMENTS AND CONDITIONS

Add Article 1.17, paragraph C

C. Submit an e-mail to cmccuistion@utah.gov designating the Stone Matrix Asphalt (SMA) supplier and proposed plant to use on the project. The Department considers a proposal non-responsive if this e-mail has not been received before 12:00 PM on the date set for receiving proposals.

SPECIAL PROVISION

PROJECT #
PIN #

SECTION 00223S

ASPHALT QUALITY FACTOR

Add Section 00223

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures for bidding utilizing the Asphalt Quality Factor.
   1. This factor will be used to adjust Stone Matrix Asphalt (SMA) material unit prices for award determination only.
   2. This factor is being implemented to encourage supplier compliance to contractual requirements and increase the quality of SMA materials placed in Utah Department of Transportation projects.

B. Description of how the Asphalt Quality Factor affects SMA material pricing for award determination only.
   1. Refer to Section 00515M for information regarding determination of the low bidder.
   2. This factor affects asphalt material bid item prices and is used for determination of the low bidder.
   3. Refer to project special provision Section 00120M for information regarding how to designate which supplier will be used for bidding purposes.

1.2 RELATED SECTIONS

A. Section 00515M: Contract Award and Execution

B. Section 00555: Prosecution and Progress

C. Section 00250S: Prebid Conference
   1. Inclusion of Section 00222S requires a mandatory Prebid Conference.

D. Section 02744S: Stone Matrix Asphalt (SMA)

E. Section 00120: Bidding Requirements and Conditions

1.3 REFERENCES Not Used

1.4 DEFINITIONS

A. Supplier – Refers to a Department Asphalt Mix Plant Qualified Supplier.

1.5 SUBMITTALS Not Used

1.6 ASPHALT QUALITY FACTOR

A. The Department will determine the PT(average) as follows.
   1. The PT(average) is an average of a material supplier's past performance determined by quality testing over the last three years.
   2. The supplier's PTs for gradation, asphalt binder content, and density, as determined from Section 02744, for the period of 9/30/2012 to 9/30/2015 were utilized to determine a weighted average of the three factors by tonnage produced (PT(average)).
   3. A supplier that does not have previous history of placing SMA with the Department will be given a PT(average) of 90.

C. For award purposes only, the Asphalt Quality Factor will be added to the per ton price for the quantities of SMA according to Table 1.

Table 1

Asphalt Quality Factor Determination

PT(average)	Asphalt Quality Factor
>99	$ -
96-99	$ 1.67
92-95	$ 3.00
88-91	$ 5.00
84-87	$ 5.57
80-83	$ 6.32
76-79	$ 7.05
72-75	$ 7.80
68-71	$ 8.52
64-67	$ 9.25
60-63	$ 10.00
<60	$ 10.00

D. The Department has prepared the following SMA supplier list with associated quality factors (Table 2).
   1. Submittal of a bid is considered acceptance of the provided Asphalt Quality Factor.

Table 2
Region 4
SMA - Asphalt Quality Factor Table
January 2016

Asphalt Mix Plant	Q Factor
Granite Portable	5.57
Granite Construction	5.00
LeGrand Johnson @ Moab Plant	5.57
Nielson Construction	5.57
Staker Parson Centerfield	3.00
Staker Parsons Portable Plant	3.00
Staker & Parson Keigley Hot Plant	5.57
Western Rock Portable	5.00
Western Rock @ Cedar City	6.32
Western Rock @ Ft. Pierce	7.05
W.W. Clyde Portable	8.52
WWClyde at Cedar Plant	5.00
Sunroc at Ft. Pierce	5.57

E. An existing supplier, if recertified, will utilize the past performance data associated with the previous entity.

F. After award, the Stone Matrix Asphalt (SMA) supplier and proposed supplier must be utilized through the duration of the project. A supplier with an Asphalt Quality Factor equal to or less than that proposed may be used if approved by the Engineer.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SPECIAL PROVISION

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SECTION 00515M

CONTRACT AWARD AND EXECUTION

Delete Article 1.6 and replace with the following:

1.6 PROPOSAL CONSIDERATION

A. This project uses a price + time or price + time + asphalt quality process. These processes provide:
   1. For the determination of the low bidder based on the price of construction plus the costs associated with contract time and asphalt quality.
   2. An incentive/disincentive for completion of project time-related milestones based on durations established by Contractor bid as applicable.
   3. A factor based on asphalt quality as described in Section 00223S.

B. The Department publicly opens properly executed proposals using the current version of the Electronic Bid System (EBS) to compare bids on the basis of the summation of the products of the quantities and the unit bid prices.
   1. The Department makes the results of the comparisons available to the public.
   2. The unit bid prices govern if a discrepancy exists between unit bid prices and extensions.

C. The Department reserves the right to reject any or all proposals, waive technicalities, or advertise for new proposals.

D. The bidder can request withdrawal of a bid after bid opening by:
   1. Submitting to the Director for Construction and Materials a notarized affidavit within 24 hours after bid opening declaring a clerical or mathematical error in bid preparation.
   2. Submitting accompanying declaration with original work sheets used in bid preparation.
   3. Describing specific errors in detail.
   4. Verifying that error has a significant monetary effect in the amount of 3 percent of the bid or greater.

E. The bidder may not request bid withdrawal for judgmental errors.

June 30, 2015

SPECIAL PROVISION

PROJECT #
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SECTION 02744S

STONE MATRIX ASPHALT (SMA)

Add Section 02744:

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for laying and compacting a surface course of one or more layers of fiber stabilized SMA comprised of aggregate, asphalt binder, lime, and other additives.

1.2 RELATED SECTIONS

A. Section 01452: Profilograph and Pavement Smoothness

B. Section 01456: Materials Dispute Resolution

C. Section 02741: Hot Mix Asphalt

D. Section 02742S: Project Specific Surfacing Requirements

E. Section 02745: Asphalt Material

F. Section 02746: Hydrated Lime

G. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO M 231: Weighing Devices used in the Testing of Materials

B. AASHTO M 325 – 08: Stone Matrix Asphalt (SMA)

C. AASHTO R 46: Designing Stone Matrix Asphalt

D. AASHTO R 28: Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)

E. AASHTO T 11: Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing

F. AASHTO T 19: Unit Weights and Voids in Aggregate

G. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

H. AASHTO T 30: Mechanical Analysis of Extracted Aggregate

I. AASTHO T 85: Specific Gravity and Absorption of Coarse Aggregate

J. AASHTO T 89: Determining the Liquid Limit of Soils

K. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

L. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

M. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

N. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate

O. AASHTO T 166: Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated-Surface Dry Specimens

P. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

Q. AASHTO T 195: Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures

R. AASHTO T 209: Maximum Specific Gravity of Bituminous Paving Mixtures

S. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt (RTFO)

T. AASHTO T 255: Total Moisture Content of Aggregate by Drying

U. AASHTO T 304: Uncompacted Void Content of Fine Aggregate

V. AASHTO T 305: Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures

W. AASHTO T 308: Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method

X. AASHTO T 312: Method for Preparing and Determining the Density of Hot-Mix Asphalt (SMA) Specimens by Means of the Superpave Gyratory Compactor

Y. AASHTO T 313: Determining the Flexural Creep Stiffness of an Asphalt Binder Using the Bending Beam Rheometer (BBR)

Z. AASHTO T 315: Determining the Rheological Properties of an Asphalt Binder Using the Dynamic Shear Rheometer (DSR)

AA. AASHTO T 335: Determining the Percentage of Fractured Particles in Coarse Aggregate

BB. ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation

CC. ASTM D 3549: Thickness or Height of Compacted Bituminous Paving Mixture Specimens

DD. ASTM D 4402: Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus

EE. ASTM D 4753: Evaluating, Selecting, and Specifying Balances and Scales for use in Soil and Rock Testing

FF. NAPA Quality Improvement Series Publication 122: Designing and Constructing SMA Mixtures – State-of-the-Practice

GG. UDOT Materials Manual of Instruction, Part 8, Sections 960, 984, and 985

HH. UDOT Minimum Sampling and Testing Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Mix design at least 10 working days before paving according to the UDOT Materials Manual of Instruction 960.

B. Verification that hydrated lime meets the requirements of Section 02746.

C. Verification that asphalt binder meets the requirements of Section 02745.

D. Changes in job mix design
   1. Submit a written request for any proposed change in the job-mix gradation.
      a. Allow at least 12 hours for approval before incorporating a minor target change into production.
      b. Allow at least six working days for verification and approval of any other change.
   2. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements. Department acceptance test results or Contractor QC test data or both are acceptable.
   3. Submit samples according to the UDOT Materials Manual of Instruction 960 for a volumetric mix design verification for anything other than approved minor target changes, as defined in Section 02741. This includes changes in the aggregate source, asphalt binder source, or asphalt binder grade.

E. Corrective action plan according to Section 02741 and this Section, Article 1.6 paragraph G2.

F. Refer to this Section, Article 1.7 paragraphs B and C for laboratory correlation submittals.

G. Refer to this Section, Article 2.4 paragraph B for volumetric mix design.

H. Refer to this Section, Article 2.4 paragraph H for sample submittals.

I. Refer to this Section, Article 2.6 for contractor initiated changes in stone matrix asphalt mix design.

1.6 ACCEPTANCE

A. A lot equals the number of tons of SMA placed during each production day. The Department will:
   1. Divide each lot into four sublots based on the scheduled production day.

2. Take random samples from the plant (UDOT Materials Manual of Instruction Part 8-984: Sampling Methods), and determine random numbers/locations from a random numbers table or generator. (UDOT Materials Manual of Instruction Part 8-981: Random Sampling)
    a. Dispute Resolution Sampling – Increase sample sizes to accommodate paired-T testing. Split additional material with contractor designated lab and continue until testing discrepancies between labs are identified and resolved as defined in this Section, Article 1.7 (UDOT Materials Manual of Instruction, Part 8: Chapter 4, Appendix C).
3. Inform the Contractor of the time and place for the sample not more than 15 minutes before sampling.
4. Conduct the following tests:
    a. Asphalt Binder Content: One per sublot using ignition oven. AASHTO T 308
    b. Aggregate gradation: One test per sublot on the residue of the ignition oven tests. AASHTO T 30
    c. VMA: 3 tests per lot. AASHTO T 312
    d. Maximum Specific Gravity: Three per lot in conjunction with VMA determination. AASHTO T 209
    e. VCA_{DRC}: One test per lot on un-limed cold-feed samples taken at the same time as mix samples for the first week of production or as directed by the Resident Engineer. AASHTO R 46
    f. VCA_{MIX}: Taken from daily Gmb average of lot acceptance pucks used in conjunction with VCA_{DRC}
5. Use the average of the Maximum Specific Gravity tests for each lot to determine density of cores.
6. Determine thickness of cores according to ASTM D 3549.
7. Add the lot to the previous day's production if the minimum number of samples cannot be obtained for the final day's production and evaluate with the appropriate sample size.
8. Add the lot to the next day's production if the minimum number of samples cannot be obtained and evaluate with the appropriate sample size.

B. The Engineer conducts the acceptance testing for asphalt binder content (AASHTO T 308), gradation (AASHTO T 30), VMA (AASHTO T 312), density (AASHTO T 166), and thickness (ASTM D 3549). The Engineer may elect to accept material based on visual inspection for small projects with plan quantities of SMA less than 500 tons or for work such as utility work or traffic signals.

1. The Engineer reserves the option of conducting any acceptance tests necessary to determine the material and workmanship meets the project requirements when acceptance is intended to be based on visual inspection.
2. Acceptance is limited to material being furnished from sources found satisfactory under normal sampling and testing procedures.
3. Material that is visually accepted will be documented daily using the "Visual Inspection Report."

C. Obtain samples for density and thickness.

1. The Engineer marks coring locations for in-place density and joint density cores. Obtain two cores per sublot, randomly as instructed and in the presence of the Engineer within two days after the pavement is placed. (UDOT Materials Manual of Instruction Part 8- 981: Random Sampling, UDOT Materials Manual of Instruction Part 8-984: Sampling Methods).
2. Move transversely to a point one foot from the edge of the pavement if the random location for cores falls within one foot of the edge of the overall pavement section (outer part of shoulders).
3. Fill core holes with SMA and compact.
4. The Department witnesses the coring operation and takes possession of the cores immediately and begins testing the cores within 24 hours for density acceptance.

D. Density: The in-place target density for determining acceptance and incentive/disincentive is 94.0 percent of Maximum Specific Gravity density, AASHTO T 209. In-place density is based on cores obtained in paragraph C and tested according to AASHTO T 166.

1. Use Table 4 with n=10 to determine PT for density.
2. Asphalt binder content and VMA from lots are combined in order to obtain an appropriate sample size for evaluation. A lot for density determination is defined as the combined production days.

E. Thickness: Base acceptance on the average thickness of a lot. A thickness lot equals a density lot.

1. The same core samples taken for density will be used for thickness verification. ASTM D 3549
2. The Department accepts a lot when:
   a. The average thickness of all sublots is not more than ½ inch greater nor ¼ inch less than the total thickness specified.

b. No individual sublot shows a deficient thickness of more than ⅜ inch.
c. Place additional materials where lots or sublots are deficient in thickness. The minimum depth of compacted surface for correcting deficient thickness is 3 times the nominal maximum aggregate size.
d. The Department pays for the quantity of additional material to bring the surface to design grade.
e. The Department does not pay for the quantity of additional material above the design grade due to the minimum paving thickness required.
f. The Engineer may allow excess thickness to remain in place or may order its removal. Remove and replace the entire depth of the course if it is necessary to remove portions of the course.
g. The Department pays for 50 percent of the mix in excess of the +½ inch tolerance when excess thickness is allowed to remain in place.

F. Smoothness Tests
1. Determine acceptance and correct according to Section 01452.

G. Cease production when any two out of three consecutive lots meet one of the following:
1. Criteria
a. A net disincentive
b. Air voids at N_{des} averaged for each lot are less than 2.5 or greater than 4.5 percent
c. VMA is less than 17.0 percent
d. Refer to Table 2 of this section.
2. Submit a corrective action plan to the Engineer before production continues indicating the changes in production procedures that will be implemented to correct the deficiencies.

H. The Department pays incentive/disincentive on the assessed quantities of SMA mix according to Table 1. Base the incentive/disincentive on Percent Within Limit (PT) computation using Tables 3, 4, and 5. Use lowest single value combined for gradation (each of the sieves) and asphalt binder content for calculating the gradation/asphalt binder content incentive/disincentive in Table 1.
1. Meet PT of 88 or greater for density for eligibility for incentive in gradation/asphalt binder content.
2. Meet control requirements of Table 2 for VMA/VCA.
a. The Department does not pay incentive for gradation/asphalt binder content if the contractor does not meet the conditions of “continue paving” action from table 2.

3. Incentives/disincentives do not apply to material accepted on the basis of visual inspection.

I. The Department rejects the lot if the PT for any individual measurement is less than 60 percent. The disincentive for the lot is $35.00/Ton deduction if the rejected lot is allowed to remain in place.

J. The Engineer may, in concurrence with the Contractor, choose to combine production from several days to form a single lot to reduce over-testing of small quantity production days such as ramps or bridgework.

K. Design a mix with the minimum binder content as found in Section 02742S, as a percentage of the total mix.

Table 1
Incentive/Disincentive for Asphalt Binder Content, and Density

PT Based on Min. Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	1.50
96-99	1.00
92-95	0.60
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
<60	Reject

Incentive/Disincentive for Gradation

PT Based on Min. Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	1.50
96-99	1.00
92-95	0.60
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
56-59	-5.00
52-55	-10.00
<52	Reject

Table 2
Production Control for VMA/VCA_{MIX}

VMA Average Value, x, (%) Minimum of three Samples	**VCA_{MIX} Job – Mix Design**	**Action**
X ≥ 16.5 and X ≤18.5	$VCA_{MIX} < VCA_{DRC}$	Continue Paving
X < 16.5 or X >18.5	$0 < VCA_{MIX} - VCA_{DRC} \leq 0.5\%$	Shut Down Production until a corrective action plan is approved.
X < 15.5 or X >19.5	$0.5 < VCA_{MIX} - VCA_{DRC}$	Shut Down Production and resubmit Mix Design

Table 3
Upper and Lower Limit Determination

Parameter	**UL and LL**
$^3/_8$" sieve for ½" SMA	Target Value ± 5.0%
#4 sieve	Target Value ± 4.0%
# 8 sieve	Target Value ± 3.0%
# 50 sieve	Target Value ± 3.0%
# 200 sieve	Target Value ± 2.0%
Asphalt Binder Content	Target Value ± 0.3%
Density	Lower Limit: Target Value - 2.0% Upper Limit: Target Value + 3.0%

Table 4
Quality Index Values for Estimating Percent Within Limits

PU/PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12.	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	.0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.23

Table 4 Continued

PU/PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
58	0.29	0.24	0.23	0.22	0.21	0.21	0.21	0.21	0.21	0.20
57	0.25	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.16	0.16	0.16	0.15	0.15
55	0.18	0.15	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Enter table in the appropriate sample size column and round down to the nearest value.

Table 5

Definitions, Abbreviations, and Formulas for Acceptance

Term	Explanation
Target Value (TV)	The target values for gradation and asphalt binder content are given in the CONTRACTOR's mix design. The target value for density is 94.0 percent of maximum (Rice) density.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results, the arithmetic mean.
Standard Deviation (s)	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE, divided by the number of test results minus one. This statement does not limit the methods of calculations of s; other methods that obtain the same value may be used.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 3)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 3)
Upper Quality Index (QU)	QU = (UL - AVE)/s
Lower Quality Index (QL)	QL = (AVE - LL)/s
Percentage of Lot Within UL PU)	Determined by entering Table 4 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL.
Total Percentage of Lot (PL) Within UL and LL (PT)	PT = (PU + PL) - 100
Incentive/Disincentive	Determined by entering Table 1 with PT or PL.

All values for AVE, s, QU, and QL will be calculated to a minimum two decimal place accuracy that will be carried through all further calculations. Rounding to lower accuracy is not allowed.

1.7 LABORATORY CORRELATION

A. Perform the following to be eligible for dispute resolution:
   1. Perform split-sample, paired-T testing with the Department based on project quality control testing using UDOT LQP qualified lab.
      a. Perform split-sample, paired-T analysis on all mix acceptance tests related to volumetric properties and the following background testing:
         1) Maximum Specific Gravity of Mix, AASHTO T 209
         2) Bulk Specific Gravity of Mix, AASHTO T 166

3) Bulk Specific Gravity of Coarse Aggregates, AASHTO T 85

b. Continue until attaining successful Paired-T test results, meeting $\alpha = 0.05$, for a minimum of two consecutive production days (UDOT Materials Manual of Instruction, Part 8: Chapter 4, Appendix C).

c. The engineer may require that all QC testing data be received before disclosure of the QA testing results. This applies to paired-T and all subsequent QA/QC testing data.

B. Submit a detailed report showing tabular summaries of daily test data, paired–T calculations and any corrections made to account for failed comparisons.

C. Submit summary before submitting engineering analysis for dispute resolution.

1.8 DISPUTE RESOLUTION

A. Refer to Section 01456, Materials Dispute Resolution

PART 2 PRODUCTS

1.9 ASPHALT BINDER

A. Refer to Section 02742S, Project Specific Surfacing Requirements.

B. Asphalt Material according to Section 02745.

C. Adhere to UDOT Minimum Sampling and Testing Guide Quality Management Plan 509: Asphalt Binder Quality Management System sampling, testing and handling of Asphalt Binder.

2.2 AGGREGATE

A. Refer to the UDOT Minimum Sampling and Testing Guide for testing frequencies.

B. Use crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.

C. Use the following requirements, including Table 6, to determine the suitability of the aggregate.

1. Coarse aggregates:

a. Retained on No. 4 sieve. AASHTO T 27

2. Fine aggregates:
   a. Clean, hard grained, and angular.
   b. Passing the No. 4 sieve. AASHTO T 27

Table 6
Aggregate Properties - SMA

Test Method	Test No.	Category 1	Category 2
One Fractured Face	AASHTO T 335	100% min.	85% min. (1 inch and ¾ inch), and 90% min. (½ inch and $^{3}/_{8}$ inch)
Two Fractured Face	AASHTO T 335	90% min.	80% min. (1 inch and ¾ inch), and 90% min. (½ inch and $^{3}/_{8}$ inch)
Fine Aggregate Angularity	AASHTO T 304	45 min.	45 min.
Flakiness Index	UDOT MOI (Based on 3/8 inch and above)	25% max.	25% max.
L.A. Wear	AASHTO T 96	28% max.	30% max.
Sand Equivalent	AASHTO T 176 (Pre-wet method)	60 min.	45 min.
Plasticity Index (Does not Apply to Mineral Filler)	AASHTO T 89 and T 90	0 max.	0 max.
Unit Weight	AASHTO T 19	75 lb/cu. ft. min.	75 lb/cu. ft. min.
Soundness (sodium sulfate)	AASHTO T 104	10% max. loss with five cycles	10% max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max	2% max.
Natural Fines	N/A	0 max.	0 max.

Category 1: National Highway System and Truck Routes – Refer to section 02741.
Category 2: All Other Routes

D. Meet gradation requirements in Table 7. (AASHTO T 11, AASHTO T 27)

Table 7
Stone Matrix Asphalt Percent Passing by Mass
(See SMA Mix design for sample calculations)

Sieve Size		½"	3/8"
Control Sieves	**1.5"**		
	1"		
	¾"	100	
	½"	90 - 100	100
	3/8"	45 - 78	90 - 100
	#4	20 - 28	26 - 50
	#8	16 - 24	20 - 28
	#16	13 - 21	13 - 21
	#30	12 - 18	12 - 18
	#50	12 - 15	12 - 15
	#200	8 - 10	8 - 10

2.3 ADDITIVES / STABILIZERS

A. Hydrated Lime: Meet the requirements of Section 02746.

B. Fibers: Made from virgin basalt, diabase, slag, or cellulose treated with a cationic sizing agent to enhance disbursement of the fiber as well as increase adhesion of the fiber surface with the Asphalt binder. This additive will also be used to control drain-down. All fibers will conform to AASHTO M 325 - 08.

1. Mineral Fiber
   a. Dosage rate between 0.3 percent to 0.6 percent, by weight of the total mix.
   b. Average fiber length 0.25 inches, maximum
   c. Average Fiber thickness 0.0002 inches, maximum
   d. Shot content (ASTM C 612)
      Passing No. 60 sieve 90 - 100 percent
      Passing No. 230 sieve 65 - 100 percent

2. Cellulose Fiber
    a. Dosage rate for cellulose is 0.2 percent to 0.4 percent by weight of total mix.
    b. Using Alpine sieve analysis, fiber length of 0.25 inches max. passing the #100 sieve 70 percent (+/- 10 percent).
    c. Using a mesh screen analysis, fibers will pass
        #20 sieve 85 percent (+/- 10 percent)
        #40 sieve 65 percent (+/-10 percent)
        #140 sieve 30 percent (+/-10 percent)
    d. Ash content will be 18 percent (+/- 5 percent)
    e. PH will be 7.5 (+/- 1.0)
    f. Oil absorption will be 5.0 (+/- 1.0 percent)
    g. Moisture content will be <5 percent by weight of cellulose

C. Mineral Filler:
Consists of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash, or other suitable mineral matter. Free flowing and free of lumps.
1. Meet the following

No. 30	100 percent, Passing
No. 50	95 - 100 percent, Passing
No. 200	55 - 100 percent, Passing
No. 450	40 percent, Maximum

2. No organic Impurities
3. Plasticity Index < 4 (not appropriate for hydrated lime and hydraulic cement)

2.4 JOB-MIX DESIGN

A. Perform Stone Matrix Asphalt Mix Design according to AASHTO R 46, with the following:
1. Use a UDOT Transportation Technician Qualification Program qualified laboratory for HMA.
2. Use a Superpave Gyratory Compactor approved in accordance with UDOT Materials Manual of Instruction Part 8-961: Guidelines for Superpave Gyratory Compactor Protocol.
3. Meet all mix design requirements in Table 8 and Table 9 for the selected target gradation.
4. Refer to NAPA Quality Improvement Series Publication 122: Designing and Constructing SMA Mixtures – State-of-the-practice for additional information.

B. Submit the Volumetric Mix Design data for verification at least 10 working days before beginning paving. Do not begin paving until verification is complete.

1. Include all information regarding selection of design aggregate structure showing the target values of percent passing on all sieves listed in Table 7, and the design asphalt binder content.
2. Provide information that aggregate proposed for use meet the requirements of Table 6.
3. Supply QC data for target job mix gradation selection. Use those target values for price adjustments.
4. Run 4 sets of 2 Gyratory specimens at the design asphalt binder content to verify the optimum asphalt and all other design requirements after the design is complete.

C. Moisture Susceptibility

1. Incorporate hydrated lime into all volumetric designs. Use 1 percent, minimum, for Method A and 1½ percent, minimum for Method B (Section 02746).
   a. Prepare laboratory samples in a manner similar to field production. Construct lab samples similarly by adding hydrated lime to aggregate and drying sample before the incorporation of mineral filler and fiber if hydrated lime is to be introduced to the mix before adding mineral filler and fibers at the plant.

D. Designate asphalt binder supplier.

E. Use gyratory mixing and compaction temperatures supplied by the Engineer.

F. The Department Region Materials Lab verifies the Stone Matrix Asphalt Mix Design.

G. Comply with the following requirements for Stone Matrix Asphalt Mix Design.

Table 8

Stone Matrix Asphalt Mix Design -
SMA Compaction Parameters

Design Gyrations	**% of G_{mm}***
100	96.5

* G_{mm}: Maximum specific gravity of Mix.

Table 9
Stone Matrix Asphalt Mix Design Requirements

SMA design mixing and compaction temperatures	Provided by the Engineer
Voids in Mineral Aggregate (VMA) at N_{design} AASHTO R 46, using G_{sb}. Equation based on percent of total mix.	17.0 percent minimum
Voids In Course Aggregate (Stone Matrix Asphalt Mix Design)	$VCA_{MIX} < VCA_{DRC}$
Hamburg Wheel Tracker	< 10.00 mm at 20,000 Cycles.

H. Prepare and submit 2 sets (5 samples each) of ignition oven calibration samples.
   1. Department uses these samples to determine the correction factors for the Region and Field lab ignition oven.
   2. Submit samples a minimum of three working days before paving.

I. Mortar is the dust (minus #200 material) from the mix combined with the asphalt binder and fiber. Mortar must meet the following and this Section, Article 2.5:
   1. Unaged DSR G*/sin delta $\geq$ 5 kPa
   2. RTFO aged DSR G*/sin delta $\geq$ 11 kPa
   3. PAV aged BBR Stiffness $\leq$ 1500 Mpa

J. Meet Draindown of 0.30 percent or less according to AASHTO T 305 - Determination of Draindown Characteristics in Uncompacted Bituminous Mixtures.

K. Evaluate the mortar properties of the best trial gradation using the procedure outlined in this Section, Article 2.5.

2.5 TESTING OF STONE MATRIX ASPHALT MORTARS

A. Scope
   1. Blending and specimen preparation of stone matrix asphalt (SMA) mortars to predetermine the physical characteristics of mortars used in SMA.

B. Apparatus for Preparation
   1. Balance: 2-kg capacity, sensitive to 0.1 g. Conform to the requirement of ASTM D 4753, class GP2 or AASHTO M 231, class G2.

2. Oven: capable of maintaining the needed temperature within ± 6 degrees C.
3. Hot plate: at least 700-W capacity with adjustable temperature control.
4. Sample containers: capable of holding at least 100 g of filler and 200 g of liquid asphalt binder. A seamless ointment tin is recommended.
5. Mixing tools: wooden tongue depressors, spatulas, and spoons.
6. Insulated gloves: for handling hot samples and equipment.

C. Sample Preparation Procedure
1. Dry respective aggregate fractions containing material passing the No. 200 sieve to constant weight (mass) at 110 ± 6 degrees C. Dry sieve these aggregates and collect the dust from each aggregate. Blend the fillers to meet the percent by volume on the job-mix-formula. An example of how to blend by volume can be found in AASHTO R 46.
2. Place a quart can of pre-aged liquid asphalt binder into an oven set at 165 ± 6 degrees C. Refer to this Section, Article 2.5 paragraph D.
3. Weigh 100 ± 0.1 g of minus No. 200 blended filler into the seamless ointment tin and place into a 175 ± 6 degrees C oven. The material should remain in the oven for at least 30 minutes.
4. Weigh into the filler the proper amount of liquid asphalt binder to the nearest 0.1 g.
5. Place the tin on the hot plate and hand mix with a spatula. Slowly add the proper amount of fiber (weighed to the nearest 0.1 g) and continue mixing until the mortar is homogeneous.
6. Use loose fiber of the same type to create the mortar or use a high-shear mixer when asphalt-fiber pellets are used. Asphalt-pellet fibers will not blend into the filler under low-shear mixing conditions.

D. Testing of Mortars
1. Age the liquid asphalt binder following AASHTO T 240, AASHTO R 28, or both when performing Performance Grade Asphalt Binder testing of the mortar and prior to blending with fillers and fibers.
2. Follow ASTM D 4402 except that readings should be taken as soon as the temperature stabilizes because the fillers will sink to the bottom over time.
3. Follow AASHTO T 315 except use a higher preheat temperature of 60 degrees C. This is to insure that the specimen will adhere strongly to both plates.
4. Follow AASHTO T 313 except, using aluminum molds:
   a. Place the mold over the corner of the warm hot plate so that the mold is on the hot plate and the rubber O-rings are not.

b. Gently tamp the mortar into the mold using a wooden tongue depressor. A light coating of release agent (glycerin and talc) will assist in this procedure.
c. Repeat step b until the mold is full of mortar.
d. Continue according to AASHTO T 313.

E. Reporting
1. Report as required in this Section, Article 2.4 A.

2.6 CONTRACTOR INITIATED CHANGES IN STONE MATRIX ASPHALT MIX DESIGN

A. Submit all requests in writing to the Engineer at least 12 hours before incorporating changes into production.

B. Submit a field volumetric mix design for all target changes.
1. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements. Department acceptance or Contractor QC testing data is acceptable.
2. Field volumetric mix design verification consists of three sets of two gyratory specimens run at the new target gradation, asphalt binder content, or both. The Department's previous acceptance tests are acceptable for field verification.
3. The Engineer, in consultation with the Region Materials Engineer, provides written concurrence of the verified field volumetric mix design if the field volumetric mix design meets the volumetric requirements.
4. Submit a new laboratory volumetric mix design from a laboratory qualified by UDOT Central Materials if the field volumetric mix verification does not meet the volumetric requirements. Allow at least 7 working days for verification.
5. The Department may allow up to two minor target changes per project without penalty to the contractor. The Department charges $1,000 for each additional minor target change.
6. The Department performs up to two volumetric mix design verifications at no cost to the Contractor. The Department charges $3,000 for each additional laboratory or field verification required including all laboratory or field volumetric mix design verifications required due to contractor initiated target changes.

C. Submit a new laboratory volumetric mix design if changes occur in the aggregate source, asphalt binder source, or grade.

D. Do not make changes to production mix until request is reviewed and verified by the RE in consultation with the RME.

PART 3 EXECUTION

3.1 ADDING HYDRATED LIME

A. Method A, Lime Slurry or Method B, Lime Slurry Marination: Refer to Section 02746.

1.10 SMA

A. Dry aggregate to an average moisture content of not more than 0.2 percent by weight. Use AASHTO T 255 for verification. Adjust burners to avoid damage or soot contamination of the aggregate.

B. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.
- Use AASHTO T 195 for verification.
- Discontinue operation and make necessary corrections if material is not properly coated.

C. Maintain temperature of the SMA between identified compaction limits as defined on Volumetric Mix Design Verification Letter.
- Department rejects materials heated over the identified limits.
- Remove all material rejected by the Department for overheating.

1.11 SMA PLANT

A. Provide:
- Positive means to determine the moisture content of aggregate on a daily basis.
- Positive means to sample all material components.
- Sensors to measure the temperature of the SMA at discharge.
- The ability to maintain discharge temperature of the mix according to the mix design.

B. Asphalt Binder Storage Tanks:
- Provide calibrated tanks so the quantity of material remaining in the tank can be determined at any time.
- Provide a positive means of sampling the asphalt binder from the tanks.

C. Fiber Supply System:
- Provide separate proportioning device interlocked with the aggregate feed or weigh system to maintain correct proportions and uniform distribution for all rates of production and batch sizes.

- Provide flow indicators or sensing devices interlocked with plant controls.
- Uniformly distribute fibers in aggregate before injecting the asphalt into the mixer. (8 to 12 seconds).
- Do not allow the fiber to become entrained in the exhaust system of the plant.

D. Mineral Filler Supply System:
- Provide separate proportioning device interlocked with the aggregate feed or weigh system to maintain correct proportions and uniform distribution for all rates of production and batch sizes.
- Provide flow indicators or sensing devices interlocked with plant controls.
- Uniformly distribute filler in aggregate before injecting asphalt into the mixer.
- Do not allow the filler to become entrained in the exhaust system of the plant.

1.12 SURFACE PREPARATION

A. Locate, reference, and protect all utility covers, monuments, curb and gutter, and other components affected by the paving operations.

B. Remove all moisture, dirt, sand, leaves, and other objectionable material from the prepared surface before placing the mix.

C. Allow sufficient cure time for prime coat/tack coat before placing SMA. Refer to Section 02748.

1.13 SURFACE PLACEMENT

A. Provide a 3:1 (horizontal to vertical) sloped edge adjacent to the next lane to be paved when full-width or echelon paving is impractical and more than one pass is required.

B. Construct the longitudinal joint to within 6 inches of the lane lines or at the center of the lane at the direction of the Engineer, but never in a wheel path. All long joints will be cored and tested for compaction according to the specification if the lift is 2 or more inches thick. Verify all edges of the adjacent areas to through lanes have straight and uniform longitudinal lines and neat vertical edges.

C. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.

D. Do not allow construction vehicles, general traffic, or rollers to pass over the uncompacted end or edge of freshly placed mix until the mat temperature drops to a point where damage or differential compaction will not occur.

E. Taper the end of a course subjected to traffic at approximately 50:1 (horizontal to vertical).
- Make a transverse joint by saw or wheel cutting and removing the portion of the pass that contains the tapered end.
- Tack the contact surfaces before fresh mix is placed against the compacted mix.

F. Use a Material Transfer Vehicle (MTV) to apply all courses of SMA. Use an MTV that internally performs additional mixing of the SMA mix and then deposits material into the paver at a uniform temperature and consistency.

1.14 COMPACTION

A. Use a small compactor or vibratory roller in addition to normal rolling at structures.

B. Operate in a transverse direction next to the back wall and approach slab.

C. Use aggressive rolling techniques to minimize risk of under-compacted SMA courses. Use a 9 ton (minimum) roller.

D. Roll surface immediately after placement staying as close as possible to the lay-down machine and assuring proper mix design placement temperatures. Minimize the use of vibratory rollers.

E. Do not use Pneumatic tire rollers.

F. Discontinue vibration if aggregate breakdown occurs or if bleeding occurs. The material has been excessively vibrated if the proper surface texture is lost.

1.15 LIMITATIONS

A. Do not place SMA on frozen base or subbase.

B. Use a UDOT approved release agent for all equipment and hand tools used to mix, haul, and place the SMA. Contact the Engineer for approved product.

C. Do not place SMA during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.

D. Place SMA from April 15, to October 15, and when the air temperature in the shade and the roadway surface temperature are above 50 degrees F.
   - The Department determines if it is feasible to place SMA outside the above limits. Obtain written approval from the Engineer before paving from October 15, to April 15.

END OF SECTION