

## SECTION 02786

# OPEN-GRADED SURFACE COURSE (OGSC)

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Materials and procedures for constructing OGSC.

#### 1.2 RELATED SECTIONS

- A. Section 01452: Profilograph and Pavement Smoothness
- B. Section 02741: Hot Mix Asphalt (HMA)
- C. Section 02745: Asphalt Material
- D. Section 02746: Hydrated Lime
- E. Section 02748: Prime Coat/Tack Coat

#### 1.3 REFERENCES

- A. AASHTO T 11: Materials Finer Than 75  $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing
- B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- C. AASHTO T 30: Mechanical Analysis of Extracted Aggregate
- D. AASHTO T 89: Determining the Liquid Limit of Soils
- E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- F. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
- G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

- H. AASHTO T 112: Clay Lumps and Friable Particle in Aggregate
- I. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- J. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
- K. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
- L. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- M. AASHTO T 308: Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method
- N. ASTM D 979: Sampling Bituminous Paving Mixtures
- O. ASTM D 3042: Standard Test for Insoluble Residue in Carbonate Aggregate
- P. ASTM D 3665: Random Sampling of Construction Materials
- Q. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- R. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate
- S. UDOT Quality Management Plan
- T. UDOT Materials Manual of Instruction
- U. UDOT Minimum Sample and Testing Guide

#### **1.4 ACCEPTANCE**

- A. A lot equals the number of tons placed during each production day. When daily production rates are anticipated at less than 900 tons per production day, lots may be increased to equal the number of tons placed during up to three production days as agreed upon in advance by both the Contractor and the Engineer.
- B. Submit an engineering analysis within one week, if requesting a rejected lot remain in place.
  - 1. Include in the analysis: Data and engineering principles that indicate why the pavement should remain in place.

2. The Engineer, Region Materials Engineer, and Region Construction Engineer review the analysis for acceptance, denial, or revision within three working days.
3. If the request is denied, remove the rejected material from the project within 72 hours and replace it with an acceptable material.
4. If rotomilling is required, agree on removal time period.
5. Department deducts \$15.00 per ton if a rejected lot is allowed to remain in place.

C. Binder Content and Gradation

1. Engineer takes four random samples per lot at the plant according to UDOT Materials Manual of Instruction Part 8 - 894. ASTM D 979, ASTM D 3665.
2. If only three samples can be taken on the production day for reasons beyond the Contractor's control; compute incentive/disincentive from the three random samples rather than four.
3. Add the lot to the next day's production if four random samples cannot be taken. Evaluate pay adjustment with the appropriate sample size.
4. Add the lot to the previous day's production for the last day's production if four random samples cannot be taken. Evaluate with the appropriate sample size.
5. Obtain the binder content from the ignition oven test. AASHTO T 308.
6. Compute Incentive/Disincentive for binder content per lot based on Table 1 using the single test result with the largest deviation from the target.

<b>Table 1</b>	
<b>Binder Content</b>	<b>Pay Adjustment in \$/ton OGSC</b>
Within $\pm 0.30\%$ of target	+1.00
Between $\pm 0.31\%$ and $\pm 0.45\%$ of target	0.00
Between $\pm 0.46\%$ $\pm 0.60\%$ of target	-2.00
Greater than $\pm 0.61\%$	Reject

7. Engineer conducts aggregate gradations tests per lot on the residue of the ignition oven test. AASHTO T 30.
8. Incentive/Disincentive for gradation is based on Percent Within Limits computation using Table 2, 3, 4, and 5.
9. The Department will reject the lot if the Percent Within Limits is less than 60 percent.

<b>Table 2</b>	
<b>Gradation Upper and Lower Limit Determination</b>	
<b>Parameter</b>	<b>UL and LL</b>
3/8" sieve	Target Value $\pm$ 6.0 percent
# 4 sieve	Target Value $\pm$ 6.0 percent
# 8 sieve	Target Value $\pm$ 5.0 percent
# 200 sieve	Target Value $\pm$ 2.0 percent

<b>Table 3</b>	
<b>Incentive/Disincentive for Gradation</b>	
<b>Gradation</b>	
<b>PT Based on Min. Four Samples</b>	<b>Incentive/Disincentive (Dollars/Ton)</b>
> 99	0.83
96-99	0.67
92-95	0.37
88-91	0.06
84-87	-0.24
80-83	-0.54
76-79	-0.84
72-75	-1.15
68-71	-1.45
64-67	-1.75
60-63	-2.06
<60	Reject

<b>PU/PL</b>	<b>n=3</b>	<b>n=4</b>	<b>n=5</b>	<b>n=6</b>	<b>n=7</b>	<b>n=8</b>	<b>n=10</b>	<b>n=12</b>	<b>n=15</b>	<b>n=20</b>
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
<60	≤ 0.35	≤ 0.29	≤ 0.27	≤ 0.26	≤ 0.25	≤ 0.25	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24

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

<b>Table 5 Definitions, Abbreviations, and Formulas for Acceptance</b>	
<b>Term</b>	<b>Explanation</b>
Target Value (TV)	The target values for gradation, asphalt binder content and VMA are given in the Contractor's volumetric mix design. See article 1.4, line E, for density target values.
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 and 2 with PT or PL.

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

10. Any lot rejected based on either gradation or binder content will not be eligible for any incentive.
- D. Thickness
1. Verify the thickness with a depth probe and take corrective action if necessary.
    - a. Minimum thickness: Plan depth minus 1/4 inch.
- E. Smoothness
1. Determine acceptance and correct in accordance with Section 01452.

## **PART 2 PRODUCTS**

### **2.1 ASPHALT MATERIAL**

- A. As specified, and following Section 02745.
- B. Sampling procedure: UDOT Quality Management Plan - 509 Asphalt Binder.

### **2.2 HYDRATED LIME**

- A. Meet the requirements of Section 02746.

### **2.3 AGGREGATE MATERIALS**

- A. Refer to the UDOT Minimum Sample and Testing Requirements, Section 1, Tabulation of Acceptance Sampling and Testing.
- B. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.
- C. Meet the following requirements, including Table 3, to determine the acceptability of the aggregate.
  - 1. Coarse aggregate:
    - a. Retained on # 4 sieve.
  - 2. Fine aggregate:
    - a. Clean, hard grained, and angular.
    - b. Passing the # 4 sieve.

<b>Table 6</b>		
<b>Aggregate Properties</b>		
<b>Properties</b>	<b>Test Method</b>	<b>Test Requirement</b>
One Fractured Face	ASTM D 5821	95 percent min.
Two Fractured Face	ASTM D 5821	90 percent min.
Fine Aggregate Angularity	AASHTO T 304	45 min.
Flat and Elongated (1 to 3 ratio)	ASTM D 4791 (Based on 3/8 inch and above)	10 % max.
L.A. Wear	AASHTO T 96	30 % max.
Sand Equivalent	AASHTO T 176	60 min.
Plasticity Index	AASHTO T 89 and T 90	0
Polish Test	AASHTO T 278 & T 279	31 min.
Soundness (sodium sulfate)	AASHTO T 104	12 % max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2 % max.
Standard Test Method for Insoluble Residue in Carbonate Aggregates	ASTM D 3042	30 % max.
Natural Fines	None	None

D. Meet the following gradation:

<b>Table 7</b>	
<b>Aggregate Gradation (Percent Passing by Dry Weight of Aggregate - AASHTO T11, T27)</b>	
<b>Sieve Size</b>	<b>Percent</b>
½ inch	100
3/8 inch	90 - 100
# 4	35 - 45
# 8	14 - 20
# 200	2 - 4

## **2.4 JOB-MIX**

- A. Obtain approval for job mix gradation:
  - 1. Submit at least 10 working days before paving.
  - 2. Show definite single values for the percentage of aggregate passing each sieve based on the dry weight of aggregate.
  - 3. Stay within the single value gradation limits of Table 4.
  - 4. Add Hydrated Lime:
    - a. Method A, Lime Slurry; or Method B, Lime Slurry Marination.
    - b. Refer to Section 02746.
    - c. Incorporate minimum hydrated lime by dry weight of aggregate into all mixtures. (1 percent for Method A; 1- 1/2 percent for Method B).
- B. Binder Content
  - 1. The Engineer determines the binder content and supplies samples to determine the correction factor.
- C. Changes in job mix gradation:
  - 1. Submit a written request for a change in a job-mix gradation.
  - 2. Give the Engineer 5 working days to review and approve the changes and to readjust the quantity of asphalt binder to be used.

## **PART 3 EXECUTION**

### **3.1 MIXING**

- A. Mix as specified in Section 02741. The mineral aggregate coating will be considered satisfactory when all particles are coated.

### **3.2 SURFACE PLACEMENT**

- A. Apply the tack coat at a uniform rate of 0.10 gal/yd<sup>2</sup> undiluted emulsion or 0.15 gal/yd<sup>2</sup> 2:1 diluted emulsion. Note: 2:1 diluted emulsion represents 2 parts undiluted emulsion and 1 part water. Refer to Section 02748.
- B. Maintain a steady paver speed
- C. Roll sufficiently to seat without fracturing aggregate.
- D. Bring all passes up even transversely at the end of each working day.

- E. Construct longitudinal joints within 6 inches of lane lines.
- F. Remove slick spots as directed by the Engineer.

### **3.3 LIMITATIONS**

- A. Place between May 1, and September 15, and only when both the air temperature in the shade and the pavement surface temperature are above 60 degrees F and rising.
- B. Obtain written approval from the Engineer before placing OGSC after September 15.
- C. Do not place when it is determined by the Engineer that excessive moisture may be present in the pavement structure.
- D. Do not place during rain, when the surface is wet, or during other adverse weather conditions.

END OF SECTION