Recommend Approval: Rebeccah Smith 8/29/12 Team Leader Date Division Chief 8/28/12 Date	Maryland Department of Transportation State Highway Administration Office of Materials Technology MARYLAND STANDARD METHOD OF TESTS	
Approved: Tim Smith 10-02-12 Director Date	**PROCEDURES FOR SAMPLING ASPHALT MIXTURES / DENSITY CORES AND RANDOM SAMPLING METHODS**	MSMT 457

SCOPE:

These procedures are used for sampling asphalt mixtures from the roadway prior to compaction, taking cores from the roadway to determine density, and to determine the locations for securing core samples for testing. The mixtures and core samples obtained from this procedure will be used for acceptance or rejection in accordance with applicable specifications. All sampling shall be Global Positioning System (GPS) located and noted.

REFERENCE DOCUMENTS:

T 168
MSMT 735
MARTCP Technician Certification Manual
Random Sample Location Program

I. SAMPLING ASPHALT MIXTURES FROM THE ROADWAY:

There are two sampling methods outlined in this procedure. The Contractor shall indicate which particular method he intends to use in his Quality Control Plan. The Contractor shall not change the method of sampling without approval.

1. **Method A -** This method samples the asphalt mixture from behind the paver using a plate placed on the roadway prior to placement of the asphalt mat.

2. **Method B -** This method samples the asphalt mixture from behind the paver using a shovel after placement of the asphalt mat and prior to compaction.

The Engineer and Contractor will select sampling locations using a random selection method. The sampling locations are to be marked prior to rolling and the samples taken after the paving train passes.

SIGNIFICANCE AND USE:

Sampling for acceptance will be obtained by the Contractor's qualified personnel as directed by the Engineer. Every precaution shall be taken to obtain samples that will yield an acceptable representation of the mixtures sampled.

MATERIALS AND EQUIPMENT:

General

The Contractor will be responsible for supplying the following materials and equipment:

1. **Random Sample Location Program** or Random Selection Cards numbered from 0 to width of the paving lane in increments of 1 foot. Use only one of the randomly selected locations for obtaining a mixture sample.
2. Measuring Tape – 25 foot minimum
3. Sample boxes, waterproof labels, tape
4. Shovel, spatula
5. Spray paint or other suitable marking method
6. GPS equipment

Method A

1. Sampling Plates - Three plates (minimum) with a minimum area of 2 ft^2. The material and thickness of the plate shall be such that the plate can safely hold a mass of 35-60 lbs/ ft^2. The sampling plate shall have a hole of approximately ¼ in. diameter in each corner.
2. Masonry nails or equivalent
3. Pitchfork
4. Square-end shovel, fire shovel, or grain shovel
5. Scoop
6. 24 ft of 18 gauge mechanical wire or equivalent to tie through each hole of the plate.

Method B

1. Shovel and spatula

PROCEDURE:

METHOD A

The Engineer will witness the sampling performed for acceptance or verification and take immediate possession of the samples.

1. **Option A**: The **Random Sample Location Program** may be used for location selection. Enter all required information. Five locations will be given; select one for the

Administration. If necessary, recalculate and use the second page for the Contractor's random location selection.

2. **Option B:** The Contractor shall select one card from a group of random selection cards. The number drawn will determine the location in the transverse direction of the roadway. The longitudinal direction location will be selected by the Engineer. The longitudinal location and the transverse location will determine where to place the plate to obtain the first sample increment.

3. Determine the location of the plate before the paver reaches the selected location. Measure from the right or left side of the mat (whichever is safely accessible) the number of feet selected across the width of the mat to determine the center of the plate location. For all subsequent samples, take the measurement from the same side of the mat unless safety is an issue.

4. Place the plate with wire attached (optional) at the determined location. Drive a nail(s) into the pavement then place the plate hole onto the nails (if necessary) to avoid movement, lifting, or slippage of the plate.

5. Place a square metal sheet or a piece of plywood on the shoulder, non-traffic or other safe area near or across from the plate. Use this area to mix and split the sample increments.

6. If the wire attachment is used, extend the wire tightly beyond the paving width. The wire attached to the end of the plate shall be held to the ground to allow construction and paving equipment to pass over the plate and wire. The wire shall not pass under a grade leveler attached to the paver.

7. After the mixture is placed, locate the plate. If the wire attachment is used, locate the plate by raising the wire.

8. Raise the plate slightly using a pitchfork or a shovel. Take care to avoid losing any of the mixture from the plate.

9. Lift the plate with the mixture sample then put the sample on the square metal sheet or piece of plywood placed for mixing and splitting. Carefully scrape then re-add any material adhering to the plate to the sample increment.

10. The Contractor shall immediately replace the material removed from the roadway. Do not broadcast material across the mat.

11. The Contractor shall complete the appropriate information on the mixture box label and submit along with Administration samples.

METHOD B

The Engineer will witness the sampling performed for acceptance or verification and take immediate possession of the samples.

1. **Option A**: The **Random Sample Location Program** may be used for location selection. Enter all required information. Five locations will be given; select one for SHA. If necessary, recalculate and use the second page for the Contractor's random location selection.

2. **Option B**: The Contractor shall select one card from a group of random selection cards. The number drawn will determine the location on the paved mat where the sample shall be taken.

3. The Engineer and the Contractor's qualified technician will proceed to a location just ahead of the paver and mark the roadway with a suitable marker.

4. Wait until the paver has passed the previous mark.

5. Facing the rear of the paver, measure from the right or left side of the mat (whichever is safely accessible) the number of feet previously determined across the width of the mat to determine the center of the sample location. For all subsequent samples, measure from the same side of the mat unless safety is an issue. The sample shall be taken perpendicularly to the rear of the paver.

6. Preheat the shovel used for removing the sample from the selected location prior to sampling. Ensure the shovel is free of any material or solvent.

7. Empty the contents from the shovel into the sampling box; make certain to fill the box to the top.

8. Scrape any material adhering to the shovel into the box with a spatula.

9. Repeat Steps 6 and 7 from the point where the sample was taken until enough material has been obtained to complete all the tests required by the Administration.

10. The Contractor shall immediately replace the material removed from the roadway.

11. Mark the boxes with the method of sampling, sample location (GPS, station, etc.), name of the qualified technician performing the sampling, and the name of the Administration's qualified person witnessing the sampling. Also include the time, date, tonnage and mix number from the representative load ticket.

REPORT:

Report the following items on the box sample label.

1. Sampling location (Station #, GPS location)
2. Method of sampling (Method A-plate or Method B)
3. Date, time, mix design number and tonnage from the load ticket(s) that represent the material(s) sampled.
4. Contract number
5. Name of Contractor's personnel sampling the material
6. Name of Administration's personnel witnessing the sampling.

II. CORE SAMPLING PROCEDURE TO DETERMINE DENSITY:

SIGNIFICANCE AND USE:

Randomly selected core samples taken from the roadway are used to determine acceptance of the mixture and the pay factor at which the Contractor will be paid for the Hot Mix Asphalt (HMA) on the project. Cores will be tested at the Administration Laboratory. Protect the cores from light and heat until tested to ensure accuracy of the test results.

MATERIALS AND EQUIPMENT:

1. Coring machine
2. Core bits - 4 in. and 6 in.
3. Core extractor
4. SHA-73.0-1 Field Compaction Report-Core Method.
5. Random Sampling Method (computer program, random number table, cards)
6. Global Positioning System (GPS) equipment
7. Core Storage Containers

PROCEDURE:

Sampling frequency shall be as outlined in the Sample Frequency Guide and in conformance with the Specifications. Extract the cores from the pavement without damaging the sample as follows:

1. The Engineer and Contractor shall use one of the Random Sampling methods to determine their respective coring locations. The locations shall be marked after the pavement is rolled and as the paving train progresses, or as directed. All core samples shall be GPS located and noted.

2. Cut then extract all cores before the roadway is opened to traffic. The Engineer will witness the cutting of the cores. Place the cores in a container suitable for transporting. Core sheets must be signed by certified technicians. Include Random Sampling Sheets or random sampling printouts with the cores.

3. The Engineer will take possession of the Administration's cores, core sheets and random sampling sheets/printouts and transport promptly to a designated drop box or laboratory for testing.

III. RANDOM SAMPLING PROCEDURE TO DETERMINE DENSITY

SAMPLING LOCATIONS

Select sampling locations for core and density gauge/core methods using a random number selection procedure to ensure any area of pavement being placed will have an equal chance of being selected. Use the **Random Sample Location Program** or the following random sampling method to select the sampling locations:

Use random numbers from TABLE 1, column X and Y, to select the location to be sampled or tested within each 500 ton sublot or less. Determine these locations by multiplying the random numbers by the length of each sublot using the multiplier from TABLE 2. Refer to the example calculations and worksheet in the CALCULATIONS section. Select a different set of random numbers for each lot.

SAMPLING METHOD

Use consecutive four digit numbers from Table 1 to sample each lot. For example, if number 13 is randomly selected as the starting point from column X and Y for the first lot, and five locations are required, numbers 13 - 17 would be the five consecutive four digit numbers. For the second lot, select a new starting point and use a separate set of consecutive four digit numbers. Use the same procedure for additional lots.

CALCULATIONS

EXAMPLE:

Assuming an estimated 1700 ton placement, a minimum of 10 locations (5 SHA and 5 contractor) per day's production are required, resulting in 5 sublots of 340 tons each (1700/5 = 340).

Depth of placement = 2 in., and

Width of placement = 12 ft

1. From Table 2, determine the length for a 340 ton sublot = 340 x 6.65 = 2261 ft.

   Assuming the beginning station is 100 + 00, therefore sublots are:

   Sublot 1 Beginning Sta.= 100 + 00

   Sublot 2 Beginning Sta.= 122 + 61

   Sublot 3 Beginning Sta.= 145 + 22

   Sublot 4 Beginning Sta.= 167 + 83

   Sublot 5 Beginning Sta.= 190 + 44

2. Select the next five consecutive random numbers (1 for each sublot) from Table 1 to obtain random decimal fractions in X and Y columns (for example numbers 13-17).

   Place the four digit numbers in the X and Y columns on the worksheet. Multiply these values by the length (L) and width (W) in the adjacent columns.

   Add the resulting length to the beginning station and place in the next column on the worksheet to obtain the sample locations as follows:

   Sublot 1, Beginning at Station 100 + 00.

   Coordinate X = 0.7159 x 2261 = 1619 ft

   Coordinate Y = 0.6181 x 12 = 7.4 ft

   Sample Location = Sta. 100 + 00 plus 1619 ft = Sta. 116 + 19

   Measure 7.4 ft from the right edge of the paving lane.

Sublot 2, Beginning at Station 122 + 61.

Coordinate X = 0.3609 x 2261 = 816 ft

Coordinate Y = 0.6454 x 12 = 7.7 ft

Sample Location = Sta. 122 + 61 plus 816 ft = Sta 130 + 77

Measure 7.7 ft from the right edge of the paving lane.

Sublot 3, Beginning at Station 145 + 22.

Coordinate X = 0.8915 x 2261 = 2016 ft

Coordinate Y = 0.2636 x 12 = 3.2 ft

Sample Location = Sta. 145 + 22 plus 2016 ft = Sta 165 + 38

Measure 3.2 ft from the right edge of the paving lane.

Sublot 4, Beginning at Station 167 + 83.

Coordinate X = 0.6442 x 2261 =1456 ft

Coordinate Y = 0.3182 x 12 = 3.8 ft

Sample Location 167 + 83 plus 1456 = Sta 182 + 39

Measure 3.8 ft from the right edge of the paving lane.

Sublot 5, Beginning at Station 190 + 44.

Coordinate X = 0.1904 x 2261 = 430 ft

Coordinate Y = 0.2000 x 12 = 2.4 ft

Sample Location 190 + 44 plus 430 ft = Sta 194 + 74

Measure 2.4 ft from the right edge of the pavement lane.

MSMT 457 - TABLE 1

RANDOM POSITIONS IN DECIMAL FRACTIONS (4 PLACES)

	X	Y		X	Y
1	0.4721	0.2135	51	0.6985	0.8636
2	0.6936	0.3182	52	0.3410	0.5636
3	0.6112	0.2909	53	0.5937	0.3727
4	0.7930	0.8908	54	0.6912	0.4545
5	0.0652	0.4818	55	0.0318	0.7272
6	0.4604	0.2091	56	0.1303	0.8090
7	0.0167	0.3727	57	0.6893	1.0000
8	0.0077	0.6181	58	0.3886	0.7817
9	0.6777	0.8636	59	0.0312	0.8090
10	0.8010	0.8362	60	0.0166	0.5909
11	0.3027	0.3454	61	0.4609	0.4000
12	0.9831	0.2364	62	0.0893	0.9726
13	0.7159	0.6181	63	0.4542	0.1999
14	0.3609	0.6454	64	0.9363	0.2111
15	0.8915	0.2636	65	0.8183	0.5636
16	0.6442	0.3182	66	0.9401	0.5091
17	0.1904	0.2000	67	0.5967	0.9726
18	0.6074	0.8908	68	0.7545	0.2636
19	0.7522	0.9181	69	0.0101	0.2909
20	0.7041	0.8362	70	0.2896	0.8362
21	0.5102	0.2364	71	0.8011	0.6454
22	0.2471	0.3182	72	0.6718	0.6454
23	0.5693	0.5636	73	0.5567	0.1818
24	0.8583	0.4545	74	0.0481	0.2636
25	0.3093	0.1818	75	0.4266	0.9454
26	0.9144	0.9181	76	0.3941	0.5636
27	0.7944	0.5909	77	0.9876	0.7545
28	0.8725	0.2636	78	0.6313	0.7272
29	0.0135	0.8908	79	0.6803	0.3182
30	0.2044	0.7272	80	0.7955	0.7726
31	0.2517	0.2909	81	0.7399	0.8080
32	0.2763	0.8090	82	0.9328	0.5909
33	0.0314	0.4818	83	0.1507	0.4000
34	0.9560	1.0000	84	0.3087	0.3182
35	0.4622	0.4000	85	0.7513	0.1818
36	0.1327	0.7817	86	0.6469	0.4818
37	0.6922	0.5636	87	0.2536	0.7545
38	0.0010	0.2111	88	0.1488	0.2000
39	0.7609	0.2091	89	0.9411	0.5636
40	0.5957	0.1000	90	0.0571	1.0000
41	0.3115	0.4000	91	0.4797	0.9454
42	0.3377	0.8362	92	0.0866	0.4272
43	0.5651	0.2132	93	0.2889	0.1999
44	0.4742	0.6727	94	0.4783	0.7000
45	0.9483	0.4000	95	0.0304	0.9181
46	0.2951	0.6451	96	0.8945	0.4515
47	0.0441	0.1705	97	0.4499	0.2081
48	0.9143	0.2168	98	0.9205	0.9454
49	0.5723	0.8362	99	0.5827	0.5636
50	0.6069	0.4000	100	0.4560	0.8908

X – decimal fraction of total length measured along the road from starting point

Y – decimal fraction of the width measured across the road from the right edge in the direction of placement.

MSMT 457 – TABLE 2		
DEPTH OF PLACEMENT in.	**WIDTH OF PLACEMENT ft.**	**MULTIPLIER TO DETERMINE APPROXIMATE LENGTH OF SUBLOT ft.**
1.0	12	13.39
1.5	12	8.89
2.0	12	6.65
2.5	12	5.34
3.0	12	4.44
1.0	10	16.06
1.5	10	10.67
2.0	10	7.98
2.5	10	6.41
3.0	10	5.33
1.0	8	20.08
1.5	8	13.33
2.0	8	9.98
2.5	8	8.01
3.0	8	6.67
1.0	6	26.77
1.5	6	17.78
2.0	6	13.31
2.5	6	10.68
3.0	6	8.89

EXAMPLE:

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Rev. 06/12

MARYLAND STATE HIGHWAY ADMINISTRATION
OFFICE OF MATERIALS TECHNOLOGY
WORKSHEET TO COMPUTE CORE OR DENSITY TEST LOCATIONS

DATE SAMPLED:_____ CONTRACT NO.:_____ MIX NO.:_____

DEPTH OF PLACEMENT: 2 in. WIDTH OF PLACEMENT (W): 12 ft LOT SIZE: 1700 tons

SUBLOT SIZE: 340 tons SUBLOT LENGTH (L) 6.65 x 340 = 2261 ft ft

MULTIPLIER FROM TABLE 2: 6.65

SUBLOT NUMBER	SUBLOT BEGINNING STATION NUMBER	RANDOM NUMBER FROM TABLE 1		SUBLOT LENGTH L = 2261 ft	SUBLOT WIDTH W = 12 ft	TEST/SAMPLE LOCATION		
		X	Y	X x L	Y x W	GPS	STATION	OFFSET
1	100 + 00	0.7159	0.6181	1619	7.4		116 + 19	7.4
2	122 + 61	0.3609	0.6454	816	7.7		130 + 77	7.7
3	145 + 22	0.8915	0.2636	2016	3.2		165 + 38	3.2
4	167 + 83	0.6442	0.3182	1456	3.8		182 + 39	3.8
5	190 + 44	0.1904	0.2000	430	2.4		194 + 74	2.4

Locations computed by: _____

Original: Laboratory w/compaction report
cc: Project Engineer

MARYLAND STATE HIGHWAY ADMINISTRATION
OFFICE OF MATERIALS TECHNOLOGY
WORKSHEET TO COMPUTE CORE OR DENSITY TEST LOCATIONS

DATE SAMPLED:_____ CONTRACT NO.:_____ MIX NO.:_____

DEPTH OF PLACEMENT:_____ WIDTH OF PLACEMENT (W):_____LOT SIZE:_____

SUBLOT SIZE:_____ SUBLOT LENGTH (L):_____

MULTIPLIER FROM TABLE 2: _____

SUBLOT NUMBER	SUBLOT BEGINNING STATION NUMBER	RANDOM NUMBER FROM TABLE 1		SUBLOT LENGTH L =_____ft	SUBLOT WIDTH W =_____ ft	TEST/SAMPLE LOCATION		
		X	Y	X x L	Y x W	GPS	STATION	OFFSET
1								
2								
3								
4								
5								

Locations computed by: _____

Original: Laboratory w/compaction report
cc: Project Engineer