In Place Density Determination of Asphalt Concrete by the Coring Method

---

1. Scope:

This procedure is for determining the density of in place asphalt concrete pavement.

2. Apparatus:

2.1 Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 gram. The scale or balance will be equipped with a suitable suspension apparatus and holder to permit weighing the sample while suspended from the center of the scale pan of the weighing device.

2.2 Coring device capable of getting a minimum 4” diameter core from the pavement.

2.3 Diamond tipped blade cut off saw capable of sawing the 4" or larger core on the correct lift line without distortion and damage to the core.

2.4 The water bath for immersing the sample will be equipped with an overflow outlet for maintaining a constant water level. An aquarium heater will suffice to control the temperature of the water bath at 77° ± 2° F. The water bath must be large enough to allow the suspension apparatus holder to be covered with water at all times. The sample and suspension apparatus must be completely covered with water during weighing. The wire suspending the suspension apparatus will be the smallest practical size to minimize any possible effects of a variable immersed length.

3. Procedure:

3.1 Randomly select 2 core sites per 1000 ton sublot and mark for the Contractor to core. Random core locations will be located within the pay factor asphalt mix being placed in the sublot. Core locations that fall within one foot from the edge of the paving sublot will be adjusted so that the core is taken one foot from the paving sublot edge line. Exercise care when removing the core from the pavement to prevent distortion or cracking. Label the core sample.

3.2 After removing the core, fill the hole in the pavement before the end of the next working day with mix and tamp to a density, which will be close to that of the surrounding pavement.

3.3 Transport the cores to the field laboratory site. Measure the core lift to the nearest .05 inch or 1/16” and record the measurements on a core dry back worksheet (DOT-42Q). Remove the pavement lift of interest from the core by using a cut off or masonry saw with a diamond tipped blade. Inspect the core

for damage. Record the sawed core thickness on line (A) of the core dry back worksheet (DOT-42Q).

3.4 Weigh the core and record the apparent dry weight in air to the nearest 0.1 gram on line (B).

NOTE: Cores and pucks will be **weighed individually**.

3.5 Immerse each core in water at 77° ± 2° F for 3 to 3.5 minutes and record the submersed weight in water to the nearest 0.1 gram on line (C). Maintain a constant level of water in the water bath at the overflow outlet through the entire test procedure.

3.6 Remove each core from the water and surface dry by blotting with a damp terry cloth towel and record the saturated surface-dry weight in air to the nearest 0.1 gram on line (D).

3.7 Calculate the volume of the core (D - C). Record on line (E).

NOTE: Cores have taken on water from the coring and sawing process. The following procedure must be used to get the water out of the cores.

3.8 Record the pan number on line (F).

3.9 Record the weight of the pan to the nearest 0.1 gram on line (G).

3.10 Place the core in the pan and place in an oven at 230 ± 9° F for 2 hours. Record the start time on the DOT-42Q.

3.11 After the 2 hour period, record the weight of the core and the pan to the nearest 0.1 gram on the first time space on line (J).

3.12 Place the core and pan back in the oven and weigh at 1 hour intervals until the core has reached a constant weight. Constant weight is attained when the weight loss is within 0.1 percent of the apparent dry weight. Calculate the amount of allowable loss (B x .001) to the nearest 0.1 gram. Record on line (M).

3.13 After a constant weight has been attained, cool the pan and core to room temperature. Record the weight of cooled core and pan to the nearest 0.1 gram on line (N).

3.14 Determine the actual dry weight of the core (N - G). Record on line (H).

3.15 Determine the core bulk specific gravity (H / E) to the nearest 0.001. Record on line (I).

3.16 Determine the moisture in the core (D - H). Record on line (K).

3.17 Calculate the percent water absorbed by volume (K / E x 100) to the nearest 0.1 percent. Record on line (L).

Example for determining coring locations using QC/QA stratified random sampling procedure:

Each 1000 ton sublot is divided into two 500 ton sections of pavement (one core per 500 ton). Using a random number table generate two random numbers to determine the location for each core. The first random number determines the tonnage into the sublot where the core will be taken. The second random number determines the offset distance from centerline or paving edge line where the core will be taken. The station of the random tonnage can be taken from the asphalt checkers weigh tickets. Round the longitudinal distances to the nearest foot and the offset distances to the nearest 0.5 foot.

The table shows a method using random numbers to determine the core stationing and offset distance from the beginning tonnage of the lot. The tonnage corresponds to the station, which is on the asphalt checkers weigh ticket. Cores to be used for IA testing will be taken at the same offset as the QA core. Note that the whole lot does not need to be completed prior to determining the coring locations for each individual core.

21

Core site	(Longitudinal location)			Distance from centerline		
		Random #	Tonnage	Station		
1A	0 +	(500 x 0.57) =	285 ton;	83+86	12 x 0.82 = 9.8’	- 10’ Lt.
1B	500 +	(500 x 0.90) =	950 ton;	97+21	12 x 0.34 = 4.1’	- 4’ Lt.
2A	1,000 +	(500 x 0.47) =	1235 ton;	102+90	12 x 0.68 = 8.2’	- 8’ Lt.
2B	1,500 +	(500 x 0.07) =	1535 ton;	108+88	12 x 0.24 = 2.9’	- 3’ Lt.
3A	2,000 +	(500 x 0.87) =	2435 ton;	126+94	12 x 0.42 = 5.0’	- 5’ Lt.
3B	2,500 +	(500 x 0.90) =	2950 ton;	137+17	12 x 0.88 = 10.6’	- 10.5 Lt.
4A	3,000 +	(500 x 0.88) =	3440 ton;	146+95	12 x 0.97 = 11.6’*	- 11’ Lt.
4B	3,500 +	(500 x 0.19) =	3595 ton;	150+10	12 x 0.70 = 8.4’	- 8.5’ Lt.
5A	4,000 +	(500 x 0.34) =	4170 ton;	161+61	12 x 0.36 = 4.3’	- 4.5’ Lt.
5B	4,500 +	(500 x 0.85) =	4925 ton;	176+66	12 x 0.23 = 2.8’	- 3’ Lt.

* Any transverse distance closer than one (1) foot from either paving edge line is moved to one (1) foot from the paving edge line from typical section.

The Contractor will take cores with the quality assurance technician witnessing the sampling. The core will l be centered over the selected coring location and immediately transported to the QA Lab for testing. The cores will be measured and then separated on the lift line by means of sawing with a diamond blade cut off or masonry saw being careful not to damage the core. The density of each core is determined and the average core density for each 1,000 ton sublot is then determined. The average of the lot’s maximum specific gravity (Rice) tests is used to compute the lot average density.

4. Report:

4.1 Calculate the core bulk specific gravity to the nearest 0.001.

4.2 Calculate the core density percent of standard to the nearest 0.01 percent by dividing the core bulk specific gravity by the lot's average maximum theoretical specific gravity.

4.3 Calculate the average density percent of standard of the two cores in each sublot to the nearest 0.1 percent.

5. References:

DOT-42Q

Sample ID: 2229719

Density Report - Bituminous Surfacing

DOT-42Q
3-19

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Class and Type Class Q2 Hot Mixed Asphalt Concrete Lift 1 of 1 Thickness 2"

% Asphalt Binder 5.1 Actual Finished Width 12.00 Station 665+10

Tested By Tester, Two Checked By Tester, One Date Tested 06/08/2019

Specification Requirement - Percent of Standard Required 92.0 - 96.0

Lot No. 1 Lot Location Sta. 623+15 to 482+50 Lt & 623+15 to 550+90 Rt

Core Site Length 21,290.00 Lot Width 24 Quantity Represented 5000 tons

Core Measurement Before Sawing	5 1/2	5 1/2	5 3/4	5 1/2	6	5 1/4	4 3/8	4 3/8	5	5 1/2								
Core Number	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B
Lift Measured Thickness																		
21.80																		
A. Sawed core thickness	2 1/8	3	2 1/2	1 7/8	2 1/4	2 1/8	2 1/16	2 1/8	2 1/8	2 5/8								
B. Apparent dry weight in air	993.70	1,432.10	1,303.20	925.30	1,009.60	1,032.60	1,025.40	995.50	1,062.60	1,276.80								
C. Submersed weight in water	559.70	829.30	739.10	526.70	568.70	592.80	580.60	562.70	611.40	734.50								
D. SSD weight in air	994.20	1,439.90	1,303.80	925.80	1,010.10	1,033.20	1,026.00	995.90	1,063.00	1,277.30								
E. Volume of the core (D - C)	434.50	610.60	564.70	399.10	441.40	440.40	445.40	433.20	451.60	542.80								
F. Pan number	1	2	3	1	4	5	2	3	6	3								
G. Weight of pan	134.800	132.300	131.400	134.800	134.000	128.700	132.400	131.600	132.400	131.500								
H. Actual dry weight (N - G)	985.1	1,432.1	1,287.9	916.6	998.6	1,029.5	1,020.1	988.1	1,058.5	1,270.5								
I. Core bulk specific gravity (H / E)	2.267	2.345	2.281	2.297	2.262	2.338	2.290	2.281	2.344	2.341								
K. Moisture in core (D - H)	9.1	7.8	15.9	9.2	11.5	3.7	5.9	7.8	4.5	6.8								
L. Percent water absorbed by volume (K / E) * 100	2.1	1.3	2.8	2.3	2.6	0.8	1.3	1.8	1.0	1.3								
M. Maximum allowable weight loss in 1 hour (B × 0.001)	1.0	1.4	1.3	0.9	1.0	1.0	1.0	1.0	1.1	1.3								

Figure 1

mso.mat 9-21

SD 315
Page 5

mso.mat 9-21

	Time (J)	Core Drying Weigh Back Area																	
After reaching constant weight, allow the core & pan to cool to room temp. before weighing for the final time (N)	8:30 am																		
	10:30 am	1,120.30	1,564.70	1,420.00															
	11:30 am	1,119.50	1,563.70	1,418.90															
	10:00 am																		
	12:00 pm				1,051.40	1,132.70	1,158.10	1,152.50	1,120.20	1,190.80									
	1:00 pm				1,051.30	1,132.60	1,157.80	1,152.30	1,119.50	1,190.60									
	9:15 am																		
	11:15 am										1,402.40								
	12:15 pm										1,402.00								
N. Weight of cooled core and pan		1,119.90	1,564.40	1,419.30	1,051.40	1,132.60	1,158.20	1,152.50	1,119.70	1,190.90	1,402.00								

Theoretical Maximum Specific Gravity

Sublot No.	1	2	3	4	5
Max. Sp. Gr.	2.479	2.478	2.477	2.473	2.468

Lot Average Maximum Specific Gravity (Standard) 2.475

Figure 1A

In-Place Density Measurement

Percent of Standard = [(Core Bulk Specific Gravity / Lot Average Maximum Specific Gravity)] × 100

Core Sublot No.	Height	Rand. No.	Cumulative Tonnage	Station for Core	Rand. No.	Paving Width	Distance from C/L	Actual Dry Weight	Weight in Water	SSD Weight	Core Bulk Sp. Gr.	% of Stand.	**Avg. % Stand.**
1A	2 1/8	0.660	330	641+60	0.530	24	12.7 LT	985.1	559.7	994.2	2.267	91.60	93.2
1B	3	0.250	625	612+30	0.730	24	17.5 LT	1432.1	829.3	1439.9	2.345	94.75	
2A	2 1/2	0.820	1410	617+50	0.190	24	4.6 LT	1287.9	739.1	1303.8	2.281	92.16	92.5
2B	1 7/8	0.750	1875	587+20	0.090	24	2.2 LT	916.6	526.7	925.8	2.297	92.81	
3A	2 1/4	0.700	2350	570+40	0.600	24	14.4 LT	998.6	568.7	1010.1	2.262	91.39	92.9
3B	2 1/8	0.280	2640	550+90	0.450	24	10.8 LT	1029.5	592.8	1033.2	2.338	94.46	
4A	2 1/16	0.730	3365	582+80	0.550	24	13.2 LT	1020.1	580.6	1026.0	2.290	92.53	92.3
4B	2 1/8	0.510	3755	556+70	0.520	24	12.5 LT	988.1	562.7	995.9	2.281	92.16	
5A	2 1/8	0.620	4310	515+60	0.380	24	9.1 LT	1058.5	611.4	1063.0	2.344	94.71	94.7
5B	2 5/8	0.740	4870	482+50	0.810	24	19.4 LT	1270.5	734.5	1277.3	2.341	94.59	

Percent Density
93.1