In Place Density Determination of Asphalt Concrete by the Coring Method

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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 shall 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 shall 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 shall 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 shall 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 or lifts to the nearest .05 inch or 1/16” and record the measurements on a core dry back worksheet (DOT-8). 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-8).

3.4 Weigh the core and record the “Apparent dry weight” to the nearest 0.1 gram on line (B).

NOTE: Cores and pucks shall 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 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 mass 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-8.

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 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 gram. 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. Note that the whole lot does not need to be completed prior to determining the coring locations for each individual core.

Core site	(Longitudinal location) Random #	Tonnage	Station	Distance from centerline		
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 shall take cores with the quality assurance technician witnessing the sampling. The core shall be centered over the selected coring location and immediately transported to the QA Lab for testing. The cores shall 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 on the DOT-8.

4.2 Transfer the information from the DOT-8 to the DOT-42Q.

4.3 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. 18

4.4 Calculate the average density percent of standard of the two cores to the nearest 0.1 percent.

5. References:

DOT-8
DOT-42Q

Sample ID 2204678
File No.

Core Dry Back Worksheet

INFO.

DOT - 8
9-14

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

Tested By Tester, One Checked By Tester, Two Test Date 06/08/2016

Material Type Class Q2 Hot Mixed Asphalt Concrete

Steps

1. Measure and record the thickness of the core and all lifts prior to sawing. (average of 4 locations around core)
2. Saw the lift to be tested from the core and record thickness (A).
3. Using SD 315, record the core apparent dry weight in air (B), the submersed weight under water (C), and the saturated surface dry weight in air (D) to the nearest 0.1 gram.
4. Calculate the volume of the core (E).
5. Record the pan number (F).
6. Weigh and record the weight of the pan to the nearest 0.1 gram (G).
7. Place the core and pan in an oven at 230 + or - 9 degrees F for 2 hours.
8. After the 2 hour period, record the weight of the core and the pan to the nearest 0.1 gram. Record the time of weighing in column (J).
9. 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 (M).
10. After the above constant weight has been reached, cool the pan and core to room temperature, record the weight (N), and then determine the actual dry weight of the core (H).
11. Perform calculations (I), (K), and (L).

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	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B
1 lift measured thickness	2 1/8	3	2 5/8	1 7/8	2 1/4	2 1/8	2 1/8	2 1/8	2 1/2	2 5/8
_____ lift measured thickness										
_____ lift measured thickness										

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:	993.7	1432.1	1303.2	925.3	1009.6	1032.6	1025.4	995.5	1062.6	1276.8
C.	Submersed weight in water:	559.7	829.3	739.1	526.7	568.7	592.8	580.6	562.7	611.4	734.5
D.	SSD weight in air:	994.2	1439.9	1303.8	925.8	1010.1	1033.2	1026.0	995.9	1063.0	1277.3
E.	Volume of the core: (D - C)	434.5	610.6	564.7	399.1	441.4	440.4	445.4	433.2	451.6	542.8
F.	Pan number:	1	2	3	1	4	5	2	3	6	3
G.	Weight of pan:	134.8	132.3	131.4	134.8	134.0	128.7	132.4	131.6	132.4	131.5
H.	Actual dry weight: (N - G)	985.1	1432.1	1287.9	916.6	998.6	1029.5	1020.1	988.1	1058.5	1270.5
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	.8	1.3	1.8	1.0	1.3
M.	Maximum allowable weight loss in 1 hour: (B x 0.001)	1.0	1.4	1.3	0.9	1.0	1.0	1.0	1.0	1.1	1.3

	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	1,120.3	1,564.7	1,420.0							
	11:30 am	1,119.5	1,563.7	1,418.9							
	10:00 am										
	12:00 pm				1,051.4	1,132.7	1,158.1	1,152.5	1,120.2	1,190.8	
	1:00 pm				1,051.3	1,132.6	1,157.8	1,152.3	1,119.5	1,190.6	
	9:15 am										
	11:15 am										1,402.4
	12:15 pm										1,402.0
N.	Weight of cooled core and pan	1,119.9	1,564.4	1,419.3	1,051.4	1,132.6	1,158.2	1,152.5	1,119.7	1,190.9	1,402.0

Figure 1

Sample ID 2229719 **Density Report - Bituminous Surfacing** **DOT-42Q**
File No. **9-14**

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 06/08/2016
Specification Requirement - Percent of Standard Required 92 - 96
Lot No. 1 Lot Location Sta. 623+15 to 482+50 Lt & 623+15 to 550+90 Rt
Core Site Length 21290.00 Lot Width 24 Quantity Represented 5000 tons

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

In-Place Density Measurement

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

Core Sublot No.		Height	Rand Nbr	Cumulative Tonnage	Station for Core	Rand Nbr	Paving Width	Distance from C/L		Actual Dry Weight	Weight in Water	SSD Weight	Reheat Correction Factor	Core Bulk Specific Gravity	Percent of Standard	Average Percent Standard
1	A	2 1/8	.66	330	641+60	.53	24	12.7	LT	985.1	559.7	994.2		2.267	91.60	
1	B	3	.25	625	612+30	.73	24	17.5	LT	1432.1	829.3	1439.9		2.345	94.75	93.2
2	A	2 1/2	.82	1,410	617+50	.19	24	4.6	LT	1287.9	739.1	1303.8		2.281	92.16	
2	B	1 7/8	.75	1,875	587+20	.09	24	2.2	LT	916.6	526.7	925.8		2.297	92.81	92.5
3	A	2 1/4	.70	2,350	570+40	.60	24	14.4	LT	998.6	568.7	1010.1		2.262	91.39	
3	B	2 1/8	.28	2,640	550+90	.45	24	10.8	LT	1029.5	592.8	1033.2		2.338	94.46	92.9
4	A	2 1/16	.73	3,365	582+80	.55	24	13.2	LT	1020.1	580.6	1026.0		2.290	92.53	
4	B	2 1/8	.51	3,755	556+70	.52	24	12.5	LT	988.1	562.7	995.9		2.281	92.16	92.3
5	A	2 1/8	.62	4,310	515+60	.38	24	9.1	LT	1058.5	611.4	1063.0		2.344	94.71	
5	B	2 5/8	.74	4,870	482+50	.81	24	19.4	LT	1270.5	734.5	1277.3		2.341	94.59	94.7

Percent Density: 93.1

Figure 2