
TANK MEASUREMENT AND ASPHALT CEMENT CONTENT DETERMINATION
(General Rewrite)**GENERAL**

This Instructional Memorandum covers the procedures used by the contracting authority to determine: (1). The quantity of asphalt cement incorporated in a project, and (2) the asphalt cement content of individual production runs of asphalt mixtures. This I.M. also provides instruction for completing Form #E216 (#M216). The plant inspector is referred to the applicable specifications and instructions for the specified tolerances and measurement frequencies.

Tables are furnished for computing quantities of materials stored in standard horizontal cylindrical tanks, and for correcting volumes to standard temperature. The plant inspector is responsible for checking to see that appropriate gauging tables and calibrated sticks are available prior to beginning work on a project. The contractor is required to furnish the calibrated measuring sticks, and gauging tables, for all storage tanks.

PROCEDURES

Refer to example, Form #E216 (#M216)

PROJECT NO.

Enter the project number listed on the project plans.

CONTRACT ID

Enter the county listed on the project plans.

DATE

Enter the date the tank measurement is recorded.

REPORT NO.

Enter the report number of the Daily ACC Plant Page, which reflects the daily virgin AC tank stick information.

START OF PERIOD

TANK NO., TANK IDENTIFICATION

Each asphalt cement storage tank shall be identified by a number or letter and listed on the form. If a separate working tank or surge tank is provided, it will be necessary to establish a uniform procedure for determining the quantity or level of material in the tank. It is recommended that the plant inspector arrange with the contractor to maintain a uniform storage level in the surge tank.

Enter the tank number for each tank being used each day of production. Four tanks may be used on a given day and recorded on a single sheet.

TIME

Enter the beginning time for each tank that is measured each day of production.

TANK CAPACITY (A)

The capacity of each tank depends upon its dimensions. The capacity of standard cylindrical tanks may be computed by determining the length and radius from actual measurements. All dimensions must be inside measurements. The volume of a cylindrical tank is obtained by multiplying the length of the tank, by the radius of the tank ($\frac{1}{2}$ the diameter) squared, by the constant pi (3.141592). That is, volume (V) = $1(\pi)r^2$. When measurements are obtained in meters, convert m^3 to liters by multiplying by 1,000. When measurements are obtained in feet, convert $ft.^3$ to gallons by multiplying by 7.48 gal./ $ft.^3$. The contractor is required to furnish the manufacturer's data for nonstandard tanks. The contractor should not be permitted to allow the level of the asphalt cement to drop below the level of the heating coils, because accurate measurements cannot be made when the cross section of the storage area varies.

Enter the tank capacity in liters (gallons) for each tank being used each day of production.

OUTAGE (PERCENT OF DIAMETER) (B)

The number entered in this row is obtained from the actual tank measurement using the calibrated stick provided for each tank. The measurement is made by placing the stick through the designated tank hatch down to the level of the stored material. The percent outage is read from the stick at the reference elevation, which is normally the inside shell wall. The reference elevation can be checked by placing the stick at the full elevation and checking to see that the zero percentage line and the top of the tank coincide. When the tank shell is full, the outage percentage is zero, and when the tank is empty the outage is 100%.

When non-standard tanks are used, the manufacturer's tables, measuring sticks, and instructions must be followed.

Enter the outage tank stick reading for each tank when the [T104](#) tables are used. If a direct reading measurement is made for a tank stick reading, leave this row blank.

INNAGE (PERCENT OF CAPACITY) (C)

Enter the FILLED PERCENT OF CAPACITY figure from the [T104](#) tables which coincides with the Outage (Percent of Diameter) (B) figure listed above for each tank used. If a direct reading measurement is made for a tank stick reading, leave this row blank. Refer to the manufacturer tables for non-standard tanks.

DIRECT READING (D)

Enter the direct reading measurement figure that is calculated for each tank being used. If you do not use a direct reading tank measurement stick, leave this row blank.

TEMPERATURE (E)

The temperature of the asphalt cement in each tank must be determined at the time the measurements are made. This is done by lowering a maximum registering thermometer to the approximate center of the asphalt cement stored. The thermometer must be shook down to a temperature less than that of the asphalt cement in the storage tank and must be allowed to adjust to the temperature of the stored material. From 3 to 5 minutes should be allowed for this adjustment. Thermometers mounted permanently in the storage tanks by the manufacturers may be used if they agree with the thermometers checked by the Central Laboratory.

Enter the Celsius (Fahrenheit) temperature at the time each tank is measured.

T102 TEMPERATURE CORRECTION FACTOR (F)

The volume of asphalt in the tank at the time of measurement must be corrected to 15°C (60°F). Refer to tables [T102](#) or [T103](#) to obtain the appropriate four-digit correction factor which corresponds to the Celsius (Fahrenheit) temperature recorded for each tank used.

CORRECTED LITERS (GALLONS) (G)

Enter the corrected liters (gallons) at 15°C (60°F) for each tank being used by multiplying rows A, C, & F or D & F, depending on which method is used to measure the AC. Divide result by 100 when C is expressed as a whole number percent. This is the standard temperature at which pay quantities are determined.

TOTAL CORRECTED LITERS (GALLONS) (H)

Enter the total corrected liters (gallons) by adding the corrected liter (gallons) figures for each tank being used.

TOTAL AC ADDED

TOTAL KILOGRAMS (POUNDS) (I)

This space provides for entering the total quantity of asphalt added during the production run. Care must be exercised to ensure that mass (weight) tickets are obtained for each load placed in the storage tank during the production run. Each shipment ticket should be logged in the plant field book, with the appropriate date and unloading time. The mass (weight) is converted to corrected liters (gallons) at 15°C (60°F) by dividing by the mass (weight) per liter (gallon) coefficient provided by the supplier. Quantities added shall be certified or determined at the job site.

Enter the total kilograms (pounds) added to each tank being used.

MASS (WEIGHT) PER LITER (GALLON) (J)

The asphalt cement supplier provides the average mass per liter (gallon). If asphalt cement from different sources has been used during the production run, it is necessary to compute a massed average mass per liter (gallon) for the total quantity used. If emulsified asphalt cement or cutback asphalt cement is being used, it is necessary to reduce the mass of the diluted material to asphalt cement residue. The quantity of asphalt cement residue incorporated is determined by multiplying the total mass of emulsion or cutback by the percent residue value furnished by the supplier.

Enter the mass (weight) per liter (gallon) listed on the AC shipment tickets. The mass (weight) per liter (gallon) can not change on a given day of production.

TOTAL CORRECTED LITERS (GALLONS) (K)

Enter the total corrected liters (gallons) added during the day by adding the (I) row figures together and dividing by the (J) figure.

END OF PERIOD

TIME

Enter the ending time for each tank that is measured each day of production.

TANK CAPACITY (L)

Enter the tank capacity in liters (gallons) for each tank being used each day of production.

OUTAGE (PERCENT OF DIAMETER) (M)

Enter the outage tank stick reading for each tank when the [T104](#) tables are used. If a direct reading measurement is made for a tank stick reading, leave this row blank.

INNAGE (PERCENT OF CAPACITY) (N)

Enter the FILLED PERCENT OF CAPACITY figure from the [T104](#) tables which coincides with the Outage (Percent of Diameter) (B) figure listed above for each tank used. If a direct reading measurement is made for a tank stick reading, leave this row blank.

DIRECT READING (O)

Enter the direct reading measurement figure that is calculated for each tank being used. If you do not use a direct reading tank measurement stick, leave this row blank.

TEMPERATURE (P)

Enter the Celsius (Fahrenheit) temperature at the time each tank is measured.

T102 TEMPERATURE CORRECTION FACTOR (Q)

The volume of asphalt in the tank at the time of measurement must be corrected to 15°C (60°F). Refer to tables [T102](#) or [T103](#) to obtain the appropriate four-digit correction factor which corresponds to the Celsius (Fahrenheit) temperature recorded for each tank used.

CORRECTED LITERS (GALLONS) (R)

Enter the corrected liters (gallons) at 15°C (60°F) for each tank being used by multiplying rows L, N, & Q or O & Q, depending which method is used to measure the AC. Divide result by 100 when C is expressed as a whole number percent. This is the standard temperature at which pay quantities are determined.

TOTAL CORRECTED LITERS (GALLONS) (S)

Enter the total corrected liters (gallons) by adding the corrected liter (gallons) figures for each tank being used.

CALCULATIONS

TOTAL CORRECTED LITERS (GALLONS) USED (T)

Enter the total corrected liters (gallons) used each day of production by adding (H) and (K), then subtracting (S).

MASS (WEIGHT) PER LITER (GALLON) (U)

Enter the four-digit figure listed in the (J) row from above.

TOTAL KILOGRAMS (POUNDS) OF AC USED (V)

This number is obtained by multiplying (T) by (U).

TOTAL KILOGRAMS (POUNDS) OF MIX PRODUCED (W)

Enter the total kilograms (pounds) of mix produced by the plant each day.

The total kilograms (pounds) of mixture are determined by adding the net mass (weight) of all the scale tickets. This total includes all mixture produced, including rejected, wasted, or commercial loads. Mixtures, such as cold mixes, which contain moisture, must be corrected for the moisture content.

TOTAL KILOGRAMS (POUNDS) OF MIX WASTED (X)

Enter the total kilograms (pounds) of mix wasted during the day. This figure includes road waste, plant waste and other mix which was wasted, sold rejected or otherwise disposed of. All mix so wasted should be weighed, if at all possible. It may be necessary to estimate small quantities of waste in some cases.

TOTAL KILOGRAMS (POUNDS) OF AC WASTED (Y)

This number is determined by multiplying the percent asphalt cement (Z) by the total pounds of mix wasted (X). This quantity will not be included in the project pay quantity total.

NET MEGAGRAMS (TONS) OF ASPHALT CEMENT INCORPORATED IN THE PROJECT

This is the net quantity of asphalt cement for which the contractor is eligible to receive pay.

This number is obtained by subtracting (Y) from (V) and then dividing by 1000 for Megagrams or 2000 for Tons. **THIS FIGURE SHALL BE GIVEN TO THE ROAD INSPECTOR EACH DAY.**

NET MEGAGRAMS (TONS) OF MIX INCORPORATED IN THE PROJECT

This number is obtained by subtracting (X) from (W) and then dividing by 1000 for Megagrams or 2000 for Tons. This is the net quantity eligible for payment. **THIS FIGURE SHALL CORRELATE WITH THE ROAD FIGURE EACH DAY.**

PERCENT VIRGIN ASPHALT CEMENT, BY TANK MEASUREMENT (Z)

This percent virgin AC is obtained by dividing (V) by (W) and multiplying by 100.

This percentage is obtained by dividing the total net kilograms (pounds) of asphalt cement incorporated (V) by the total net kilograms (pounds) of mix produced (W). The plant inspector is, at this point, directed to refer to appropriate specifications to determine if this percentage is within the allowable tolerance.

COMMENTS

Self-explanatory.

ALL COMPUTATIONS SHOULD BE CHECKED THOROUGHLY AND PROMPTLY; ANY CORRECTIONS SHOULD BE REPORTED TO THE CONTRACTOR AND RECORDED ON THE DAILY REPORT FORMS. UPON COMPLETION OF THE PROJECT THE COMPLETED FORM #904 SHALL BE INCORPORATED IN THE RESIDENT OR COUNTY ENGINEER PROJECT FILE.

8/96

Form E216

DAILY VIRGIN AC TANK MEASUREMENT SHEET

Project No.: _____

Date: _____

Contract ID.: _____

Report No.: _____

Start Of Period

Tank No.:				
Time:				
Tank Capacity (Gallons) (A):				
Outage (% of Diameter) (B):				
T-104 Innage (% of Capacity) (C):				
Direct Reading (Gallons) (D):				
Temp. °F (E):				
T-102 Temp. Corr. Factor (F):				
Corrected Gallons (G)= (A*C*F)or(D*F):				
Total Corrected Gallons (H)= (G+G+G+G):	_____			

Total AC Added

Total Pounds (I):				
Weight Per Gallon (J):				
Total Corrected Gallons (K)= (I+I+I+I/J):	_____			

End Of Period

Time:				
Tank Capacity (Gallons) (L):				
Outage (% of Diameter) (M):				
T-104 Innage (% of Capacity) (N):				
Direct Reading (Gallons) (O):				
Temp. °F (P):				
T-102 Temp. Corr. Factor (Q):				
Corrected Gallons (R)= (L*N*Q)or(O*Q):				
Total Corrected Gallons (S)= (R+R+R+R):	_____			

Calculations

Total Corrected Gallons Used (T)= (H+K-S): _____

Average Weight Per Gallon (U): _____

Total Pounds Of AC Used (V)= (T*U): _____

Total Pounds Of Mix Made (W): _____

Total Pounds Of Mix Wasted (X): _____

Total Pounds Of AC Wasted (Y)= (X*Z): _____

Net Tons Of AC Used On Road = ((V-Y) / 2000): _____

Net Tons Of Mix Used On Road = ((W-X) / 2000): _____

Percent Virgin AC by Tank Stick (Z)= ((V / W) * 100): _____

Comments: _____

8/96

Form E216

DAILY VIRGIN AC TANK MEASUREMENT SHEET

Project No.: NHSN-63-9(19)-2R-45
 Contract ID.: 45-0639-019

Date: 09/08/96
 Report No.: 5

Start Of Period

Tank No.:	1		
Time:	06:47		
Tank Capacity (Gallons) (A):	25,000		
Outage (% of Diameter) (B):	15.6		
T-104 Innage (% of Capacity) (C):	90.0440		
Direct Reading (Gallons) (D):			
Temp. °F (E):	300		
T-102 Temp. Corr. Factor (F):	0.9187		
Corrected Gallons (G)= (A*C*F)or(D*F):	20,681		
Total Corrected Gallons (H)= (G+G+G+G):	<u>20,681</u>		

Total AC Added

Total Pounds (I):	103,066		
Weight Per Gallon (J):	8.5641		
Total Corrected Gallons (K)= (I+I+I+I/J):	<u>12,035</u>		

End Of Period

Time:	06:58		
Tank Capacity (Gallons) (L):	25,000		
Outage (% of Diameter) (M):	69.4		
T-104 Innage (% of Capacity) (N):	25.9350		
Direct Reading (Gallons) (O):			
Temp. °F (P):	295		
T-102 Temp. Corr. Factor (Q):	0.9204		
Corrected Gallons (R)= (L*N*Q)or(O*Q):	5,968		
Total Corrected Gallons (S)= (R+R+R+R):	<u>5,968</u>		

Calculations

Total Corrected Gallons Used (T)= (H+K-S):	<u>26,748</u>
Average Weight Per Gallon (U):	<u>8.5641</u>
Total Pounds Of AC Used (V)= (T*U):	<u>229,073</u>
Total Pounds Of Mix Made (W):	<u>4,001,650</u>
Total Pounds Of Mix Wasted (X):	
Total Pounds Of AC Wasted (Y)= (X*Z):	
Net Tons Of AC Used On Road = ((V-Y) / 2000):	<u>114.54</u>
Net Tons Of Mix Used On Road = ((W-X) / 2000):	<u>2,000.83</u>
Percent Virgin AC by Tank Stick (Z)= ((V / W) * 100):	<u>5.72</u>

Comments: Example using T-104 Tables.

8/96

Form E216

DAILY VIRGIN AC TANK MEASUREMENT SHEET

Project No.: NHSN-63-9(19)-2R-45
Contract ID.: 45-0639-019

Date: 09/08/96
Report No.: 5

Start Of Period

Tank No.:	1	2	2	
Time:	06:47	10:05	02:00	
Tank Capacity (Gallons) (A):	25,000	25,000	25,000	
Outage (% of Diameter) (B):				
T-104 Innage (% of Capacity) (C):				
Direct Reading (Gallons) (D):	23,450	21,075	15,000	
Temp. °F (E):	300	300	300	
T-102 Temp. Corr. Factor (F):	0.9187	0.9187	0.9187	
Corrected Gallons (G)= (A*C*F)or(D*F):	21,544	19,362	13,781	
Total Corrected Gallons (H)= (G+G+G+G):	<u>40,906</u>			

Total AC Added

Total Pounds (I):	103,066			
Weight Per Gallon (J):	8.5641			
Total Corrected Gallons (K)= (I+I+I+I/J):	<u>12,035</u>			

End Of Period

Time:	06:58	10:30	02:25	
Tank Capacity (Gallons) (L):	25,000	25,000	25,000	
Outage (% of Diameter) (M):				
T-104 Innage (% of Capacity) (N):				
Direct Reading (Gallons) (O):	9,750	15,000	8,560	
Temp. °F (P):	295	300	300	
T-102 Temp. Corr. Factor (Q):	0.9204	0.9187	0.9187	
Corrected Gallons (R)= (L*N*Q)or(O*Q):	8,974	13,781	7,864	
Total Corrected Gallons (S)= (R+R+R+R):	<u>30,619</u>			

Calculations

Total Corrected Gallons Used (T)= (H+K-S):	<u>22,322</u>
Average Weight Per Gallon (U):	<u>8.5641</u>
Total Pounds Of AC Used (V)= (T*U):	<u>191,168</u>
Total Pounds Of Mix Made (W):	<u>3,207,523</u>
Total Pounds Of Mix Wasted (X):	<u>10,000</u>
Total Pounds Of AC Wasted (Y)= (X*Z):	<u>596</u>
Net Tons Of AC Used On Road = ((V-Y) / 2000):	<u>95.29</u>
Net Tons Of Mix Used On Road = ((W-X) / 2000):	<u>1,598.76</u>
Percent Virgin AC by Tank Stick (Z)= ((V / W) * 100):	<u>5.96</u>

Comments: Example using Direct Reading.

Tank 2 was measured twice during the day of production.

8/96

Form M216

DAILY VIRGIN AC TANK MEASUREMENT SHEET

Project No.: _____
 Contract ID.: _____

Date: _____
 Report No.: _____

Start Of Period

Tank No.:			
Time:			
Tank Capacity (Liters) (A):			
Outage (% of Diameter) (B):			
T-104 Innage (% of Capacity) (C):			
Direct Reading (Liters) (D):			
Temp. °C (E):			
T-102 Temp. Corr. Factor (F):			
Corrected Liters (G)= (A*C*F)or(D*F):			
Total Corrected Liters (H)= (G+G+G+G):	<hr/>		

Total AC Added

Total Kilograms (I):			
Mass Per Liter (J):			
Total Corrected Liters (K)= (I+I+I+I/J):	<hr/>		

End Of Period

Time:			
Tank Capacity (Liters) (L):			
Outage (% of Diameter) (M):			
T-104 Innage (% of Capacity) (N):			
Direct Reading (Liters) (O):			
Temp. °C (P):			
T-102 Temp. Corr. Factor (Q):			
Corrected Liters (R)= (L*N*Q)or(O*Q):			
Total Corrected Liters (S)= (R+R+R+R):	<hr/>		

Calculations

Total Corrected Liters Used (T)= (H+K-S): _____

Mass Per Liter (U): _____

Total Kilograms Of AC Used (V)= (T*U): _____

Total Kilograms Of Mix Made (W): _____

Total Kilograms Of Mix Wasted (X): _____

Total Kilograms Of AC Wasted (Y)= (X*Z): _____

Net Mg. Of AC Used On Road = ((V-Y) / 1000): _____

Net Mg. Of Mix Used On Road = ((W-X) / 1000): _____

Percent Virgin AC by Tank Stick (Z)= ((V / W) * 100): _____

Comments: _____

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Form M216

DAILY VIRGIN AC TANK MEASUREMENT SHEET

Project No.: NHSN-63-9(19)-2R-45
Contract ID.: 45-0639-019

Date: 09/09/96
Report No.: 1

Start Of Period

Tank No.:	<u>1</u>		
Time:	<u>06:30</u>		
Tank Capacity (Liters) (A):	<u>94,635</u>		
Outage (% of Diameter) (B):	<u>10.0</u>		
T-104 Innage (% of Capacity) (C):	<u>94.7960</u>		
Direct Reading (Liters) (D):			
Temp. °C (E):	<u>149</u>		
T-102 Temp. Corr. Factor (F):	<u>0.9183</u>		
Corrected Liters (G)= (A*C*F)or(D*F):	<u>82,381</u>		
Total Corrected Liters (H)= (G+G+G+G):	<u>82,381</u>		

Total AC Added

Total Kilograms (I):	<u>46,750</u>		
Mass Per Liter (J):	<u>1.0262</u>		
Total Corrected Liters (K)= (I+I+I+I/J):	<u>45,556</u>		

End Of Period

Time:	<u>06:35</u>		
Tank Capacity (Liters) (L):	<u>94,635</u>		
Outage (% of Diameter) (M):	<u>80.0</u>		
T-104 Innage (% of Capacity) (N):	<u>14.2380</u>		
Direct Reading (Liters) (O):			
Temp. °C (P):	<u>149</u>		
T-102 Temp. Corr. Factor (Q):	<u>0.9183</u>		
Corrected Liters (R)= (L*N*Q)or(O*Q):	<u>12,373</u>		
Total Corrected Liters (S)= (R+R+R+R):	<u>12,373</u>		

Calculations

Total Corrected Liters Used (T)= (H+K-S):	<u>115,564</u>
Mass Per Liter (U):	<u>1.0262</u>
Total Kilograms Of AC Used (V)= (T*U):	<u>118,592</u>
Total Kilograms Of Mix Made (W):	<u>2,014,080</u>
Total Kilograms Of Mix Wasted (X):	<u>12,000</u>
Total Kilograms Of AC Wasted (Y)= (X*Z):	<u>707</u>
Net Mg. Of AC Used On Road = ((V-Y) / 1000):	<u>117.89</u>
Net Mg. Of Mix Used On Road = ((W-X) / 1000):	<u>2,002.08</u>
Percent Virgin AC by Tank Stick (Z)= ((V / W) * 100):	<u>5.89</u>

Comments: Example using T-104 tables.

8/96

Form M216

DAILY VIRGIN AC TANK MEASUREMENT SHEET

Project No.: NHSN-63-9(19)-2R-45
 Contract ID.: 45-0639-019

Date: 09/09/96
 Report No.: 1

Start Of Period

Tank No.:	1	2		
Time:	06:30	08:00		
Tank Capacity (Liters) (A):	94,635	94,635		
Outage (% of Diameter) (B):				
T-104 Innage (% of Capacity) (C):				
Direct Reading (Liters) (D):	34,629	74,898		
Temp. °C (E):	149	149		
T-102 Temp. Corr. Factor (F):	0.9183	0.9183		
Corrected Liters (G)= (A*C*F)or(D*F):	31,800	68,779		
Total Corrected Liters (H)= (G+G+G+G):	<u>100,579</u>			

Total AC Added

Total Kilograms (I):	116,782			
Mass Per Liter (J):	1.0262			
Total Corrected Liters (K)= (I+I+I+I/J):	<u>113,800</u>			

End Of Period

Time:	06:35	05:00		
Tank Capacity (Liters) (L):	94,635	94,635		
Outage (% of Diameter) (M):				
T-104 Innage (% of Capacity) (N):				
Direct Reading (Liters) (O):	53,016	59,105		
Temp. °C (P):	149	149		
T-102 Temp. Corr. Factor (Q):	0.9183	0.9183		
Corrected Liters (R)= (L*N*Q)or(O*Q):	48,685	54,276		
Total Corrected Liters (S)= (R+R+R+R):	<u>102,961</u>			

Calculations

Total Corrected Liters Used (T)= (H+K-S):	<u>111,418</u>
Mass Per Liter (U):	<u>1.0262</u>
Total Kilograms Of AC Used (V)= (T*U):	<u>114,337</u>
Total Kilograms Of Mix Made (W):	<u>2,014,080</u>
Total Kilograms Of Mix Wasted (X):	<u>12,000</u>
Total Kilograms Of AC Wasted (Y)= (X*Z):	<u>682</u>
Net Mg. Of AC Used On Road = ((V-Y) / 1000):	<u>113.66</u>
Net Mg. Of Mix Used On Road = ((W-X) / 1000):	<u>2,002.08</u>
Percent Virgin AC by Tank Stick (Z)= ((V / W) * 100):	<u>5.68</u>

Comments: Example using Direct Reading.