**ATT-16/95, PRODUCTION RATE AND PLANT CHECK
PART III, Drum Mix Asphalt Plants**

1.0   SCOPE

This method describes the procedures for verifying the drum mix asphalt plant calibration while the plant is operating and for determining the test series and daily totalizer asphalt contents.

2.0   EQUIPMENT

calculator
tachometer
stop-watch

Data Sheet: Drum Plant Inspection, MAT 6-42

3.0   PROCEDURE

When performing the following checks, the production rate must be constant. The checks must be done for each series of tests and all data must be recorded on the data sheet (MAT 6-42), which also serves as a report form.

A typical example of a completed form is shown in Figure 1.

3.1   Drum Plant Inspection

1.   Complete the headings on the data sheet.

2.   Note and record the relative density dial setting (line "B"), the aggregate totalizer span setting (line "D") and zero setting (line "E"), the revolution or flow counter calibration factor (line "F") and the temperature in $^{\circ}$C of the asphalt in the storage tank (line "C").

      NOTE: The data obtained in steps 2 and 3 should agree with the calibration data.

3.   Note and record the asphalt content dial setting (line "W") and the aggregate moisture content dial setting (line "K").

      NOTE: There are various types of moisture dials. They all read from 0 to 100 but the increments for some plants is 1% and for others is 10%.

                  For example, a setting of 3 should be read as 3% if the increment is 1%. The same reading of 3 should be read as 30% for the 10% dial increment type.

4.   Simultaneously perform the following:

  a) start the stop-watch,

  b) take an initial aggregate totalizer tonnes counter reading and record it in line "I",

  c) have another technologist take an initial reading on the flow meter or revolution counter (line "P"), depending on what the plant is equipped with,

  d) if the plant is not equipped with a flow meter or revolution counter, take a tachometer reading on the asphalt pump and record as Actual Speed of Asphalt Pump in rev/min (line"S").

5.   Note and record the production rate meter reading in the t/h of the dry aggregate (line "M") and of the asphalt pump (line "U"). Also record the meter reading in rev/min of the asphalt pump speed (line "R").

6.   When the aggregate totalizer tonnes counter has counted a minimum of 10 tonnes, simultaneously perform the following:

  a) stop the stop-watch,

  b) take a final aggregate totalizer tonnes counter reading and record it in line "H", and

  c) have another technologist take a final reading on the flow meter or revolution counter, (line "O").

7.   Convert the elapsed time to seconds and record it in line "G".

3.1.1 Aggregate Production Rate

1.   Subtract the initial aggregate totalizer reading (line "I") from the final reading (line "H"). and record the tonnes of aggregate counted in line "J".

2.   If the plant aggregate totalizer displays wet aggregate, calculate the Dry Aggregate Totalizer Count (line "L") as follows:

$$\frac{Aggregate\ Totalizer\ Count\ (Line\ "J")}{100\ \%\ Moisture\ Content\ Dial\ Setting\ (line\ "K")} \times 100\%$$

If the aggregate totalizer displays dry aggregate, transfer the count recorded in line "J" to line "L".

DRUM PLANT INSPECTION

PROJECT _99:18_ CONTRACT NO. _6666/95_ CONTRACTOR _Blacktop Paving_

DATE _95.06.14_ LOT NO. _2_ PLANT TYPE _Douglas 400_

A	WT. OF ASPHALT/REVOLUTION OF PUMP _2.27_ kg/rev or WT. OF ASPHALT/UNIT VOLUME _____ kg/ℓ, gal				
	TIME	07:30	09:55	13:15	16:05
	TEST NO.	1	2	3	4

PLANT SETTINGS

B	RELATIVE DENSITY DIAL SETTING		9.44	9.44	9.44	9.44
C	TEMPERATURES	ASPHALT STORAGE °C	148	147	178	149
		PLANT MIX °C	138	142	140	137
D	TOTALIZER SPAN SETTING		544	544	544	544
E	TOTALIZER ZERO SETTING		505	505	505	505
F	REVOLUTION OR FLOW COUNTER CALIBRATION FACTOR		0.2187	0.2187	0.2187	0.2187

AGGREGATE TOTALIZER SYSTEM

								DAILY AVERAGE	DAILY TOTALIZER
G	ELAPSED TIME		s	178	180	182	180		
AGGREGATE TOTALIZER	H	FINAL READING	t	37 589	38 332	39 377	40 254		40 376
	I	INITIAL READING	t	37 569	38 312	39 357	40 234		37 475
	J	COUNT H - I	t	20	20	20	20		2901
K	AGGREGATE MOISTURE CONTENT DIAL SETTING		%	5.6	5.6	5.6	5.6	5.6	5.6
L	DRY AGGREGATE TOTALIZER COUNT 100 J / (100 + K)		t	18.94	18.94	18.94	18.94		2747.16
DRY AGGREGATE PRODUCTION RATE	M	METER READING	t/h	382	378	376	380	379	
	N	ACTUAL 3600 L / G	t/h	383	379	375	379	379	

ASPHALT TOTALIZER SYSTEM

								DAILY AVERAGE	DAILY TOTALIZER
REVOLUTION OR FLOW METER	O	FINAL READING	rev, l, gal	11 847	30 132	56 541	78 875		82 002
	P	INITIAL READING	rev, l, gal	11 346	29 628	56 034	78 377		8 974
	Q	COUNT O - P	rev, l, gal	501	504	507	498		73 028
SPEED OF ASPHALT PUMP	R	METER READING	rev/min	168	169	167	167	168	
	S	ACTUAL 60 Q / G	rev/min	169	168	167	166	168	
T	WT. OF ASPHALT PUMPED Q A / 1000		t	1.137	1.144	1.151	1.130		165.77
VIRGIN ASPHALT PRODUCTION RATE	U	METER READING	t/h	23.0	23.0	23.0	23.0	23.0	
	V	ACTUAL 3600 T / G	t/h	23.0	22.9	22.8	22.6	22.8	
ASPHALT CONTENT	W	DIAL SETTING	%	6.0	6.0	6.0	6.0	6.0	
	X	ACTUAL SETTING (CAL. GRAPH)	%	6.0	6.0	6.0	6.0	6.0	
	Y	ACTUAL 100 T / L	%	6.00	6.04	6.08	5.97	6.02	6.03

DAILY TOTALIZER ASPHALT CONTENT

AA	TRUCK SCALE TOTAL WEIGHT OF MOIST MIX		t	2940
BB	MIX MOISTURE CONTENT		%	0.4
CC	WEIGHT OF DRY MIX	100 AA / (100 + BB)	t	2928
DD	WEIGHT OF DRY AGGREGATE	CC - T	t	2762
EE	BELT SCALE ERROR	100 (DD - L) / DD (ALLOWABLE ERROR ± 2%)	%	0.5
FF	DAILY TOTALIZER ASPHALT CONTENT	100 T / DD	%	6.00

AGGREGATE BIN PROPORTIONING SYSTEM

BIN MOTOR SPEED (TACHOMETER READING)	GG	BIN NUMBER 1	rev/min	1410	1400	1390	1420		
	HH	BIN NUMBER 2	rev/min	690	680	720	730	MATERIAL TYPE	BIN NO.
	II	BIN NUMBER 3	rev/min	510	560	530	540	Coarse	1
	JJ	BIN NUMBER 4	rev/min	400	390	430	400	Natural Fines	3
DRY AGGREGATE PRODUCTION RATE (CALIBRATION GRAPH)	KK	BIN NUMBER 1	t/h	210	209	207	212	Manufactured Fines	2
	LL	BIN NUMBER 2	t/h	84	82	86	87	Blend Sand	4
	MM	BIN NUMBER 3	t/h	56	56	52	53		
	NN	BIN NUMBER 4	t/h	30	29	33	30		
OO	TOTAL BIN DRY AGG. PROD. RATE KK + LL + MM + NN	t/h	380	376	378	382	DAILY AVERAGE	DESIGN OR TARGET
PERCENT SPLIT	PP	BIN NUMBER 1 100 KK / OO	%	55.3	55.6	54.8	55.5	55.3	56
	QQ	BIN NUMBER 2 100 LL / OO	%	22.1	21.8	22.8	22.8	22.4	22
	RR	BIN NUMBER 3 100 MM / OO	%	14.7	14.9	13.7	13.9	14.3	14
	SS	BIN NUMBER 4 100 NN / OO	%	7.9	7.7	8.7	7.8	8.0	8

MAT6 - 42/95

MATERIALS TECHNOLOGIST _J. Goodson_   PROJECT MANAGER _I. M. Keen_

FIGURE 1

3. Calculate the "Actual" Dry Aggregate Production Rate in t/h (line "N") using the formula:

$$\frac{Dry\ Aggregate\ Totalizer\ Count\ (line\ "L")}{Elapsed\ Time\ in\ Seconds\ (line\ "G")} \times 3600\ s/h$$

4. Compare the Actual Dry Aggregate Production Rate (line "M") to the Meter Reading (line "N"). The actual value should be within ±5 t/h of the meter reading.

3.1.2 Speed of Asphalt Pump

1. Subtract the initial revolution or flow meter reading (line "P") from the final reading (line "O") and record as Revolution Count or Flow Meter Count (line "Q").

2. If a tachometer reading was not taken, calculate the actual speed of the asphalt pump in rev/min (line "S") using the formula:

$$\frac{Number\ of\ Revolutions\ (line\ "Q")}{Elapsed\ Time\ in\ Seconds\ (line\ "G")} \times 60\ s/min$$

3. Compare the Actual Speed of Asphalt Pump (line "S") to the Meter Reading (line "R") obtained using the tachometer, or in a case of Boeing Plants, the rev/min Meter. The two figures should be within ± 2 rev/min. Also the two figures should be within ± 1 rev/min of the speed of the pump obtained during the calibration of the plant.

3.1.3 Asphalt Production Rate

1. Obtain from the plan calibration data the weight of asphalt delivered per revolution of pump or the weight of asphalt per unit volume (as measured by the flow meter) and record it in line "A".

2. Calculate the weight of asphalt used in tones (line "T") using one of the following formulas:

$$\frac{Number\ of\ Revolutions\ (line\ "Q") \times Wt.\ of\ Asphalt\ (kg)\ per\ Rev.\ (line"A")}{1000\ kg/t}$$

or

$$\frac{Flow\ Meter\ Count\ (line\ "Q") \times Wt.\ of\ Asphalt\ (kg)\ per\ Unit\ Vol.\ (line"A")}{1000\ kg/t}$$

3.   Determine the "Actual" Asphalt Production Rate in t/h (line "V") as follows:

$$' \quad \frac{Weight\ of\ Asphalt\ (line\ "T")}{Elapsed\ Time\ in\ Seconds\ (line\ "G")} \times 3600\ s/h$$

4.   If the plant is equipped with a flow meter device, compare the Actual Asphalt Production Rate (line "V") to the Meter Reading (line "U"). The actual value should be within ± 5% of the meter reading. If not, check the asphalt content methods. If they also indicate a variance, they may be out of calibration.

5.   If the plant is not equipped with a flow meter device, use the Actual Speed of Asphalt Pump (line "S") and the Calibration Graph showing the rev/min of pump plotted against the t/h of asphalt to pick off the t/h of asphalt delivered and record it in line "V". This value should be within ± 5% of the meter reading figure shown in line "U".

3.1.4   Totalizer Asphalt Content

1.   Calculate the test series totalizer asphalt content in % (line "Y") using either of the following formulas:

$$Actual\ Asphalt\ Content\ (\%)\ ' \quad \frac{Wt.\ of\ Asphalt\ Pumped\ (line\ "T")}{Dry\ Aggregate\ Totalizer\ Count\ (line\ "L")} \times 100\%$$

$$Actual\ Asphalt\ Content\ (\%)\ ' \quad \frac{Actual\ Asphalt\ Production\ Rate\ (line\ "V")}{Actual\ Dry\ Agg.\ Production\ Rate\ (line\ "N")} \times 100\%$$

2.   The test series totalizer Asphalt Content (line "Y") and the Dial Setting (line "W") should be the same as the calibration data.

3.   Use the Asphalt Content Dial Setting (line "W") and the calibration graph of dial versus actual asphalt content to determine the percent asphalt delivered at that particular setting. Record as Actual Setting (line "X").

4.   The test series totalizer asphalt content (line "Y") and the Actual Setting (line "X" must be the same. If they are not, the plant must be recalibrated.

        This check will detect problems in the asphalt electronic proportioning system and, on Boeing plants, a problem with the revolution counter. It will not detect if a problem exists with the belt scale or flow meter, unless they totally malfunction.

5.   The totalizer asphalt content (line "Y") should be within ± 0.3% of the design or target asphalt content.

6.   If the dial setting (line "W") is the same as the actual setting (line "X"), the totalizer asphalt content (line "Y") should compare to the dial setting.

3.1.5   Asphalt Content Between Tests

The totalizer asphalt content can be determined between drum plan inspection tests as follows:

1.   Obtain from the data sheet the final reading on the aggregate totalizer (line "H") and the final reading on the revolution counter or flow meter (line "O") of a test series, as shown in Figure 2.

Use the final readings of the previous day (or initial readings of the day) for the check between the start of the day's production and the first test series.

DRUM PLANT INSPECTION

Alberta Transportation and Utilities

PROJECT _99:18_   CONTRACT NO. _6666/95_   CONTRACTOR _Blacktop Paving_
DATE _95.06.14_   LOT NO. _2_   PLANT TYPE _Douglas 400_

A   WT. OF ASPHALT/REVOLUTION OF PUMP _2.27_ kg/rev or WT. OF ASPHALT/UNIT VOLUME _____ kg/ℓ, gal

TIME							
TEST NO.			0-1	1-2	2-3	3-4	4-END

PLANT SETTINGS

B	RELATIVE DENSITY DIAL SETTING						
C	TEMPERATURES	ASPHALT STORAGE °C					
		PLANT MIX °C					
D	TOTALIZER SPAN SETTING						
E	TOTALIZER ZERO SETTING						
F	REVOLUTION OR FLOW COUNTER CALIBRATION FACTOR						

AGGREGATE TOTALIZER SYSTEM

				0-1	1-2	2-3	3-4	4-END
G	ELAPSED TIME		s					
	AGGREGATE TOTALIZER	H FINAL READING	t	37 569	38 312	39 357	40 234	40 376
		I INITIAL READING	t	37 475	37 589	38 332	39 377	40 254
		J COUNT H-I	t	94	723	1025	857	122
K	AGGREGATE MOISTURE CONTENT DIAL SETTING		%	5.6	5.6	5.6	5.6	5.6
L	DRY AGGREGATE TOTALIZER COUNT 100 J / (100 + K)		t	89.02	684.66	970.64	811.55	115.53
	DRY AGGREGATE PRODUCTION RATE	M METER READING	t/h					
		N ACTUAL 3600 L / G	t/h					

ASPHALT TOTALIZER SYSTEM

				0-1	1-2	2-3	3-4	4-END
	REVOLUTION OR FLOW METER	O FINAL READING	rev, l, gal	11 346	29 628	56 034	78 377	82 002
		P INITIAL READING	rev, l, gal	8 974	11 847	30 132	56 541	78 875
		Q COUNT O-P	rev, l, gal	2 372	17 781	25 902	21 836	3 127
	SPEED OF ASPHALT PUMP	R METER READING	rev/min					
		S ACTUAL 60 Q / G	rev/min					
T	WT. OF ASPHALT PUMPED Q A / 1000		t	5.38	40.36	58.80	49.57	7.10
	VIRGIN ASPHALT PRODUCTION RATE	U METER READING	t/h					
		V ACTUAL 3600 T / G	t/h					
	ASPHALT CONTENT	W DIAL SETTING	%					
		X ACTUAL SETTING (CAL. GRAPH)	%					AVERAGE
		Y ACTUAL 100 T / L	%	6.04	5.89	6.06	6.11	6.15 6.05

MAT6 - 42/95

FIGURE 2

2.   Obtain from the data sheet the initial readings on the aggregate totalizer (line
        "I") and on the revolution counter or flow meter (line "P") of the following test
        series.

        Use the final readings of the day for the check between the day's last test
        series and the end of the day's production.

3.   Subtract the test series final reading from the following test series initial
        reading (or final reading of the day, if performing the last check of the day).

4.   Record the aggregate totalizer count between test series (line "J") and the
        number of revolutions or flow meter count (line "Q").

5.   Calculate the weight of dry aggregate (Section 3.1.1, Step 2), the weight of
        asphalt used (Section 3.1.3, Step 2) and the totalizer asphalt content
        between test series (Section 3.1.4, Step 1).

        Figure 2 shows a completed example using values from Figure 1.

3.1.6   Bin Proportioning System

1.   Record on the lower right side of the data sheet the number assigned to the
        coarse bin (C) natural fines bin (NF), manufactured fines bin (MF), and blend
        sand bin (BS).

2.   Take two or more tachometer readings on the electric motor on the feed
        conveyor of each bin.

3.   Record the speed in rev/min of each bin on the line which corresponds to the
        assigned bin number (lines "GG" to "JJ").

4.   Plot the speed of each bin on the Aggregate Calibration Graph. Pick off the
        corresponding curve, the production rate in t/h of each material type.

5.   Record the production rate of each material on the line which corresponds to
        the assigned bin number (lines "KK" to "NN").

6.   Calculate the total dry aggregate bin production rate in the t/h and record it
        in line "OO".

7.   Calculate the proportion of each bin using the formula:

$$Bin\ \%\ Split = \frac{Bin\ Production\ Rate\ (t/h)}{Total\ Bin\ Production\ Rate\ (t/h)} \times 100\%$$

8.   Record the percent split of the bin on the line which corresponds to the
        assigned bin number (lines "PP" to "SS").

3.2   Daily Totalizer Asphalt Content

1.   Before the asphalt plant starts producing for the day, take an initial totalizer
        tonnes counter reading (last column, line "I") and an initial flow meter or
        revolution counter reading (last column, line "P").

2.   When the plant shuts down for the day, take a final totalizer tonnes counter
        reading (line "H") and a final flow meter or revolution counter reading (line
        "O").

3.   At the end of the production day, obtain from the scale person, the weight in
        kg of all loads of mix rejected or diverted during that day.

        NOTE: For each totalizer asphalt content, ensure the loads rejected at
                     the plant which do not pass over the scales, are added to the mix
                     produced. Occasionally the contractor may be asked to divert
                     loads of mix to another project, i.e., patching. Since these loads
                     are typically recorded on separate scale sheets, ensure that you
                     account for all mix produced by the asphalt plant during the time
                     period.

4.   Obtain, from the office person, the total weight in kg of moist mix produced
        during the day, as shown in the scale sheet.

5.   Calculate the total weight of moist mix in tonnes produced by the plant during
        the day (line "AA") as follows:

$$= \frac{Scale\ Sheet\ Wt.\ of\ Mix\ \%\ Rejected\ or\ Diverted\ Wt.\ of\ Mix}{1000\ kg/t}$$

6.   Determine the average moisture content of the mix in percent and record it
        in line "BB".

7.   Calculate the Weight of Dry Mix (line "CC") using the formula:

$$Wt.\ of\ Dry\ Mix\ (t) = \frac{Total\ Wt.\ of\ Moist\ Mix\ (line"AA")}{100\ \%\ Mix\ Moisture\ Content\ in\ \%\ (line"BB")} \times 100\%$$

8.   Obtain from the plant calibration data, the weight of asphalt delivered per
        revolution of pump or the weight of asphalt per unit volume as measured by
        the flow meter and record it in line "A".

9.   Subtract the original flow meter or revolution counter reading (line "P") from
        the final reading (line "O") and record as Revolution or Flow Meter Count (line
        "Q").

10.   Calculate the weight in tonnes of asphalt (line "T") used during the totalizer
        asphalt content check using the applicable formula:

$$= \frac{No.\ of\ Revolutions\ (line"Q") \times Wt.\ of\ Asphalt\ per\ Rev.\ in\ kg\ (line"A")}{1000\ kg/t}$$

$$= \frac{Flow\ Meter\ Count\ (line"Q") \times Wt.\ of\ Asphalt\ per\ Unit\ Volume\ in\ kg\ (line"A")}{1000\ kg/t}$$

11.   Calculate the Weight of Dry Aggregate (line "DD") as follows:

$$\textit{Wt. of Dry Agg. (t)} = \textit{Wt. of Dry Mix (line "CC")} - \textit{Wt. of Asphalt (line "T")}$$

12.   Calculate the daily totalizer Asphalt Content in % (line "FF") using the formula:

$$\textit{Asphalt Content (\%)} = \frac{\textit{Wt. of Asphalt (line "T")}}{\textit{Wt. of Dry Aggregate (line "DD")}} \times 100\%$$

13.   Subtract the original totalizer tonnes counter reading (line "I") from the final reading (line "H") and record as Aggregate Totalizer Count (line "J").

14.   Obtain the Moisture Content Dial Setting for the day and record it in line "K".

15.   If the plant totalizer displays tonnes of wet aggregate, calculate the Dry Aggregate Totalizer Count in t (line "L") using the formula:

$$\textit{Dry Agg. Totalizer Count (t)} = \frac{\textit{Aggregate Totalizer Count (line "J")}}{100 - \textit{Moisture Content Dial Setting (line "K")}} \times 100\%$$

16.   Calculate the Belt Scale Error (line "EE") in % as follows:

$$= \frac{\textit{Weight of Dry Agg. (line "DD")} - \textit{Dry Agg. Totalizer Count (line "L")}}{\textit{Wt. of Dry Aggregate (line "DD")}} \times 100\%$$

If the error is greater than 1%, the belt scale must be recalibrated in the range that the plant is being operated.

4.0   HINTS AND PRECAUTIONS

1.   The belt scale must be warmed up for half hour before any tests.

2.   If settlement or movement of the belt scale conveyor occurs, the belt scale must be recalibrated as directed in ATT-17, until it is reading accurately.

3.   The belt scale must be checked with known amount of test weights. This determines if the load cell signal is the same as when it was calibrated and if the totalizer is working properly. However, the test does not necessarily indicate that the belt scale is accurate.

4.   Make sure that percent moisture and relative density dials are set correctly.