ATT-17/96, PLANT CALIBRATION
Part II, Center Feed Recycle Drum Mix Asphalt Plant

1.0   SCOPE

This method describes the procedures for calibrating the virgin aggregate and reclaimed asphalt pavement proportioning systems and the asphalt system of center feed recycle drum mix asphalt plants.

2.0   EQUIPMENT

calculator   plant log book
tachometer   1 - tared haul truck
stopwatch   1 - distributor truck
graph paper

Data Sheets: Drum Plant Aggregate Calibration, MAT 6-38
               Recycling Drum Plan Inspection, MAT 6-66

3.0   PROCEDURE

3.1   General

The center feed recycle drum mix asphalt plant has two belt scales, one is used for virgin aggregate and the other for the reclaim material (RAP). These plants also have the following additional controls:

1.   Reclaim Moisture Dial. This dial is set at the reclaim moisture content and is used to correct for moisture in the reclaim. The "R/V Ratio" is based on the outputs of dry reclaim and virgin aggregate.

2.   Reclaim Production Rate Meter. This digital meter will read the output of the dry reclaim in t/h when the moisture dial is set at the reclaim moisture content.

3.   Reclaim Asphalt Dial. This dial is set at the asphalt content in the reclaim which is based on the weight of dry aggregate in the reclaim. This setting enables the plant electronics to determine the amount of asphalt already available.

    For example: Dry Reclaim Production Rate = 60 t/h
                   Reclaim Asphalt Content   = 5.0%

$$Reclaim\ Dry\ Agg.\ Production\ Rate \text{'} \frac{60\ t/h}{100\ \%\ 5\%} \times 100\% \text{'}\ 57.14\ t/h$$

4.   Virgin Asphalt Dial.. This dial becomes the total asphalt content dial.

5.   Automatic R/V Ration Control with R/V Ratio Dial in percent. This optional
        system is used to control the R/V ratio using the belt scale weights. The R/V
        Ratio (% Reclaim) is calculated as follows:

$$\% \ Reclaim \ (R/V) \ ' \ \frac{Wt. \ of \ Dry \ Reclaim}{Wt. \ of \ Dry \ Reclaim \ \% \ Wt. \ of \ Dry \ Virgin \ Aggregate} \ \times 100\%$$

3.2   Calibration of Belt Scale and Test Weights

1.   Calibrate the virgin aggregate and the reclaim belt scales as described in
        ATT-17, Part I, Section 3.2, for the type of totalizer being used. Check each
        scale in the proper production range.

        For example: Desired Production Rate   = 300 t/h
                                    R/V Ratio   = 20/80

        Calibration Production Rate $' \ \dfrac{300 \ t/h \times 80\%}{100\%} \ ' \ 240 \ t/h$
        of Virgin Aggregate

        Calibration Production Rate $' \ \dfrac{300 \ t/h \times 20\%}{100\%} \ ' \ 60 \ t/h$
        of Reclaim

        Use virgin aggregate to calibrate the reclaim belt scale because aggregate
        flows more consistently than reclaim.

2.   After each belt scale is calibrated, calibrate the test weights as directed in
        ATT-17, Part I, Section 3.2.2.2.

3.3   Cold Feed Bins Calibration

1.   Calibrate each virgin aggregate cold feed bin and the RAP bin as described
        in ATT-17, Part I, Section 3.3.2.

        NOTE: While calibrating the RAP bin, make sure the contractor is
                         loading **fresh RAP** into the bin. Re-used RAP may feed more
                         uniformly but does not simulate operating conditions. Fresh
                         RAP should feed within ±5%.

2.   If the reclaim (RAP) bin motor is controlled by the master feed dial, set and
        check the proportions as described in ATT-17, Part I, Section 3.3.3.

        If the RAP bin motor is controlled by an automatic system which uses the belt
        scale signal to control the R/V ratio, convert the virgin aggregate proportions
        to base (without RAP) using the following calculations:

a) Divide the % of crushed coarse, % of natural fines, % of manufactured fines and the % of blend sand based on total dry recycle (R+V) by the percent of virgin aggregate (% of V).

b) Multiply the result of step (a) by 100.

For example:

Design Proportions (%)	Reclaim	Crushed Coarse	Manufactured Fines	Natural Fines	Blend Sand
	20	60	0	14	6

Therefore the design R/V ratio is 20/80. This means that the combined virgin aggregate proportions based on total product is 80% (60+14+6).

The % of coarse, % of fines and % of blend sand are converted back to base as follows:

$$\% \; Crushed \; Coarse \; ' \; \frac{60\%}{80\%} \times 100\% \; ' \; 75.0\%$$

$$\% \; Natural \; Fines \; ' \; \frac{14\%}{80\%} \times 100\% \; ' \; 17.5\%$$

$$\% \; Blend \; Sand \; ' \; \frac{6\%}{80\%} \; x \; 100\% \; ' \; 7.5\%$$

Therefore, the Total Virgin = 100% Aggregate Produced

c) Set and check the proportions.

3. Set up a table so that the contractor can manually adjust the reclaim bin setting to ensure that the correct R/V ratio is maintained at different production rates. Calculate the Reclaim and the Virgin aggregate production rate meter readings by multiplying each desired total production rate (R+V) by the percent of Reclaim and by the percent of Virgin Aggregate.

For example:

R/V = 20/80   Reclaim Prod. Rate   = 300 x 20/100 = 60 t/h
R+V = 300 t/h Virgin Agg. Prod. Rate   = 300 x 80/100 = 240 t/h

Desired Production Rate (t/h)	Reclaim Meter (t/h)	Virgin Aggregate Meter (t/h)
300	60	240
275	55	220
250	50	200
225	45	180

3.4   Calibration of Asphalt System

The calibration of the asphalt system of a dual belt scale plant is similar to a single belt scale plant. The weight per revolution or unit volume is determined and then the asphalt content is checked by diverting asphalt back to the storage tank.

With a dual belt scale recycle plant there are other variables besides the production rate and asphalt content. They are the R/V ratio and differences in the reclaim and the total asphalt content. The number of tests on the asphalt blending system will vary depending on the variables.

The Recycling Drum Plant Inspection Report, MAT 6-66, shown in Figure 1, is used for the asphalt calibration procedure because it shows the calculations of the total asphalt content and R/V ratio.

The asphalt calibration may be performed in the automatic mode, or in the manual mode (with plant checks).

3.4.1   Asphalt Calibration in Automatic Mode

1.   Determine the production rate for each belt scale by multiplying the anticipated total dry aggregate production by the R/V ratio.

eg.:   total dry aggregate production rate   = 300 t/h
        R/V ratio   = 20/80
        desired reclaim production rate   = 300 x 0.2 =   60 t/h
        desired virgin agg. production rate   = 300 x 0.8 = 240 t/h

2.   Place enough weights on each scale to simulate the design R/V ratio at the desired output. If the contractor has a fixed weight system and the design R/V ratio cannot be achieved, the span dials of each totalizer can be temporarily adjusted. Calculate the adjusted span setting using the following equation:

$$\frac{Scale\ Test\ Weights\ Production\ Rate}{Span\ Setting} = \frac{Desired\ Production\ Rate}{Adjusted\ Span\ Setting}$$

For example:

Virgin Aggregate Scale Test Weights Production Rate   = 220 t/h
Desired Production Rate   = 240 t/h
Span Setting   = 454

Substituting the values into the above equation:

$$\frac{220}{454} = \frac{240}{x} \qquad Therefore,\ adjusted\ span\ setting = \frac{240\ x\ 454}{220} = 495$$

3.   Place the asphalt control system in the automatic mode.

4.   Set the reclaim and the total asphalt content dials at the design or target settings. Record the settings in lines "W" and "II" respectively.

5.   Set the virgin aggregate and reclaim moisture dial settings at zero. Record the settings in lines "K" and "R", respectively.

6.   Simultaneously perform the following:

    a)   When the virgin aggregate or reclaim totalizer turns to a whole tonne, start pumping asphalt into a tared distributor truck.

        NOTE: Count to an "even tonne" the totalizer with the lowest R/V ratio or the totalizer with the least decimals. The other totalizer will be counted simultaneously and may have a decimal.

    b)   Start the stop watch.

    c)   Take the initial reading on the Virgin Aggregate Totalizer Tonnes Counter, (line "I"). Reclaim Totalizer Tonnes Counter, (line "P"), and Revolution Counter or Flow Meter (line "BB").

    d)   If the plant is not equipped with a Revolution Counter or Flow Meter, use a tachometer to obtain the asphalt pump speed in rev/min.

7.   Record on the data sheet the production rate meter readings for Virgin Aggregate (line "M"), Reclaim (line "T") and Virgin Asphalt (line "EE"). Also record the Asphalt Pump Speed Meter Reading at the bottom of the data sheet.

8.   When at least 3500 kg of asphalt have been pumped into the distributor truck and the totalizer with the lowest R/V ratio or with the least decimals is at an even tonne, simultaneously perform the following:

    a)   Stop pumping asphalt into the distributor.

    b)   Stop the stop watch.

    c)   Take the final reading on the Virgin Aggregate Totalizer Tonnes Counter (line "H"), the Reclaim Totalizer Tonnes Counter (line "O") and the Revolution Counter or Flow Meter (line "AA").

9.   Have the loaded distributor truck weighed and record the net weight in kg as Wt. of Asphalt Pumped (line "DD").

10.   Convert the elapsed time to seconds and record it in lines "G" and "Z".

11.   Subtract the original from the final reading and record the virgin aggregate totalizer count (lines "J" and "L"), the reclaim totalizer count (lines "Q" and "S") and the revolution count or flow meter count (line "CC"),

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

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

13.   Compare the Actual Virgin Dry Aggregate Production Rate (line "N") to the Meter Reading (line "M"). The actual value should be within ±1% of the meter reading.

14.   Calculate the "Actual" dry reclaim production rate in t/h (line "U") as follows:

$$\frac{Dry\ Reclaim\ Totalizer\ Count\ (line\ "S")}{Elapsed\ Time\ (line\ "G")} \times 3600\ s/h$$

15.   Calculate the Reclaim/Virgin ratio (percent of reclaimed aggregate, (line "V") using the formula:

$$\frac{Dry\ Reclaim\ Totalizer\ Count\ (line\ "S")}{Dry\ Reclaim\ Totalizer\ Count\ \%\ Dry\ Virgin\ Aggregate\ Totalizer\ Count\ (}$$

16.   Calculate the reclaim dry aggregate production rate in t/h (line "X") as follows:

$$\frac{Actual\ Dry\ Reclaim\ Production\ Rate\ (line\ "U")}{100\ \%\ Reclaim\ Asphalt\ Content\ Dial\ Setting\ (line\ line\ "W")} \times 100\%$$

17.   Calculate the reclaim asphalt production rate in t/h (line "Y") using the formula:

$$Actual\ Dry\ Reclaim\ Prod.\ Rate\ (line\ "U")\ \&\ Reclaim\ Dry\ Agg.\ Prod.\ Rate$$

18.   Calculate the actual speed of the asphalt pump in rev/min (at the bottom of the data sheet) using the formula:

$$Actual\ Asphalt\ Pump\ Speed\ (rev/min) = \frac{No.\ of\ Rev.\ (line\ "CC") \times 60\ s/m}{Elapsed\ Time\ in\ s\ (line\ "Z")}$$

19.   Determine the weight of virgin asphalt delivered per revolution of the asphalt pump in kg/rev (line "A"), as follows:

$$Wt.\ of\ Asphalt/Rev = \frac{Wt.\ of\ Asphalt\ Pumped\ in\ kg\ (line\ "DD")}{No.\ of\ Revolutions\ (line\ "CC")}$$

RECYCLING DRUM PLANT INSPECTION

Alberta Transportation and Utilities

PROJECT _99:08_   CONTRACT NO. _6666/95_   CONTRACTOR _Blacktop Paving_

DATE _95.06.12_   LOT NO. _____   PLANT TYPE _C. M. I._

A	WT. OF ASPHALT/REVOLUTION OF PUMP _____ kg/rev or WT. OF ASPHALT/UNIT VOLUME _1.017_ kg/l, gal							
	TIME							
	TEST NO.	1	2	3	4	5	6	7

PLANT SETTINGS

		1	2	3	4	5	6	7
B	RELATIVE DENSITY DIAL SETTING							
C	ASPHALT STORAGE AND PLANT MIX TEMPERATURES °C							
D	AGGREGATE TOTALIZER SPAN AND ZERO SETTINGS							
E	RECLAIM TOTALIZER SPAN AND ZERO SETTINGS							
F	REVOLUTION OR FLOW COUNTER CALIBRATION FACTOR							

VIRGIN AGGREGATE TOTALIZER SYSTEM

				1	2	3	4	5	6	7
G	ELAPSED TIME		s	601	899	300	301	239	241	448
AGGREGATE TOTALIZER	H	FINAL READING	t	18 388.20	18 451.32	18 494.18	18 537.50	18 571.13	18 608.63	18 652.81
	I	INITIAL READING	t	18 448.05	18 411.37	18 474.11	18 517.42	18 556.21	18 593.55	18 632.95
	J	COUNT H - I	t	40.15	39.95	20.07	20.08	14.92	15.08	19.86
K	AGGREGATE MOISTURE CONTENT DIAL SETTING		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L	DRY AGGREGATE TOTALIZER COUNT 100 J / (100 + K)		t	40.15	39.95	20.07	20.08	14.92	15.08	19.86
DRY AGGREGATE PRODUCTION RATE	M	METER READING	t/h	240	160	240	241	225	225	160
	N	ACTUAL 3600 L / G	t/h	240.50	159.98	240.84	240.16	224.74	225.26	159.59

RECLAIM TOTALIZER SYSTEM

				1	2	3	4	5	6	7
RECLAIM TOTALIZER	O	FINAL READING	t	10 274.00	10 301.00	10 329.00	10 355.00	10 389.00	10 418.00	10 450.00
	P	INITIAL READING	t	10 264.00	10 291.00	10 324.00	10 350.00	10 384.00	10 413.00	10 445.00
	Q	COUNT O - P	t	10.00	10.00	5.00	5.00	5.00	5.00	5.00
R	RECLAIM MOISTURE CONTENT DIAL SETTING		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S	DRY RECLAIM TOTALIZER COUNT 100 Q / (100 + R)		t	10.00	10.00	5.00	5.00	5.00	5.00	5.00
DRY RECLAIM PRODUCTION RATE	T	METER READING	t/h	61	39	61	60	75	75	41
	U	ACTUAL 3600 S / G	t/h	59.90	40.04	60.00	59.80	75.31	74.69	40.18
V	R/V RATIO (PERCENT RECLAIM) 100 S / (L+ S)	%		19.9	20.0	19.9	19.9	25.1	24.9	20.1
W	RECLAIM ASPHALT CONTENT DIAL SETTING	%		5.7	5.7	5.7	5.0	5.7	5.0	5.0
X	RECLAIM DRY AGG. PROD. RATE 100 U / (100 + W)	t/h		56.67	37.84	56.76	56.95	71.25	71.13	38.27
Y	RECLAIM ASPHALT PRODUCTION RATE U - X	t/h		3.23	2.20	3.24	2.85	4.06	3.56	1.91

ASPHALT TOTALIZER SYSTEM

				1	2	3	4	5	6	7
Z	ELAPSED TIME		s	601	899	300	301	239	241	448
REVOLUTION OR FLOW METER	AA	FINAL READING	rev, l, gal	2002	1996	998	1036	742	839	1098
	BB	INITIAL READING	rev, l, gal	0	0	0	0	0	0	0
	CC	COUNT AA - BB	rev, l, gal	2002	1996	998	1036	742	839	1098
DD	WT. OF ASPHALT PUMPED CC.A / 1000		t	*2036 kg	*2030 kg	1.015	1.054	0.755	0.853	1.117
VIRGIN ASPHALT PRODUCTION RATE	EE	METER READING	t/h	12.1	8.2	12.2	12.5	11.4	12.7	9.0
	FF	ACTUAL 3600 DD / Z	t/h	12.20	8.13	12.18	12.60	11.37	12.75	8.97
GG	TOTAL ASPHALT PRODUCTION RATE Y + FF		t/h	15.43	10.33	15.42	15.45	15.43	16.31	10.88
ASPHALT CONTENT	HH	VIRGIN 100 FF / (N + X)	%	4.11	4.11	4.09	4.24	3.84	4.30	4.53
	II	DIAL SETTING	%	5.2	5.2	5.2	5.2	5.2	5.5	5.5
	JJ	ACTUAL SETTING (CAL. GRAPH)	%	-	-	-	-	-	-	-
	KK	TOTAL 100 GG / (N + X)	%	5.19	5.22	5.18	5.20	5.21	5.50	5.50

Truck scale weight

MAT6-66/90

FIGURE 1

20.   If the plant is equipped with a flow meter, determine the weight of virgin asphalt in kg delivered per unit volume of the flow meter (line "A") using the formula:

$$Wt.\ of\ Asphalt/Unit\ Volume = \frac{Wt.\ of\ Asphalt\ Pumped\ in\ kg\ (line\ "DD")}{Flow\ Meter\ Count\ (line\ "CC")}$$

   NOTE: The weight per revolution or unit volume should not fluctuate by more than 2%.

21.   Determine the "Actual" asphalt production rate in t/h (line "FF") using the formula:

$$Actual\ Asphalt\ Prod.\ Rate\ (t/h) = \frac{Wt.\ of\ Asphalt\ in\ kg\ (line\ "DD") \times 3.6}{Elapsed\ Time\ in\ s\ (line\ "Z")}$$

22.   Compare the Actual Asphalt Production Rate (line "FF") to the Meter Reading (line "EE"). The actual value should be within ±1% of the meter reading. If not, the electronics controlling the meter must be adjusted.

23.   Calculate the total asphalt production rate in t/h (line "GG") using the formula:

$$= Virgin\ Asphalt\ Prod.\ Rate\ (line\ "FF") + Reclaim\ Asphalt\ Prod.\ Rate\ (line\ "Y"$$

24   Calculate the Virgin Asphalt Content (line "HH") in % using the formula:

$$= \frac{Actual\ Asphalt\ Production\ Rate\ (line\ "FF")}{Reclaim\ Dry\ Agg.\ Prod.\ Rate\ (line\ "X") + Actual\ Dry\ Agg.\ Prod.\ Rate\ (line\ "N"}$$

25.   Calculate the Total Asphalt Content (line "KK") in % using the formula:

$$= \frac{Total\ Asphalt\ Production\ Rate\ (line\ "GG")}{Reclaim\ Dry\ Agg.\ Prod.\ Rate\ (line\ "X") + Actual\ Dry\ Agg.\ Prod.\ Rate\ (line\ "N"}$$

26.   Compare the Total Asphalt Content (line "KK") to the Dial Setting (line "II"). If the two figures do not agree, the electronics controlling the dial must be adjusted until the dial reads within ±0.3% of the Actual.

27.   Take weight off both belt scales to simulate a production rate approximately 25% lower than the desired output, but still maintaining the design R/V ratio.

   e.g.,   Reclaim production rate   = 60 x 0.75 =   45 t/h
           Virgin agg. production rate   = 240 x 0.75 = 180 t/h
           Total (R+V) production rate   = 300 x 0.75 = 225 t/h

           Check the R/V ratio: Reclaim   = 45 x 100/225 = 20
                                 Virgin Aggregate = 180 x 100/225 = 80
                                 Therefore,   R/V= 20/80

28.   Repeat the calibration procedure as described in steps 4 to 25 at the same (design or target) reclaim and total asphalt contents.

Figure 1 shows a completed example of an asphalt calibration performed at two production rates but at the same R/V ratio, reclaim asphalt dial and total asphalt dial settings.

29   Once the meters have been calibrated and the weight of asphalt per revolution or unit volume has been determined, have the asphalt diverted to the storage tanks.

30.   Replace the weights on the virgin aggregate and reclaim belt scales to simulate the desired production rate at the design (or target) R/V ratio.

31.   Ensure the virgin aggregate moisture content dial setting (line "K") and the reclaim moisture content dial setting (line "R") are set at zero and the reclaim asphalt content dial setting (line "W") and the total asphalt content dial setting (line "II") are at the design (or target) setting.

32.   Simultaneously perform the following:

    a)   Start the stop watch.

    b)   Take an initial virgin aggregate totalizer tonnes counter reading, (line "I") and a reclaim totalizer tonnes counter reading (line "P").

    c)   Take an initial reading on the flow meter or revolution counter (line "BB").

33.   Note and record the production rate meter readings in t/h of the virgin dry aggregate (line "M"), reclaim (line "T") and virgin asphalt (line "EE").

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

    a)   Stop the stop watch.

    b)   Take the final virgin aggregate totalizer tonnes counter reading (line "H"), and the final reclaim totalizer tonnes counter reading (line "O").

    c)   Take the final reading on the flow meter or revolution counter (line "AA").

35.   Complete the virgin aggregate and reclaim feed calculations as described in steps 10 to 17.

36.   Calculate the weight of asphalt pumped (line "DD") using one of the following formulas:

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

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

37.   Complete the remainder of the asphalt system calculations (lines "FF" to "KK") by repeating steps 21 to 26.

38.   Determine if the asphalt control system is tracking correctly by performing various simulated runs as described in steps 32 to 34, 10 to 17, 36, and 21 to 24 at varying R/V ratios and asphalt dial settings.

     The example in Figure 1 shows that for runs #4 to #6, the total (virgin aggregate and reclaim) production rate remained at the desired output of 300 t/h (60 + 240). For run #7, the total production rate was reduced to 200 t/h (40 + 160). The following variations were used:

     Run #4:   The reclaim % asphalt was reduced (from 5.7) to 5.0. The total asphalt content (5.2) and R/V ratio (20/80) remained at design settings.

     Run #5:   The R/V ratio was changed to 25/75 but both asphalt contents remained at the design settings.

     Run #6:   The R/V ratio was maintained at 25/75, the reclaim asphalt content was dropped to 5.0 and the total asphalt content was increased to 5.5.

     Run #7:   The R/V ratio was changed back to design (20/80), the total production rate was reduced to 200 t/h (from 300 t/h), the reclaim and total asphalt contents remained at 5.0 and 5.5 respectively.

3.4.2   Asphalt Calibration in Manual Mode

The weight per litre or revolution can also be determined with the asphalt controls on manual. However, the tests should still be done at approximately the same virgin asphalt production rates that will be used during mixing.

The **approximate** virgin asphalt production rate can be determined. Assuming the design asphalt content is 5.2%, the R/V ratio is 20/80 and the total dry aggregate production rate is 300 t/h.

$$Virgin\ Asphalt\ Content \quad \prime \quad \frac{5.2\% \times 80\%}{100\%} \quad \prime \quad 4.16\ \%$$

$$Virgin\ Asphalt\ Prod.\ Rate \quad \prime \quad \frac{4.16\% \times 300\ t/h}{100\%} \quad \prime \quad 12.48\ t/h$$

The asphalt pump should be checked at the anticipated virgin asphalt production rate of 12.5 t/h and at about 25% below the anticipated virgin asphalt production rate or approximately 9.4 t/h.

Once the weight per litre or revolution has been established manually, runs can be done on automatic as explained in steps 30 to 38.