ATT-74/22, IGNITION ASPHALT CONTENT
Part III, Correction Factor for RAP & VIRGIN AGG

1.0 SCOPE

This method describes the procedure to determine the Ignition Oven Asphalt Content Correction Factor for mix designs that have RAP and VIRGIN AGGREGATE.

Solvent extractions with Trichloroethylene or other solvents have been used for many decades to determine asphalt contents of asphalt mixtures and a method of recovering aggregate for additional tests, such as determining Correction Factors. However, use of this method has declined, and alternative test methods are being recommended, due to health concerns and environmental concerns in regards to chlorinated solvents.

Developed in the mid 1990's, the ignition oven procedure was rapidly implemented by labs to eliminate the use of hazardous solvents needed for extraction methods. The ignition method removes the binder from mixture samples by burning the binder at a high temperature, typically 538°C. The test is competed when the change in mass does not change by more than 0.01% for three consecutive minutes.

Since the extremely high temperature used in this test may result in some loss of aggregate mass, the determination of an asphalt content Correction Factor (CF) is essential for each mix type and each ignition oven used.

For this test we have therefore modified the test procedure in Part II, and removed the requirement for doing extractions on the RAP, and then doing separate correction factors on the extracted RAP. This new procedure now adds the % of RAP directly to the Virgin Aggregate, by using the average AC in the RAP from the mix design, and calculating the amount of binder and dry aggregate in the RAP, then burning the combined material in the ignition oven.

This correction factor will be subtracted from all subsequent QA & QC uncorrected ignition oven asphalt content tests to yield the "Corrected Ignition Asphalt Content" for each ACP mix type.

Asphalt binder content results may be affected by the type of virgin aggregate and RAP material in the mixture, and also by the type of ignition oven being used. Therefore, ignition oven correction factors must be established by testing a set of correction factor specimens using the job mix formula for each mix type. Each furnace is unique, and correction factors vary from furnace to furnace. Even two seemingly identical furnaces that operate in the same location may behave differently.

2.0 EQUIPMENT

Ignition Oven and accessory equipment (as described in ATT-74, Part I).

Lab Oven: convection or forced draft, thermostatically controlled to operate at the temperature of 110°C to 150°C (±5°C) to dry aggregate and the blended HMA mixtures.

Electronic Balance, approx 12 kg capacity, readable to 0.1 gram (as described in ATT-74, Part I).

25,000 µm minus Sieve Analysis Equipment (see ATT-26, Section 2.0).

Representative 1 litre sample of asphalt cement,
Miscellaneous Equipment such as Assorted Spatulas, Stem Thermometers, Pans, Stainless Steel (s/s) Mixing Bowls and Spoons, Sieve Set, Wash Bottles, and Brushes, for preparing HMA mixtures and removing aggregate from sample trays and catch pans, Mix Design showing mix types, asphalt grades and mixing temperatures.

Data Sheet: Asphalt Content Correction Factor (Ignition Method)

3.0 PROCEDURE

A correction factor for the ignition procedure is required because of the complex interaction of various elements (mass, temperature, airflow, aggregate type) which produces a “mass loss” effect, and this “mass loss” effect results in a higher measured than actual asphalt content. Some of the asphalt is also absorbed into the aggregate and cannot be extracted.

For asphalt concrete pavement mixes (ACP), this procedure compares the actual Virgin Design Asphalt Content added to the Aggregate and the calculated amount of binder in the RAP, to the resulting ignition asphalt content of the same mix.

This correction factor procedure is performed on three samples and the average difference is the correction factor. This value is subtracted from all ignition asphalt content results on field mix samples to determine the actual percent asphalt in the mix.

Each correction factor determination takes approximately 1 day to complete the initial aggregate oven drying process, weighing out of the 2000 gram dry aggregate samples, adding the virgin binder to the aggregate, and then the ignition oven testing to determine the correction factors. These correction factors should be performed before the asphalt plant starts mixing.

3.1 SAMPLE PREPARATION

1. Obtain a representative 1 litre sample of the mix design asphalt cement from the contractor.

2. Place the asphalt cement sample in the oven at a temperature of 140°C ± 5°C.

3. Label and tare 3 hot stainless steel mixing bowls, with hot stainless steel spoons, at 140°C ± 5°C, and record the bowl numbers and weights on line "A" of the data sheet MAT 6-99B as shown in Figure 2 for ACP and for RAP mixes.

   Proceed to Section 3.1.1 for split stockpiles or to Section 3.1.2 for single stockpiled aggregates.

3.1.1 Virgin Aggregate Split Stockpiles

1. Obtain a representative sample of approximately 10 kg from each aggregate stockpile; E.g. 10 kg of coarse, 10 kg of manufactured fines, 10 kg of blend sand, and 10 kg of RAP, as directed in ATT-38, SAMPLING, Gravel and Sand.

2. Oven dry the RAP at a temperature of 60°C, to a constant mass.

3. Oven dry all the Virgin Aggregates at a temperature of 110 ± 5°C.

4. Cool the Coarse Aggregates, then separate it by sieving on the 5000 µm sieve.

5. Place each aggregate portion (coarse +5000, coarse -5000, manufactured fines, natural fines, blend sand, RAP, etc.) in separate labelled pans. Blend each of the aggregate samples thoroughly.

6. Obtain the Mix Design aggregate proportions for the job and the design % passing the 5000 µm sieve of the coarse aggregate.

7. Calculate the weight of dry aggregates required to fabricate the combined 2000 gram samples based on the percentages in the asphalt mix design:

Example Mix Design: where Coarse Agg = 50% N.F. = 25% M.F. = 15% RAP = 10%

A. Design % passing 5,000µm Coarse Agg sieve = 45%
This number is from the asphalt mix design.
Ensure that you are using the number from the Coarse Aggregate portion, NOT THE COMBINED AGG.

B. Design % retained on the 5,000 sieve = 100% – A = 100% - 45% = 55%

C. Design % Splits: Coarse Agg = 50% M.F. = 25% B.S. = 15% RAP = 10%

D. ***Required Dry Wt of Aggregate to fabricate 2000 gram samples:***

Coarse Aggregate =	2000 grams x C = 2000 x 50% = 1000 grams
Natural Fines (N.F.) =	2000 grams x C = 2000 x 25% = 500 grams
Manufactured Fines (M.F.) =	2000 grams x C = 2000 x 15% = 300 grams
RAP =	2000 grams x C = 2000 x 10% = 200 grams

E. Req'd Dry Wt. of +5000µm Coarse Agg. = (D x B) / 100 = 1000 x 55 = 550 grams

F. Req'd Dry Wt. of -5000µm Coarse Agg. = (D x A) / 100 = 1000 x 45 = 450 grams

The reason that the Coarse Aggregate is split on the 5,000 µm sieve is so that a more accurate representative sample can be weighed out and used for the correction factor.

A typical example of a table showing these calculations is shown in Figure 1 below.

AGGREGATE TYPE			COARSE AGG.	NATURAL FINES	MANUF. FINES	RAP
A. Design % passing 5 000µm sieve ***(Coarse Agg)***	from mix design	%	45			
B. Design % retained on 5 000µm sieve	100-A	%	55			
C. Design % Split	from mix design	%	50	25	15	10
D. Required Dry Wt. of Aggregate	2000 x (C / 100)	g.	1000	**500***	**300***	200
E. Required Dry Wt. of +5000µm Coarse Agg.	(D x B) /100	g.	**550***			
F. Required Dry Wt. of -5000µm Coarse Agg.	(D x A) /100	g.	**450***			
G. Average % AC of RAP	from mix design	%				5.06
H. Required Dry Wt of RAP needed (including AC)	(D x (100 + G)) / 100					**210.1***
			*** Weigh and combine flagged amounts**			

FIGURE 1

8. Fabricate one combined Virgin Aggregate sample, for a Wash Sieve Analysis, using the dry weight of +5,000 and -5,000 µm of coarse aggregate, and all other virgin aggregates, as calculated above in step 7. Scoop the calculated weights into a tared drying pan.

9. Oven dry the fabricated sample to a constant dry weight, then perform a wash sieve analysis as outlined in "ATT-26, SIEVE ANALYSIS 25,000 minus" on the dry sample.

10. Provide an addition gradation analysis on a representative dry sample of RAP, approximately 2000 grams, after it is burned off in the ignition oven.

11. Mathematically compute the "calculated blank" gradation for the virgin aggregate and the RAP aggregate (which has had the AC burned off in the ignition oven) by combining the individual gradation analysis at the specified mix design percentages for each material as determined in the mix design.

% Virgin Agg	*% RAP*
A. ***80***	B. ***20***

MIX TYPE
H2

GRADATION (% PASSING)						
SIEVE SIZE (µm)	C. Virgin Agg (% Passing)	D. RAP Agg (% Passing)	**Combined Gradation ((CxA) + (DxB)) / 100**	MIX DESIGN	Mix Design Tolerances	Diff from Mix Design
25 000	100.0	100.0	**100.0**	100		
20 000	100.0	100.0	**100.0**	100	± 5	0.0
16 000	100.0	100.0	**100.0**	100	± 5	0.0
12 500	96.5	100.0	**97.2**	97	± 5	0.2
10 000	85.8	78.7	**84.4**	86	± 5	-1.6
5 000	60.1	62.6	**60.6**	62	± 5	-1.4
1 250	37.1	50.9	**39.9**	37	± 3	2.9
630	30.3	43.2	**32.9**	31	± 2	1.9
315	18.7	24.1	**19.8**	21	± 2	-1.2
160	13.4	15.4	**13.8**	12.6	± 1.5	1.2
80	6.5	9.8	**7.2**	8.5	± 1.5	-1.3

FIGURE 2

12. If the gradation is within the Mix Design limits, record the sieve analysis result in the lower portion of data sheet MAT 6-99B, and then proceed with step 13 below. If the sample grading is outside the limits, investigate the reason for the discrepancy, fabricate a new sample and perform a sieve analysis on the new sample.

13. Fabricate 3 combined aggregate samples using the dry weight of +5000 µm and -5000 µm Coarse Aggregate, all other virgin aggregates, and RAP, as calculated in step 6. Scoop the calculated weight of each size into the 3 tared pans, to get three combined aggregate samples of 2000 grams of dry aggregate each. You will wind up with more than 2000 grams because the weight of the binder in the RAP is also being weighed.

14. Oven dry each fabricated sample to a constant weight to ensure **all** water is removed from the fabricated samples (the aggregate temperature must not exceed 150°C). Aggregate ***MUST NOT*** be dried on the stove burner, as this will affect the correction factor value.

15. ***After oven drying each fabricated sample to a constant weight, pour each sample into one of the previously heated, and tared, s/s mixing bowls. Keep all 3 Virgin Aggregate fabricated samples in the mixing bowls, with the mixing spoons, in the oven at 140ºC, until you are ready to add the asphalt. Proceed to Section 3.2.***

3.2 VIRGIN AGG and RAP MIX PORTIONS

3.2.1 Adding Virgin Binder to the Blended Virgin Aggregate & RAP

1. Remove a hot numbered s/s mixing bowl and s/s mixing spoon from the oven. ***Weigh and record*** on MAT 6-99B ***on Line "A"*** *as* ***"TARE OF BASIN + SPOON @ 140 ºC".*** Tare the scale so that it now reads as 0.0 grams.

2. Use of a heat shield, such as a ceramic tile, is recommended to prevent damage to the load cell in the electronic balance. Review and follow the electronic balance manufacturer's operator's manual recommendations for weighing hot objects.

3. Remove the s/s mixing bowl containing the 60ºC oven dry RAP from the oven. Pour the RAP into the s/s mixing bowl on the scale, then ***record the weight*** *on* ***Line "B****" as* ***"WT OF Oven Dry RAP"***. Tare the scale so that it now reads as 0.0 grams.

4. Remove the s/s mixing bowl containing the 140ºC oven dry Virgin Aggregate from the oven. Pour the Virgin Agg into the s/s mixing bowl on the scale, then ***record the weight*** on ***Line "C"*** *as* ***"WT of OVEN DRY VIRGIN AGGREGATE".*** Tare the scale so that it now reads as 0.0 grams.

5. Form a crater in the aggregate into which the required weight of asphalt will be poured. Tare the scale so that it now reads as 0.0 grams.

6. *Calculate* ***Line "D",*** *the* ***"TOTAL WT"***, by adding lines A + B + C, the "Tare of Basin + Spoon", the "Wt. of Oven Dry RAP", and the "Wt. of Oven Dry Agg".

   Total Wt = "Wt of Basin + Spoon" + "Wt of RAP" + "Wt of Virgin Agg"

7. *Calculate the* ***"WT of DRY AGG + RAP"*** *on* ***Line "E"***, using *Line "D" subtract Line "A".*

   Wt of Virgin Agg + RAP = Total Wt – Tare of Basin + Spoon

8. From the Mix Design, ***record the "AVERAGE %AC of RAP"*** *on* ***Line "G"***.

9. *Calculate the* ***"ACTUAL DRY AGG in the RAP"*** *on* ***Line "H"***, using the formula:
   Line "H" = (Line "F" x 100) / (100 + Line "G")

   Actual Dry Agg in the RAP = ("Wt of RAP" x 100) / (100 + "Avg. AC of RAP")

10. *Calculate the* ***"AMOUNT of BINDER in the RAP"*** *on* ***Line "I"***, using the formula:
    Line "I" = Line "F" – Line "H"

    Amount of Binder in the RAP = "Wt of RAP" – "Actual Dry Agg in RAP"

11. *Calculate the **"TOTAL DRY AGG (minus binder in RAP)"** on **Line "J"***, using the formula:
Line "J" = Line "C" + Line "H"

TOTAL DRY AGG = "Wt of Virgin Agg" + "Actual Dry Agg in RAP"

12. On ***Line "K",*** enter the ***"TARGET ASPHALT CONTENT"*** from the Mix Design.

13. *Calculate the **"WT of ASPHALT REQUIRED (minus binder in RAP)"** on **Line "L"***, using the formula:
Line "L" = (Line "J" x Line "K") / 100

Wt of Asphalt Req'd = ("Total Dry Agg" x "Target AC") / 100

14. *Calculate the **"WT of ASPHALT REQ'D (minus binder in RAP)"** on **Line "M"***, using the formula:
Line "M" = Line "L" - Line "I"

Wt of Asphalt Req'd (minus binder in RAP) (g) = "Wt of Asphalt Req'd" - "Amount of Binder in the RAP"

15. *Calculate the **"REQ'D WT of BASIN + SPOON + DRY AGG + ASP"** on **Line "N"***, using the formula: This shows you the weight of hot virgin asphalt cement you should add.
Line "N" = Line "D" + Line "M"

Req'd Wt of Basin + Spoon + Dry Agg + Asphalt (g) = "Total Wt" + "Wt of Asphalt Req'd"

16. Take the heated virgin asphalt out of the lab oven. The scale should be tared so that it reads "0.00". Pour the hot virgin asphalt weight shown in Line "M" into the crater formed in the heated aggregate. Don't worry if you add more asphalt than required, as you will enter the actual total wt now.

If you add more asphalt than you need to, DO NOT TRY AND REMOVE ANY ASPHALT, as you may also remove some of the aggregate also.

17. Remove the s/s mixing bowl from the scale. Tare the scale so that it now reads as 0.0 grams. Place the s/s mixing bowl back onto the scale, then weigh and record this weight on ***Line "O", "ACTUAL WT OF BASIN + SPOON + DRY AGG + ASPHALT***".

18. ***Remove the basin from the scale*** and then use the mixing spoon to mix the aggregate and asphalt until all the aggregate is uniformly coated.

Ensure no mix is lost during the mixing process, as this will cause inaccurate results.

DO NOT MIX THE AGGREGATE AND BINDER WHILE IT IS ON THE SCALE, as the pressure on the scale load cell may overload it, thereby damaging the scale.

19. Calculate the "Weight of Asphalt Added" (***Line "P"***) as follows:
Line "P" = line "O" – Line "D"

Wt of Asphalt Added (g) = "Actual Wt of Basin + Spoon + Dry Agg + Asphalt" - "Total Wt"

20. Calculate the "Actual Wt of Asphalt in Mix" (***Line "Q"***) as follows:
Line "Q" = line "P" – Line "I"

Actual Wt of Asphalt in Mix (g) = "Wt. of Asphalt Added" + "Amount of Binder in the RAP"

21. Calculate the "Actual Asphalt Content" (Line "R") of the mix sample using the formula:
Line "R" = (Line "Q / Line "J) x 100

$$\textit{Actual Asphalt Content (\%)} = \frac{\textit{Actual Wt. of Asphalt in Mix}}{\textit{Total Dry Aggregate (minus binder in RAP)}} \times 100$$

Alberta Transportation

MAT 6-99B/21

ASPHALT CONTENT CORRECTION FACTOR IGNITION METHOD

ATT-74, Part III, Ignition Correction Factor for RAP & VIRGIN AGG

PROJECT :	Hwy 1:99	ASPHALT TYPE & GRADE :	Husky 150-200A	DATE :	1-Jan-2021 (dd-mm-yyyy)
CONTRACT # :	12345	MIXING TEMPERATURE :	146°C	TECH :	Larry Dombrosky, C.E.T.
MIX TYPE :	L1	COMPACTION TEMPERATURE :	134°C		

Initially oven dry all the Virgin Aggregates at 110 ± 5° C, to a constant weight.

Initially oven dry the RAP at 60 ± 5° C, to a constant weight.

After fabricating each Virgin Agg sample, and pouring into the s/s mixing bowls, heat to 140° C, till you're ready to add the asphalt to the combined Virgin & RAP.

After fabricating each RAP sample, and pouring into the s/s mixing bowls, heat to 60° C, till you're ready to add the asphalt to the combined Virgin & RAP.

ACTUAL ASPHALT CONTENT AND SAMPLE PREPARATION

	SAMPLE NUMBER		1	2	3
A.	TARE OF BASIN +SPOON	Basin No.	1	2	3
		(at 140°C)	322.8	347.3	374.5
B.	WT. OF OVEN DRY RAP (including binder)	(at 60°C)	210.1	211.0	209.0
C.	WT. OF OVEN DRY VIRGIN AGGREGATE	(at 140°C)	1800.0	1798.0	1797.0
D.	TOTAL WT	A +B+C	2332.9	2356.3	2380.5
E.	WT. OF DRY AGGREGATE +RAP	D - A	2010.1	2009.0	2006.0
F.	WT. OF RAP	(including binder)	210.1	211.0	209.0
G.	AVERAGE %AC of RAP	(from the mix design)	5.06	5.06	5.06
H.	ACTUAL DRY AGG in RAP	(F x 100) / 100 + G	200.0	200.8	198.9
I.	AMOUNT OF BINDER IN THE RAP	F - H	10.1	10.2	10.1
J.	TOTAL DRY AGG (minus binder in RAP)	C +H	2000.0	1998.8	1995.9
K.	TARGET ASPHALT CONTENT	(from the mix design)	6.20	6.20	6.20
L.	WT. OF ASPHALT REQUIRED	(J x K) / 100	124.0	123.9	123.7
M.	WT. OF ASPHALT REQ'D (minus binder in RAP)	L - I	113.9	113.8	113.7
N.	REQ'D WT. OF BASIN +SPOON +DRY AGG. +ASP.	D +M	2446.8	2470.1	2494.2
O.	ACTUAL WT. OF BASIN +SPOON +DRY AGG. +ASP.		2447.0	2470.3	2494.4
P.	WT. OF ASPHALT ADDED	O-D	114.1	114.0	113.9
Q.	ACTUAL WT OF ASPHALT IN MIX	P +I	124.2	124.2	124.0
R.	ACTUAL ASPHALT CONTENT	100 * (Q / J)	6.21	6.21	6.21

AGGREGATE BLEND

50 %	12.5mm Aggregate
25 %	Natural Fines
15 %	Manufactured Fines
10 %	RAP
100 %	TOTAL % CHECK

IGNITION ASPHALT CONTENT

			A	B	A
AA.	IGNITION BASKET NO.				
BB.	WT. OF IGNITION BASKET	@ 20 ° C	2557.2	2483.3	2557.2
FF.	IGNITION BASKET TEMP. CORRECTION FACTOR (for 538°C)		5.5	4.5	5.5
S.	WT. OF IGNITION BASKET	@ 538 ° C BB-FF	2551.7	2478.8	2551.7
T.	WT. OF DRY MIX	O - A	2124.2	2123.0	2119.9
U.	WT. OF DRY AGGREGATE +BASKET @ 538 ° C	**(NOTE 1)**	4541.9	4469.2	4539.1
V.	WT. OF DRY AGG. FROM IGNITION	U - S	1990.2	1990.4	1987.4
W.	WT. OF ASPHALT	T - V	134.0	132.6	132.5
X.	IGNITION ASPHALT CONTENT	(W / V) x 100	6.73	6.66	6.67

Note 1 : Includes ash brushed off pan and spoon

IGNITION OVEN BASKET WEIGHT CORRECTION FACTOR FOR TEMPERATURE

	BASKET WT. (g)		TEMPERATURE (Celsius)
	A	B	
CC	**2557.2**	**2483.3**	**@ 20° C**
DD	2555.1	2481.1	@ 130° C
EE	**2551.7**	**2478.8**	**@ 538° C**
	Correction Factors		1-Jan-2021
FF	5.5	4.5	

IGNITION ASPHALT CONTENT CORRECTION FACTOR

Y.	DIFFERENCE OF ASPHALT CONTENTS	R - X	**-0.52**	**-0.45**	**-0.46**
Z.	AVERAGE CORRECTION FACTOR	(Y1+Y2+Y3) / 3		**-0.48**	
The Average Correction Factor should normally be within 0.05% of any single corrrection Value			**IN SPEC**	**IN SPEC**	**IN SPEC**

REMARKS

enter data into shaded areas

FIGURE 3

3.3 IGNITION BASKET WEIGHT CORRECTION FACTOR FOR TEMPERATURE

Since we will be weighing the hot sample basket assembly with the aggregate right out of the ignition oven, we need to know what the weight of the basket would be at 538°C, so the basket weight can be subtracted from the total weight to calculate the weight of dry aggregate from ignition.

The ignition sample basket weight is different at temperatures of 20°C, 130°C and 538°C. These weight differences occur because a hot object will create convection currents around the balance pan. This fluctuating force reduces the air pressure on the balance pan and can make it difficult to obtain a stable reading.

For convenience and time savings, an ignition basket weight correction factor for temperature should be established. However, the basket weight can always be obtained at 538°C prior to each test, to ensure accuracy, but this may increase the total testing time per test.

The following ignition basket weight correction factor for temperature procedure allows the weighing of a basket at 20°C (room temp) and calculating the weight at 538°C using the established basket weight correction factor for temperature for subsequent testing. The weight correction factor for temperature procedure should be checked periodically throughout the project and whenever the weight correction factor is in doubt.

1. Thoroughly clean and dry each ignition basket assembly prior to starting the correction factor. Label each sample basket assembly and record the number in the appropriate area of the data sheet, as shown in Figure 3.

2. Place the clean basket assembly in the ignition oven set at 538°C, as directed in ATT-74, Part I.

3. After 30 minutes, remove the basket from the ignition oven, using the basket carrier to move the hot sample basket.

4. Weigh the basket immediately and record the weight of the basket at 538°C in line "EE" on form MAT 6-99B.

5. Allow the basket to cool to room temperature (20°C). Weigh the basket and record the weight of the basket at 20°C in line "CC".

6. Place the basket into the laboratory oven at 130°C for 30 minutes, remove and record the weight on line "DD".

7. Subtract line "EE" from line "CC" and record as the Ignition Basket Weight Correction Factor in line "FF" for the temperature weight difference at 20°C and 538°C.

8. Repeat for each basket.

Weights of the baskets at 20°C on subsequent testing should remain fairly constant; however incomplete brushing of the aggregate from the basket may change the weight slightly from test to test. Since this aggregate will not burn off in the ignition oven during the ignition test, the weight correction factor will remain relative. Be careful not to initially weigh and record subsequent basket weights with combustible material stuck to the basket, such as asphalt residue from gloves etc., which will burn off in the ignition oven, causing an incorrect calculated basket weight at 538°C.

IGNITION BASKET WEIGHT CORRECTION FACTOR FOR TEMPERATURE			
	BASKET WT. (g)		**TEMPERATURE (Celsius)**
	A	B	
CC	**2557.2**	**2483.3**	**@ 20° C**
DD	2555.1	2481.1	@ 130° C
EE	**2551.7**	**2478.8**	**@ 538° C**
	Correction Factors		1-Jan-2012
FF	5.5	4.5	

3.4 IGNITION OVEN TEST

Most ignition ovens offer two burn modes: *Program Time* and *Auto-Control.* For ovens with an Internal Scale use "Auto-Control" mode. For ovens without an Internal Scale, use the "Program Time" mode. To access these options, review the Operators Manual for the ignition oven that you are working with. Refer to ATT-74, Part I, Ignition Asphalt Content, Section 3.5.2, Burn Parameters.

3.4.1 Method "A" (Internal Scale)

This test method is intended ***for ignition ovens with an internal, automated weighing system***. In *Auto-Contro*l mode, the oven utilizes a sophisticated weighing system to continuously measure the weight loss of the bituminous mixture during combustion and automatically displays the %AC. The oven then automatically completes the burn cycle when the incremental mass decrease of the sample falls below a cut-off limit specified by the operator.

1. Record the ***"IGNITION BASKET NUMBER***" on ***Line "AA"*** on form MAT 6-99B.

2. Weigh and record the ***empty "WT OF IGNITION BASKET"*** at room temperature on ***Line "BB"***.

3. Enter the ***"IGNITION BASKET TEMP CORRECTION FACTOR (for 538ºC)"*** calculated in Section 3.3 into ***Line "FF"***.

4. Calculate the "***WT of IGNITION BASKET @538ºC"*** on ***Line "S"*** = Line BB – Line FF, using the formula:

Wt. of Ignition Basket @ 538°C = Wt. of Ignition Basket @ 20°C - Ignition Basket Correction Factor

5. Calculate the ***"WT of DRY MIX"*** on ***Line "T"*** = Line "O" – Line "A", using the formula:

Wt of Dry Mix (g) = "Actual Wt of Basin + Spoon + Dry Agg + Asphalt" + "Tare of Basin + Spoon @ 130°C"

6. Load the correction factor sample mix into the ignition sample basket and thoroughly scrape out as much of the mix clinging to the basin with the mixing spoon into the sample basket as outlined in ATT-74, Part I. Place the ignition basket containing the mix into the lab oven at 140ºC to keep it warm, to reduce heat loss from putting a cool sample into the ignition oven, till the ash from the mixing bowl can be brushed back into the corresponding ignition basket, and it is time to place the ignition basket into the ignition oven for the burn cycle.

7. Place the hot basin and spoon into the ignition oven to ash the residual mix on the basin and spoon, as directed in ATT-74, Part I, Section 3.4, Fines Correction. Remove the basin and spoon from the ignition oven after about 6 minutes, allow the basin and spoon to cool, and then brush the ash into the ignition basket containing the corresponding freshly mixed correction factor sample.

8. Now place the ignition oven basket, containing the mix and ash fines, into the pre-heated ignition oven. Perform an ignition test on the correction factor mix and ash sample in the sample basket using the ignition asphalt content method ATT-74, Part I, Section 3.5.3, Method A (Auto-Control Burn Mode).

9. After the ignition test is complete, remove the hot sample basket from the ignition oven using the sample basket carrier, and immediately place the hot sample basket and dry aggregate on an electronic balance, which has a heat shield on it, and record the weight on ***Line "U"***, "***WT of DRY AGGREGATE + BASKET @ 538ºC****".*

10. Calculate the ***"WT of DRY AGG from IGNITION"***, ***Line "V"*** *= Line "U" – Line "S",*

Wt. of Dry Agg. from Ignition = (Wt. of Dry Agg. + Basket @ 538^{o}C) - (Wt. of Ignition Basket @ 538^{o}C)

11. Determine the ***"WT of ASPHALT"***, ***Line "W"*** *= Line "T" – Line "V".*

Wt. of Asphalt (g) = Wt. of Dry Mix - Wt. of Dry Aggregate from Ignition

12. Determine the ***"IGNITION ASPHALT CONTENT"*** on ***Line "X"*** for each of the three ignition tests to the nearest 0.01%. Discard the ignition aggregate after checking the ignition asphalt content number.

Ignition Asphalt Content (%) = 100 x (Wt. of Asphalt / Wt. of Dry Aggregate from Ignition)

3.4.2 Method "B" (No Internal Scale)

In *Program Time* mode, the burn time is set manually by the operator. This test method is intended ***for furnaces without an operating internal, automated weighing system***.

To optimize testing accuracy, a calibration time factor shall be established by testing three calibration samples for each mix type.

The following describes the process to calculate the time required to obtain a clean burn.

1. Repeat Steps 1 through Step 7 from Section 3.4.1 above.

2. Place the loaded sample basket containing the correction factor sample into the pre-heated ignition oven. Wearing appropriate safety apparel, use the sample basket carrier to gently place the basket assembly containing the sample mix on the hearth plate in the centre of the pre-heated oven.

3. After the sample has been in the ignition oven for 40 minutes:

   (a) Take the sample out of the ignition oven and immediately weigh the hot ignition basket and record the weight and time in the remarks area of the data sheet.

   Use of a heat shield, such as a ceramic tile, is recommended to prevent damage to the load cell in the electronic balance.

   (b) Place the loaded sample basket back in the ignition oven for another 10 minutes.

   (c) Repeat steps (a) and (b) above, until a constant weight is established. Enter this weight on ***Line "U",*** **"WT of DRY AGGREGATE + BASKET @ 538ºC".**

4. The time required to establish this constant weight, less 5 minutes, will be the **Calibration Time** of this first correction factor sample.

5. Repeat steps 1-4 with the other two prepared correction factor samples. The average of these 3 tests will be the **Calibration Time** to be used as the ignition oven time for a complete burn on subsequent field test samples.

6. Calculate the ***"WT of DRY AGG from IGNITION"***, ***Line "V"*** = Line "U" – Line "S", for each sample.

   Wt. of Dry Agg. from Ignition = (Wt. of Dry Agg. + Basket @ 538°C) - (Wt. of Ignition Basket @ 538°C)

7. Determine the ***"WT of ASPHALT"***, ***Line "W"*** = Line "T" – Line "V", for each sample.

   Wt. of Asphalt (g) = Wt. of Dry Mix - Wt. of Dry Aggregate from Ignition

8. Determine the ***"IGNITION ASPHALT CONTENT"*** on ***Line "X"*** for each of the three ignition tests to the nearest 0.01%. Discard the ignition aggregate after checking the ignition asphalt content number.

   Ignition Asphalt Content (%) = 100 x (Wt. of Asphalt / Wt. of Dry Aggregate from Ignition)

3.5 IGNITION OVEN ASPHALT CONTENT CORRECTION FACTOR

1. For each correction factor sample, calculate the difference between the ***"ACTUAL ASPHALT CONTENT"*** and the ***"IGNITION ASPHALT CONTENT"*** and record it as ***"DIFFERENCE of ASPHALT CONTENTS"*** on ***Line "Y".***
   Line "Y" = Line "R" – Line "X"

   Difference of Asphalt Contents = Actual Asphalt Content - Ignition Asphalt Content

2. For each mix type, determine the ***"AVERAGE CORRECTION FACTOR"*** of the three test samples to the nearest 0.01% and record this value on ***line "Z".***

   This correction factor value is the "mass loss" and will be subtracted from subsequent QA & QC uncorrected ignition asphalt contents to yield the actual "Corrected Ignition Asphalt Content" of the asphalt concrete mix.

3. This ***"AVERAGE CORRECTION FACTOR"*** should normally be within 0.05% of any single correction factor value. Redo any tests on any samples that were outside these limits.

4.0 HINTS AND PRECAUTIONS

1. ***Review and follow the manufacturer's ignition oven safety & operational procedures before using the ignition oven***.

2. ***A new correction factor must be established*** when a new Marshall Mix Design is required ***for a change in aggregate proportions*** or ***when the Target Asphalt Content changes more than 0.5%.***

3. ***Even two seemingly identical furnaces that operate in the same location may behave differently.*** Correction factors can be different for each furnace and are not related to the manufacturer or model number. Applying a correction factor that is determined for a different ignition oven furnace may lead to further inaccuracies.

4. Whenever a Consultant lab begins testing a new mix design, raw materials should be obtained from the Contractor so that unique correction factors can be determined. It is important to make sure that the Contractor alerts the lab of any changes in mix design so that the correction factors can be adjusted accordingly.

5. The Average Asphalt Correction Factor value should normally be within 0.05 % of any single correction value. Redo the tests on any samples that were outside these limits.

6. This procedure should be performed before mixing commences on each project, and whenever the results are in doubt.

7. If ignition oven asphalt contents fluctuate due to ***variable or high amounts of combustible and deleterious material*** in the aggregate, ***solvent extraction asphalt contents may be required.***

8. High Ignition Oven Asphalt Correction Factors may require that solvent extraction asphalt contents be done instead. However***, if the correction factors are high, but consistent, the ignition oven method may still be used.*** Fluctuating Ignition Oven Correction Factors may require that solvent extraction be used, as stated in Step 5 above.

9. Use care when loading and unloading the ignition sample baskets to avoid touching or scraping the hearth plate, chamber sides, heating elements, or the thermocouples, as they can be easily damaged.

10. When removing the heated sample basket, or the s/s mixing bowl, from the ignition oven, special care must be taken to use adequate protective clothing and handling equipment when moving the basket, due to the high temperatures involved. Caution must be exercised at all times when handling these items since failure to do so could result in serious injury, severe burns, or fire.

11. Use of a heat shield, such as a ceramic tile, is recommended to prevent damage to the electronic balance load cell. Review and follow the balance operator manual recommendations for weighing hot objects.

12. Following the burn cycle, and after weighing the hot sample basket, the sample basket assembly should be placed on a heat-resistant surface and then covered with the safety cage to cool. The hot sample basket assembly should not be allowed to cool near any materials that are subject to ignition at the high temperatures encountered in this procedure.

13. It is very important to observe and follow all safety precautions when working around the ignition oven. In addition, always assume the sample baskets are hot and handle them with extreme care.

14. After cooling the sample baskets, always place the sample baskets into a metal pan larger than the sample baskets, so that whenever you want to move the sample baskets you won't loose any aggregate if the baskets get bumped.

15. ***DO NOT*** attempt to heat any aggregates that may be mixed with volatile chemicals in the ignition oven.

16. ***DO NOT OVER-RIDE the ignition oven door lock****.*

    If you want to just burn off some residual asphalt and aggregate left on the bottom of a tare pan after brushing the material into the ignition oven basket, place it in the oven but ***DON"T PRESS the START button***, to start a burn cycle.

    During normal operations during a burn cycle, the chamber door cannot be opened, till the burn cycle is completed.

17. ***WARNING*** *– Before opening the ignition oven door, always look through the windrow first, to ensure that there is no combustion occurring inside the oven.*

18. Obtain and use appropriate safety equipment as per the oven manufacturer's instructions: e.g. Heat-resistant gloves that can withstand 650^{o}C, and a face shield or safety glasses to protect the face and eyes.

19. The ignition oven must heat the mix sample sufficiently to ignite and completely vaporize the liquid asphalt, and it must be equipped with an exhaust filtration system to vaporize or remove airborne particles. The furnace must be vented to the outside via an exhaust system capable of maintaining sufficient draft to prevent the escape of smoke and strong odors into the lab. The exhaust must not be vented near flammable materials.

20. It is very important to always use the special lifting fork, specially designed, and supplied with each ignition oven, for lifting the basket assembly, whenever the tech is placing the basket into and out of the ignition oven.

21. RAP material is obtained by milling the original pavement which sometimes contains patches, chip seal, and other maintenance treatments. The stockpiled RAP material may be from the base, the intermediate, or the surface courses and the stockpile may consist of several projects containing different types of RAP. ***This RAP variability is a major concern. Periodic checks of the RAP stockpile should be carried out by the Contractor to confirm that the RAP asphalt content and gradation are still similar to that shown in the mix design.***

22. ***DO NOT place anything on top of the ignition oven.***