ATT-74/18, IGNITION ASPHALT CONTENT
Part I, Ignition method

METHOD "A" (using a furnace with an Internal, Automated Weigh Scale)
METHOD "B" (using a furnace with **NO** Internal Weigh Scale)

1.0 SCOPE

This method covers the procedures for determining the asphalt content of asphalt mix samples, by ignition at temperatures that reach the flashpoint of the binder, with an ignition oven using Methods A or B as described herein. There are a number of manufacturers of ignition ovens and the basic design concept utilizes a high temperature oven with a built-in scale that continually measures the sample weight as the binder burns off of the aggregate mix. The forced-air ignition furnace heats the mix by either the convection or direct IR irradiation method.

2.0 EQUIPMENT

Ignition Oven - a forced air ignition oven specifically designed to heat the asphalt mix sample by either convection or by using an infrared (IR) element. The oven manufacturer's operators manual must be followed to ensure the safe use of the ignition oven.

Sample Basket Assembly - consisting of perforated stainless steel sample baskets of appropriate size that allows the samples to be spread thinly and allows air to flow up through and around the sample particles. The sample shall be enclosed completely with screen mesh, perforated stainless steel sheeting, or other suitable material. The sample baskets will be nested, and have a catch pan of appropriate size to hold the sample baskets so that aggregate particles and melting asphalt binder falling through the basket perforations are caught.

Safety Equipment – face shield or safety glasses, sample basket carrier, and high temperature gloves. A heat resistant surface, such as a ceramic tile capable of withstanding 580°C, to rest the hot basket assembly on after it is removed from the ignition oven (to weigh and then to cool down). Following a burn cycle, the sample basket assembly should be placed inside a safety cage to cool down to room temperature and should not be placed near any materials that are subject to ignition due to the high temperatures used in this procedure.

Ovens - Mechanical ovens, convection or forced draft, thermostatically controlled to operate at the temperature of 130°C to 150°C (±5°C) to dry aggregate and HMA mixtures, and for pre-heating HMA mixtures prior to ignition testing.

Electronic Balance - capable of reading to 0.1 grams. The balance must be operated and calibrated as per manufacturer's recommendations. Use of a heat shield is recommended, such as a ceramic tile, to prevent damage to the electronic balance. Review and follow the balance operator's manual recommendations for weighing hot objects.

Assorted tools - for preparing HMA samples and removing aggregate from pans and baskets: stainless steel drying pans, metal pails or insulated coolers, grocer scoops (large & small), core trimmers (3 sizes), large metal mixing pan, stainless steel spatulas, long handled metal tongs or pliers.

Data Sheets:
Core Density, Asphalt Content Ignition Method and Sieve Analysis, MAT 6-98
Loose Mix Ignition Asphalt Content and Sieve Analysis, MAT 6-100

3.0 PROCEDURE

The test is performed on samples of at least **2000** grams for Quality Assurance Testing and Quality Control Testing where a sieve analysis is required.

For Quality Control tests, samples as small as **1200** grams may be used, when quick asphalt content results are required, and a gradation is not required. However, a correction factor must be done at this weight and the results from small sample sizes cannot be used to show cause for an Appeal.

3.0.1 Theory of Operation

The binder ignition oven test method arose out of a desire to reduce the use of solvents in asphalt laboratories.

There are a number of different manufacturers of this equipment. The general design concept uses a high temperature oven specifically designed for incineration and capable of operating at temperatures above 400^{o}C.

A hot mix asphalt sample is dried to a constant weight, weighed, then equally divided and placed into two or three stainless steel perforated baskets that nest together with a bottom catch pan and top cover. The sample basket holes are small enough to minimize loss of mix during the burn cycle. This basket assembly is placed onto the ignition oven hearth tray. The hearth tray is mounted on four ceramic support tubes, which are in turn mounted on a digital balance platform - this integrated weighing system continually measures the binder loss during combustion and displays the mass loss and the % loss. The test continues until the weight loss stabilizes and an alarm will sound to indicate that the burn is complete.

The ovens exhaust duct vents fumes produced during the ignition to a suitable ventilation system.

3.1 SAMPLE PREPARATION

3.1.1 Cores

Coring may degrade the aggregate; therefore the asphalt core outside cut rock must be removed with the core trimmers. The trimming procedure is described later in this section.

If the cores are for quality assurance testing, additional cores(s) may have to be obtained at the same offset but located longitudinally to the segment core so that, after sawing off the tack coat and trimming, the sample size meets the minimum 2000 gram test requirement.

After the wet density of each segment core is determined, (first core taken from each segment), the core is trimmed, as per Table 1, then the uncut and cut portions of the core are dried in separate tare pans to a constant weight, and the dry density is calculated, as described in “ATT-7 Density - Immersion Method”.

The uncut rock portion of the density core is then combined with any additional core(s) uncut rock core mix portions needed to get the minimum 2000 gram sample dry weight. This combined core mix sample is loaded into the ignition baskets, and then the entire trimmed sample is processed in the ignition oven.

If performing appeal testing, as described in ATT-68, more than one core may be required from each location. Each set of cores for each location is considered to be one sample. To achieve the minimum 2000 gram sample weight, the uncut rock mix portions of the trimmed cores are combined and the combined sample is processed.

Alberta

MAT 6-98/13

CORE DENSITY, ASPHALT CONTENT AND SIEVE ANALYSIS
IGNITION METHOD
ATT-74, Part I, Ignition Method

PROJECT:	HWY 2:80	DATE LAID:	23-Jul-1999
STATION:	2+012	LOCATION:	2.0m Rt ℄
LOT NO.:	23	SEGMENT #.:	5

SEGMENT DENSITY

A.	CORE THICKNESS		mm	43
B.	SAWED CORE WEIGHT		g	1797.8
C.	SATURATED SURFACE DRY WEIGHT		g	1801.7
D.	VOLUME OF CORE		cm^3	784.4
E.	WET DENSITY	1000 B / D	kg/m^3	2291.9
F.	DRY WT. ***CUT*** ROCK CORE MIX + PAN	@ 130°C	g	1580.0
G.	WT. OF TARE PAN (PAN No. EE)	@ 130°C	g	830.9
H.	DRY WT. ***UNCUT*** ROCK CORE MIX + PAN	@ 130°C	g	1908.0
I.	WT. OF TARE PAN (PAN No. E)	@ 130°C	g	873.6
J.	TOTAL DRY WT. OF CORE MIX	(F-G) + (H-I)	g	1783.5
K.	WT. OF WATER	(B-J)	g	14.3
L.	MOISTURE CONTENT	(100 K / J)	%	0.80
M.	CORE DRY DENSITY	(1000 J / D)		2274
N.	AIRVOIDS CONTENT			7.6
O.	LOT AVE. MARSHALL DENSITY		kg/m^3	2333
P.	PERCENT COMPACTION	(100 M / O)		97.5
	TIME SAMPLE PLACED IN OVEN		hh:mm	9:15
	TIME SAMPLE TAKEN OUT OF OVEN		hh:mm	13:30
	DRYING TIME		hh:mm	4:15

ADDITIONAL CORE(S) (if applicable) see ATT-74 Part I

Q.	DRY WT. CORE MIX + PAN		g	1849.7
R.	WT. OF TARE PAN @ 130°C (PAN No. EEE)		g	798.5
S.	DRY WT. CORE MIX	(Q - R)	g	1051.2
	IGNITION DATA			
T.	TOTAL DRY WT. CORE MIX	(S + (H-I))	g	2085.6
U.	WT. OF IGNITION BASKET @ 20°C	Basket No. A	g	3485.1
V.	IGNITION BASKET WEIGHT CORRECTION FACTOR			-4.0
W.	WT. OF IGNITION BASKET @ 538°C (U + V)	see Note 1	g	3481.1
X.	WT. OF DRY AGG. + BASKET @ 538°C	see Note 2	g	5457.2
Y.	WT. OF DRY AGG. FROM IGNITION	(X - W)	g	1976.1
Z.	WT. OF ASPHALT	(T-Y)	g	109.5
AA.	UNCORRECTED ASPHALT CONTENT	(100 Z / Y)	%	5.54
BB.	IGNITION ASPHALT CORRECTION FACTOR		%	-0.61
CC.	CORRECTED IGNITION ASPHALT CONTENT	(AA+BB)	%	**4.93**
	TIME IGNITION OVEN BURN STARTED		hh:mm	13:00
	TIME IGNITION OVEN BURN COMPLETED		hh:mm	13:41
	IGNITION TIME		hh:mm	0:41

Note 1: **Calculated weight using correction factor or actual weight @ 538°C**

Note 2: **Includes ash brushed off pans and implements (fines correction).**

SIEVE ANALYSIS CALCULATIONS

WT. OF DRY AGGREGATE (Y) 1976.1

SIEVE SIZE µm	WEIGHT RETAINED g	WEIGHT PASSING g	PERCENT PASSING %	JOB MIX FORMULA	TOLERANCES FOR THE LOT MEAN FROM THE JOB MIX FORMULA
25 000	0.0	1976.1	**100**	100	± 5
20 000	0.0	1976.1	**100**	100	± 5
16 000	4.1	1972.0	**100**	100	± 5
12 500	193.5	1778.5	**90**	87	± 5
10 000	375.5	1403.0	**71**	74	± 5
5 000	395.2	1007.8	**51**	53	± 5
2 500		1007.8	**51**		
1 250	217.4	790.4	**40**	42	± 3
630	296.4	494.0	**25**	26	± 2
315	177.8	316.2	**16**	17	± 2
160	108.7	207.5	**10.5**	10.0	± 1.5
80	94.9	112.6	**5.7**	6.1	± 1.5
TARE PAN	4.3				
DD. TOTAL WEIGHT	1867.8	DIFFERENCE	% DIFFERENCE	MAXIMUM DIFFERENCE ALLOWED	
EE. DRY WASH WT. + PAN	3072.2	GG-DD	100 HH / GG		
FF. TARE OF PAN	1202.0				
GG. DRY WASH WT. (EE-FF)	1870.2	HH. 2.4	0.13	0.50 %	

RECORD CALCULATIONS

DATE TESTED:	23-Jul-1999
TECHNOLOGIST:	B. GOOD
REMARKS:	

enter data in shaded areas

FIGURE 3-1

Alberta

MAT 6-100/13

LOOSE MIX ASPHALT CONTENT AND SIEVE ANALYSIS IGNITION METHOD

ATT-74, Part I, Ignition Asphalt Content

PROJECT:	HWY 3:90	REGION:	PEACE
CONTRACT NO.:	12345	DATE SAMPLED:	23-Jul-2011
LOT NO.:	54	SAMPLE NO.:	3

MIX MOISTURE CONTENT

see ATT-15, Part V

A.	WT. OF MOIST MIX SAMPLE + PAN @ 130°C	g	1777.1
B.	WT. OF DRY MIX SAMPLE + PAN @ 130°C	g	1775.0
C.	WT. OF WATER (A-B)	g	2.1
D.	WT. OF TARE PAN @ 130°C (PAN No. _____)	g	650.5
E.	WT. DRY MIX SAMPLE (B-D)	g	1124.5
F.	MIX MOISTURE CONTENT (100 C / E)	%	0.19%
	TIME SAMPLE PLACED IN OVEN	hh:mm	13:15
	TIME SAMPLE TAKEN OUT OF OVEN	hh:mm	17:45
	DRYING TIME	hh:mm	4:30

IGNITION DATA

see ATT-74, Part I

K.	WT. OF DRY MIX @ 130°C LINE "E" or LINE "J"	g	2085.7
L.	WT. OF IGNITION BASKET @ 20°C BASKET No. A	g	3486.7
M.	IGNITION BASKET WEIGHT CORRECTION FACTOR	g	-5.6
N.	WT. OF IGNITION BASKET @ 538°C (L+M) see Note 1	g	3481.1
O.	WT. OF DRY AGG. + BASKET @ 538°C see Note 2	g	5457.3
P.	WT. OF DRY AGGREGATE FROM IGNITION (O-N)	g	1976.2
Q.	WT. OF ASPHALT (K-P)	g	109.5
R.	UNCORRECTED ASPHALT CONTENT 100 (Q / P)	%	5.54
S.	IGNITION ASPHALT CONTENT CORRECTION FACTOR	%	-0.61
T.	**CORRECTED IGNITION ASPHALT CONTENT** (R+S)	%	**4.93**
	TIME IGNITION OVEN BURN STARTED	hh:mm	13:00
	TIME IGNITION OVEN BURN COMPLETED	hh:mm	13:43
	IGNITION TIME	hh:mm	0:43

WT. OF IGNITION SAMPLE USING CALCULATED SAMPLE DRY WEIGHT

G.	WT. OF MOIST MIX + PAN or BASKET @ 130°C	g	3309.9
H.	WT. OF PAN or BASKET @ 130°C	g	1220.3
I.	WT. OF MOIST MIX (G-H)	g	2089.6
J.	WT. OF DRY MIX 100 I / (100+F)	g	2085.7

WT. OF IGNITION SAMPLE USING OVEN DRIED SAMPLE

G.	WT. OF DRY MIX + PAN or BASKET @ 130°C	g	3306.0
H.	WT. OF PAN or BASKET @ 130°C	g	1220.3
J.	WT. OF DRY MIX (G-H)	g	2085.7

Note 1: Calculated weight using correction factor or actual weight @ 538°C

Note 2: Includes ash brushed off pans and implements (fines correction).

SIEVE ANALYSIS CALCULATIONS

see ATT-26, Sieve Analysis

WT. OF DRY AGGREGATE (P) 1976.2

SIEVE SIZE µm	WEIGHT RETAINED g	WEIGHT PASSING g	PERCENT PASSING %	JOB MIX FORMULA	TOLERANCES FOR THE LOT MEAN FROM THE JOB MIX FORMULA
25 000	0.0	1976.2	**100**	100	± 5
20 000	0.0	1976.2	**100**	100	± 5
16 000	4.1	1972.1	**100**	100	± 5
12 500	193.5	1778.6	**90**	87	± 5
10 000	375.5	1403.1	**71**	74	± 5
5 000	395.2	1007.9	**51**	53	± 5
2 500					
1 250	217.4	790.5	**40**	42	± 3
630	296.4	494.1	**25**	26	± 2
315	177.8	316.3	**16**	17	± 2
160	108.7	207.6	**10.5**	10.0	± 1.5
80	94.9	112.7	**5.7**	6.1	± 1.5
TARE PAN	4.3				
W. TOTAL WEIGHT	1867.8	DIFFERENCE	% DIFFERENCE	MAXIMUM DIFFERENCE ALLOWED	
V1. DRY AGG WASH WT. + PAN	3072.2	GG-DD	100 HH / GG		
V2. TARE OF PAN	1202.0				
V3. DRY AGG WASH WT. (EE-FF	1870.2	**X.** 2.4	0.13	0.50 %	

RECORD CALCULATIONS

This sample shows both ways of calculating the dry mix for the ignition.

Line "J"

Normally only one method is used.

DATE TESTED:	23-Jul-2011
TECHNOLOGIST:	B. GOOD
REMARKS:	

enter data in shaded areas

FIGURE 3-2

Use the following table to determine the minimum number of cores required to obtain a minimum 2000 gram sample. A similar table may be required when trimmers of different diameters are used.

TRIMMED CORE REDUCTION TABLE

Core Thickness (mm)	Estimated Core Weight (g)	Estimated Trimmed Weight (g)			No. of Cores	Total Estimated Sample Weight (g)
		127mm Trimmer	114mm Trimmer	100mm Trimmer		
100	4060		2235		1	2235
90	3655	2375			1	2375
80	3250	2110			1	2110
70	2840			1280	2	2560
60	2435			1095	2	2190
50	2030		1115		2	2230
40	1625	1055			2	2110
30	1220	795			3	2385
20	810	525			4	2100
Estimated weight will vary depending upon the actual core density.						

TABLE 1

1. For each core, use a masonry saw to cut off the lift required for testing. Saw right at the tack line to eliminate any tack or seal coat chip contamination. Avoid cutting excess material off the core as it will contribute to the degradation of the sample properties.

   If a core is obtained from a lower lift which was tacked, sawing will be required at the top and bottom of the core(s) to eliminate the tack coat.

2. Label and tare two hot drying pans (at 130^{o}C) and record the tare pan number and weight in lines "G" and "I" of Form MAT 6-98, as shown in Figure 3-1. If additional material is needed to meet the required minimum sample size of 2000 grams, number and tare another tare pan and record the number and weight in Line "R".

3. After the wet density determination (ATT-7 Density), place the segment core in the tare pan recorded in Line "I".

4. Heat the core sample in the oven set at 130°C ± 5°C for about 20 minutes. This time may vary, but use the minimum time requirement which allows the specimen to be easily trimmed using a heated core trimmer. **Overheated** samples may **stick** to the pan, trimmers, spatula and mixing spoon.

5. When additional material is needed to obtain the trimmed minimum sample size, heat the additional core(s) in the tare pan for about 20 minutes. Use the tare pan from line "R". If two additional cores are needed, they can be stacked on top of each other and trimmed together.

6. Select a core trimmer as shown in Table 1. Heat the core trimmer by centering the base of the required core trimmer on the burner flame for a few minutes, or by keeping it in the oven at 130°C.

7. Centre the heated core trimmer on the heated core (allow equal clearance on all sides of the core).

8. Hold the core trimmer vertically by its handle, and then press it down through the core until it reaches the bottom of the pan. Apply a slight twist if the heated core is difficult to penetrate. Leave the trimmer in the core.

9. Use a heated spatula or mixing spoon to remove, from the pan, all the outside cut rock core mix. If the core dry density is required, place this outside cut rock material in the tared pan recorded in Line "G" and follow ATT-7 to determine the “Moisture Content” and “Dry Density” of the core. Discard this outside cut rock core material only if asphalt content and gradation tests are required.

10. Scrape off any mix adhering to the core trimmer, after each use, into the appropriate tare pan.

11. When additional core(s) are required to obtain the minimum 2000 gram sample for asphalt content and gradation:

    a) Using the core trimmer, remove from each additional core sample(s), the cut rock mix portion as described in steps 6 to 10.

    b) Discard the outside cut rock core mix portions.

12. Use a putty knife to break up the uncut rock core mix portion of each sample. Take care not to lose any material.

13. Clean any material adhering to the putty knife back into the pan(s).

14. Place the pan(s) back in the oven and dry the core mix for 2 hours. You may now have up to 3 tare pans for each segment; one with the cut rock core mix, one with the uncut rock core mix, and one with the additional uncut rock core mix. With 5 segments, this could make for a maximum of 15 tare pans in the oven drying to a constant weight.

15. Remove the pan(s) from the oven and weigh the heated sample(s).

16. Oven dry the core mix for another ½ hour, then re-weigh the hot sample(s).

17. Repeat step 16 until a constant weight is obtained.

18. Record these tare pan and core mix constant weights in the appropriate lines on MAT 6-98.
Line “F”, “Dry Weight of ***Cut*** Rock Core Mix + Pan”;
Line “H”, “Dry Weight of ***Uncut*** Rock Core Mix + Pan”;
Line “Q”, “Dry Weight of ***Additional Uncut*** Rock Core Mix + Pan”. (if applicable)

19. If applicable, calculate the “*Dry Wt. of Additional Uncut Rock”* (line “S”) of the additional cores using the formula: *Line “S” = Line “Q” - Line “R”*

Line “S” = Dry Wt. of Additional Uncut Rock Core Mix and Pan - Wt. of Tare Pan

20. For the “***IGNITION DATA***” section, calculate the *“Total Dry Wt. of Uncut Rock Core Mix”* that will be put into the ignition baskets, using the formula: *Line “T” = Line “S” + (Line “H” – Line “I”)*

T = Dry Wt. of Additional Uncut Rock + ((Dry Wt. of Uncut Rock Core Mix + Pan) – (Wt. of Tare Pan))
(additional core) + (line “S”) (density core) - (line “H” – line “I”)

21. Proceed to Section 3.2

3.1.2 Marshall Specimens

If the asphalt content of field formed Marshall specimens is required, use the two briquettes compacted for a test series. Prepare the specimens and use form MAT 6-98 as follows:

1. Label a hot tare pan, at 130^{o}C, then weigh and Record in Line "I" the pan number and weight.

2. After the wet density determination of the two Marshall specimens is completed, place the specimens in the tared pan and put the pan in the oven set at 130^{o}C ± 5^{o}C.

3. After the Marshall specimens have been in the oven for about a half hour, remove the pan from the oven and break up the briquettes to ensure the sample will dry completely. Weigh the sample pan containing the mix, and then place it back in the oven.

4. Dry the sample to a constant weight. Verify it as follows:

    a) Oven dry the mix sample for at least two hours then re-weigh.

    b) Replace the sample in the oven for another ½ hour, then re-weigh.

    c) Repeat “step 4.b” until two consecutive weights are the same.

5. Record this constant weight as “Dry Weight of the Mix and Tare Pan” in Line “H”.

    Calculate the “Total Dry Wt. of Mix” (Line "T"), by subtracting Line "I" from Line "H" and record this number.

6. Proceed to Section 3.2

3.1.3 Loose Mix Samples

If the asphalt content of an uncompacted loose mix sample is required, obtain the sample as per ATT-37 SAMPLING, Mixes. Use Form MAT 6-100, "Loose Mix Ignition Asphalt Content and Sieve Analysis" (Figure 3-2) to record the data.

1. Obtain 3/4 of a pail (20 kg) of representative mix as directed in ATT-37, SAMPLING, Mixes.

2. Dump the mix into a large heated mixing pan and use the heated large grocer scoop to thoroughly mix it. Use the grocer scoop to obtain the required size of sample for testing.

3. Proceed to 3.1.3.1 to use the "Oven Dried Sample Method", or go to 3.1.3.2 for the "Calculated Sample Dry Weight Method".

3.1.3.1 Oven Dried Sample Method

Sections 3.2 and 3.3 describe the assembly and loading of the ignition sample basket.

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

This procedure takes into account any mix residue that sticks to the stainless steel mixing bowls and stainless steel mixing spoons by heating them in the ignition oven at 538°C, then brushing the cooled ash back onto the mix in the sample basket prior to the burn cycle in the ignition oven, as described in the Fines Correction section 3.4.

For convenience and time savings, an ignition sample basket weight correction factor for temperature may be used, as described in ATT-74, Part II section 3.3.2.1. This allows weighing of the basket at 20°C or 130°C and then calculating the weight at 538°C using the basket weight correction factor for temperature.

Mix may be directly added into the ignition sample basket, a weight taken, and then oven dried to a constant weight. This will tie up a basket for at least two hours, but no fines correction is necessary. Special care must be taken when using this method because if the basket is bumped, when moving it back and forth from the electronic balance to the oven, mix may fall out through the screen holes.

If weighing the empty ignition sample basket at 538°C (thereby not needing a weight correction factor), record this weight in line "N", then allow the basket to cool down in an oven set at 130°C, and then weigh and record this weight on Line "H" (see Figure 3-2, MAT 6-100). Cooling of the basket to 130°C is required because if mix were to be placed in the basket at the high temperature of 538°C some of it may burn off, resulting in an inaccurate initial weight.

1. Label a hot drying pan, or hot ignition sample basket, at 130°C and weigh and record.

2. Record on form MAT 6-100 on Line "H", the pan or basket weight, under the section called **"*Wt. of Ignition Sample Using Oven Dried Sample*"**.

3. Use the heated grocer scoop to place the mix into the tared pan or basket assembly. Remember the minimum 2000 gram dry weight test requirement. Ensure the mix is levelled and evenly distributed over the bottom of the tare pan. When adding mix to the ignition baskets, add roughly equal amounts in each basket, and keep the mix approximately ¾ inch away from the edges of the basket.

4. Use the putty knife to clean all the mix off the scoop into the pan or basket.

5. Place the drying pan or basket with the mix in the oven set at 130°C ± 5°C and dry the mix to a constant weight.

6. When you reach a constant weight, record this weight on Line “G”, “*Wt. of Dry Mix + Pan or Basket*”, as shown in MAT 6-100 Figure 3-2.

7. Subtract line "H" from line "G" and record as “*Wt. of Dry Mix*” (Line "J").

8. Perform the ignition oven test as directed in Section 3.5.

3.1.3.2 Calculated Sample Dry Weight Method

Review the second, third and fourth paragraphs of section 3.1.3.1 “Oven Dried Sample Method”, for determining ignition basket weights at 20°C, 130°C or 538°C, prior to proceeding with this method.

This section is used when it is necessary to process the sample quickly, but it should be recognized that it may not be as accurate as drying the actual sample to a constant weight before beginning the ignition oven test. Here we will perform an ignition burn on a mix sample that still has an as yet to be determined moisture content. To determine the moisture content of the mix, we are performing a mix moisture content test on a separate sample, and then back-calculating the actual weight of dry mix used for the burn.

If weighing the empty ignition sample basket at 538°C (thereby not needing a weight correction factor), record this weight in line “N”, then allow the basket to cool down in an oven set at 130°C, and then weigh and record this weight on Line “H” (see Figure 3-2, MAT 6-100). Cooling of the basket to 130°C is required because if mix were to be placed in the basket at the high temperature of 538°C some of it may burn off, resulting in an inaccurate initial weight.

IGNITION OVEN SAMPLE
see MAT 6-100, section “WT. OF IGNITION SAMPLE USING CALCULATED SAMPLE DRY WEIGHT”

1. Label a hot drying pan or ignition sample basket at 130°C and weigh.

2. Record in line "H" the pan or basket weight, record under section **"*Wt. of Ignition Sample Using Calculated Sample Dry Weight*",** as shown in MAT 6-100.

3. Use a clean heated grocer scoop to place at least 2000 g of mix into the tare pan or ignition sample basket. When adding mix to the ignition baskets, add roughly equal amounts in each basket, and keep the mix approximately ¾ inch away from the edges of the basket.

4. Use the putty knife to clean all the mix off the scoop into the pan or basket.

5. Weigh the tare pan containing the mix and record as *“Wt. of Moist Mix + Pan or Basket”* in line ”G”.

6. Calculate the *“Wt. of Moist Mix”* (line "I") as follows:

   Wt. of Moist Mix = (Wt. of Moist Mix + (Pan or Basket)) - (Wt. of Pan or Basket)

7. Perform the ignition test as directed in Section 3.5.

MIX MOISTURE CONTENT SAMPLE
see MAT 6-100,* section *"MIX MOISTURE CONTENT"

8. Label and tare a Moisture Content drying pan to the nearest 0.1 g. Record the weight and number of the tare pan at 130^{o}C in line "D", as shown in Mat 6-100 Figure 3-2.

9. Use the heated grocer scoop to place at least 1000 g of mix into the tare pan. Ensure the mix is level and evenly distributed over the bottom of the pan. Provided that the dry weight of the moisture content sample is at least 2000 grams, after the test is completed the moisture content sample should be saved in case another Asphalt Content test is required.

   NOTE: To obtain a true moisture content, all of the moisture must be driven off the mix. If the sample is too large for the container size, some moisture may be trapped in the mix. Also, if the sample is too small, the moisture loss may be too small to accurately measure, or the moisture sample may not be representative.

10. While the scoop is still hot, use a clean putty knife to scrape off any mix adhering to the scoop.

11. Weigh the tare pan and moist mix sample to the nearest 0.1 g and record as *"Wt. of Moist Mix Sample + Pan"* (line "A").

12. Place the drying pan with the moist mix in the oven set at 130^{o}C ± 5^{o}C and record the time the sample was placed in the oven.

13. Dry the Mix Moisture Content sample to a constant weight. Verify it as follows:

    a) Oven dry the mix moisture sample for at least two hours then weigh.

    b) Replace the sample in the oven for another ½ hour, then re-weigh the hot sample.

    c) Repeat "step 4.b until two consecutive weights are the same.

14. Record the time the sample was last removed from the oven and then calculate the drying time.

15. Weigh the hot sample and record as *"Wt. of Dry Mix Sample + Pan"* (line "B").

16. Calculate the *"Weight of Water"* removed (line "C") from the Moisture Content Sample as follows:

$$\textit{Wt. of Water} = \textit{(Wt. of Moist. Mix + Pan)} - \textit{(Wt. of Dry Mix + Pan)}$$

17. Determine the oven dry weight of the Moisture Content sample (line "E") as follows:

$$\textit{Wt. of Dry Mix Sample} = \textit{(Wt. of Dry Mix + Pan)} - \textit{(Wt. of Pan)}$$

18. Calculate the *"Mix Moisture Content"* (line "F"), to the nearest 0.01%, of the fresh asphalt cement mix using the formula:

$$\textit{Moisture Content (\%)} = \frac{\textit{Wt. of Water}}{\textit{Wt. of Dry Sample}} \times 100$$

19. Calculate the *"Weight of Dry Mix"* (line "J") to be used for the ignition sample using the formula:

$$\textit{Wt. of Dry Mix (g)} = \frac{\textit{Wt. of Moist Mix}}{\textit{100 + Moisture Content of Mix in \%}} \times 100$$

3.2 IGNITION SAMPLE BASKETS

Assemble the sample basket as shown in Figure 3-4, below:

FIGURE 3-3 NCAT Ignition Oven

FIGURE 3-4 Troxler Ignition Oven

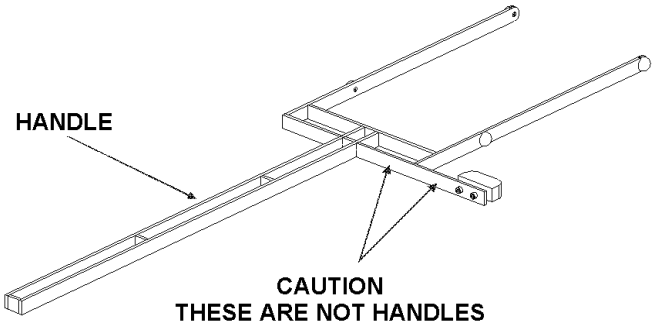

FIGURE 3-5 Troxler Basket Carrier

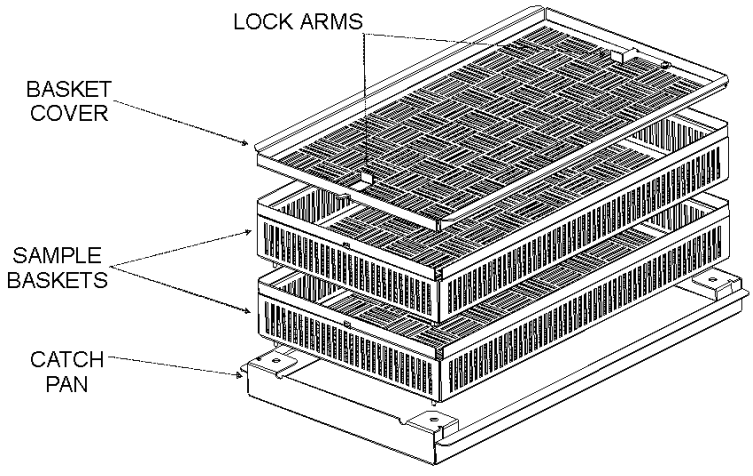

FIGURE 3-6 Troxler Sample Basket Assembly

3.3 LOADING IGNITION SAMPLE BASKET

Load the basket as described below.

1. If not done previously , weigh the empty ignition basket at room temperature (20°C) and then use the "***Ignition Basket Weight Temperature Correction Factor***" to determine the ignition basket weight at 538°C for line "W" (MAT 6-98) or line "N" (MAT 6-100).

   The basket shown in Figure 3-6 can be weighed hot, directly out of the ignition oven, with accurate results. Early first generation type baskets were difficult to weigh hot because the basket design allowed for rapid cooling when removed from the furnace, making hot weighing impossible. Therefore, for first generation type tray designs, allow the tray and aggregate to cool until a steady weight is achievable (usually about 30 minutes).

2. Set the tared ignition basket assembly in a clean drying pan to ensure that any spilled mix will be captured and can be brushed back into the basket.

3. Remove the basket cover and top basket.

4. Empty the ignition mix sample from the pan(s) into the baskets using a hot implement to disperse the mix equally around the basket. Add roughly equal amounts into each basket, keeping the mix approximately ¾" away from the edges. See section 3.4, Fines Correction, to account for the fines adhering to the pan(s) and implement(s). (Note: Fresh mix is scooped directly into the basket from a large mass of mix therefore section 3.4 is not applicable for fresh mix.)

.

5. Place the basket cover on the basket assembly. Secure the sample baskets and basket cover to the catch pan with the lock arms. Ensure the lock arms fully engage the slots in the top sample basket.

6. As a double check of the sample weight, to ensure that no mix has been lost during the loading process, using an external scale, weigh the ignition basket assembly and mix, and calculate the dry mix weight. It is extremely important not to lose any material during the loading process as the dry weight of mix that is used in line "K" on MAT 6-100 and on line "T" on MAT 6-98 is calculated and not the check weight here.

3.4 FINES CORRECTION

1. Place the stainless steel mixing bowl and stainless steel mixing spoon into the pre-heated ignition oven.

   Note: A burn cycle ***should not be initiated* using the ignition oven keypad, when burning off any material residue stuck to the tare pan or mixing bowl for the fines correction, as the oven has a lockout feature which prevents the operator from opening the oven door for approximately 30 minutes.**

2. After about 6 minutes, open the ignition oven door and take out the mixing bowl using long handled metal tongs or pliers, and place on a ceramic plate next to the oven to cool, and cover with the safety cage.

3. If the mix residue in the pan and on the mixing spoon is completely ashed, proceed to step 4. If not, place the pan and implement back in the ignition oven for additional 2 minute periods, until the mix residue is completely ashed.

4. Take the mixing bowl out of the ignition oven, place on a ceramic plate (heat shield) then cover with the safety cage, and allow them to cool until the fines can be brushed off without burning (or melting) the brush.

5. Brush the ashed fines from the mixing bowl and implement into the ignition basket containing the rest of the corresponding mix.

3.5 IGNITION TEST ON MIX IN SAMPLE BASKET

3.5.1 Ignition Oven Main Menu

The oven control software includes a number of options that can be configured by the operator for greater flexibility of operation. To access these options, review the Operators Manual for the ignition oven that you are working with.

3.5.2 Burn Parameters

The ignition oven offers two burn modes: *Program Time* and *Auto-Control*.

In the *Program Time* mode, the burn time is set manually.

In *Auto-Control* mode, the oven automatically completes a burn cycle when the incremental mass decrease of the sample falls below a cut-off limit set by the operator. This is the method that is normally used.

PROGRAM TIME

- This test method is intended for ovens without an internal weighing system. .

  To configure the oven to burn for a specified number of minutes, set the burn time as calculated in ATT-74, Ignition Asphalt Content, Part II, Correction Factor, Section 3.5.2, Method “B” (Burn Mode : Program Time). This burn method is not generally used, as the calculated burn time is very dependent on duplicating the same sample mass, oven temperature, and %AC.

AUTO-CONTROL

- Using the *Auto-Control* mode, the oven controls the burn time based on the cut-off limit.

CUT-OFF LIMIT

In the *Auto-Control* burn mode, the oven adjusts the burn time according to the *cut-off limit*. The cut-off limit can be defined in grams or as a percentage of the initial sample mass. When the change in the sample mass is less than the cut-off limit for three consecutive minutes, the oven completes the burn cycle.

CUT-OFF LIMIT IN GRAMS

The ignition oven cut-off limit allowed is generally from 0.1 to 1.0 grams in increments of 0.1 gram.

NOTE: Troxler recommends using the Auto-Control feature with the cut-off limit of 0.1 gram to accomplish a clean burn test sample.

CUT-OFF LIMIT AS A PERCENTAGE

Enter the cut-off limit as a percentage of the initial sample mass.

The ignition oven cut-off limit allowed is generally from 0.001% to 1.000% in increments of 0.001%.

NOTE: Troxler recommends using the Auto-Control feature with the cut-off limit of 0.01% to accomplish a clean burn test sample.

3.5.3 Method "A" (Burn Mode: Auto-Control)

The oven should be preheated well before the time to load the sample.

NOTE: To ensure consistent, repeatable results, Troxler recommends allowing the oven chamber to reach 400°C for a 120V ac (Model 4730) unit or 375°C for a 240V ac (Model 4731) unit before burning a sample. NCAT recommends preheating to your setpoint temperature at least 2 to 2½ hours before you begin using the ignition oven.

NOTE: Opening the chamber door also prohibits the oven from applying power to the IR element.

Each ignition oven has a slightly different procedure for entering in the initial sample weight and starting the burn procedure. Follow the manufacturer's operator's manual.

1. Enter the sample dry mix weight in the ignition basket to the nearest tenth of a gram using the ignition oven keypad. Use the "***Dry Weight of Mix***" from line "K" on MAT 6-100 or from line "T" on MAT 6-98.

2. Place the loaded sample basket 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 center of the pre-heated ignition oven.

3. Close the ignition oven door.

   The oven display should show the total weight of the sample, baskets, and catch pan as measured by the oven's internal scale. The displayed weight should be within ± 5 g of the dry weight recorded in the MAT form (Line "T" on MAT6-98 or Line "K" on MAT6-100). If not, open the oven door and check that the hearth plate and sample baskets are not touching the chamber sides which results in erroneous weight readings.

4. Press the **<START/STOP>** key to begin the burn cycle.

5. The oven automatically locks the chamber door at the start of the burn cycle. You should hear an audible click when the lock is engaged. During the burn, the oven displays the chamber temperature, the current sample mass and initial sample mass, the %Loss, and the elapsed burn time:

   After approximately five minutes of heating (depending on sample size and volatility) the asphalt will ignite. You will see a sudden increase in the main chamber temperature display. The main chamber temperature may remain significantly higher than your setpoint temperature for some time (again, depending on sample size and volatility). When the main chamber temperature begins to come down again, you will also see both the "Percent Loss" and "Mass Weight" displays begin to stabilize. After the sample weight has stabilized, an audible alarm will signal test completion and the printer will printout a summary of the burn data.

6. The test will continue until the weight loss stabilizes. When the mass loss does not exceed 0.1 grams for three consecutive one-minute periods, the burn is complete. The oven display panel shows the results of the burn. If five minutes have elapsed since the chamber temperature has peaked, the oven also releases the door lock, lights the red **BURN COMPLETE** indicator, and sounds the alarm. Typically, this five-minute period will have elapsed before the burn is complete.

7. Wearing appropriate safety apparel, use the basket carrier to remove the sample basket from the ignition oven.

8. Immediately weigh the hot basket and aggregate on an external scale and record the weight on data sheet MAT 6-98 on line "X", or on line "O" of form MAT 6-100. Use of a heat shield is recommended, such as a ceramic tile, to prevent damage to the electronic balance. Review and follow the balance operator's manual recommendations for weighing hot objects. ***Very hot objects will create convection currents around the electronic balance. This fluctuating force reduces the air pressure on the balance platform and can make it difficult to obtain a stable weight reading, as the basket is cooling rapidly, and the weight displayed on the balance will change.*** It is recommended that the weight be determined rapidly, after it is placed on the scale, as it will only stay constant for about 10-15 seconds.

8. Locate the external scale next to the ignition oven, to reduce the chance for the basket assembly to cool down before getting a final weight, and to reduce the risk of bumping the extremely hot basket into other objects.

9. Use the basket carrier to take the basket off the external balance and then place the hot basket, in a safe location, on a heat resistant plate and cover with the protective cage, until it has cooled to room temperature.

10. Unload the cooled aggregate into a pan for a sieve analysis. Brush off any fines adhering to the sample baskets and catch pan and then reassemble the basket assembly.

3.5.4 Method "B" (Burn Mode: Program Time)

The Troxler ignition oven offers two burn modes: *Program Time* and *Auto-Control.* In *Program Time* mode, the burn time is set manually by the operator. The following describes the process to calculate the time required to obtain a clean burn.

1. Place the loaded sample basket in the pre-heated ignition oven, at a setpoint of 538^{o}C. (For set-up procedure, refer to the manufacturers' operators manual)

    a) Using the basket carrier, centre the sample basket in the ignition oven chamber. 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.

    b) Wearing appropriate safety apparel, always use the basket carrier when loading and unloading the furnace (see manufacturer's operators manual).

2. Close the oven door.

3. Use the **Calibration Burn Time** established during the correction factor procedure ATT-74, Part II, Section 3.3.2.3, for the burn time required to obtain a clean burn test sample.

4. After the burn cycle is complete, immediately weigh the hot basket and record the weight on the calculations area of the data sheet. Use of a heat shield, such as a ceramic tile, is recommended to prevent damage to the electronic balance. Review and follow the balance operator' manual recommendations for weighing hot objects.

5. For the first ACP field sample, place the sample basket back in the oven for another 10 minutes, remove and re-weigh, then repeat until a constant weight is determined. This is to check that the Calibration Time works for field samples.

6. Immediately weigh the hot basket after the final weighing and record the weight on the data sheet on line "X"(MAT 6-98) or "O"(MAT 6-100).

7. Place the hot basket on a heat resistant plate and cover with the protective cage until it has cooled to room temperature.

8. Unload the cooled aggregate into a pan for a sieve analysis. Brush off any fines adhering to the sample baskets and catch pan and then reassemble the basket assembly.

3.6 Corrected Ignition Asphalt Content

1. Determine the "***Weight of Dry Aggregate from Ignition***" on line "Y" (MAT 6-98) or line "P" (MAT 6-100) using the formula:

   MAT 6-98 *line "Y" = line "X" – line "W"*
   Y = (Wt. of Dry Aggregate + Basket @538°C) - Wt. of Ignition Basket @538°C

   MAT 6-100 *line "P" = line "O" – line "N"*
   P = (Wt. of Dry Aggregate + Basket @538°C) - Wt. of Ignition Basket @538°C

2. Determine the "***Weight of Asphalt***" on line "Z" (MAT 6-98) or line "Q" (MAT 6-100) as follows:

   MAT 6-98 *line "Z" = line "T" – line "Y"*
   Z = Total Dry Wt. of Uncut Rocks - Wt. of Dry Aggregate from Ignition

   MAT 6-100 *line "Q" = line "K" – line "P"*
   Q = Wt. of Dry Mix - Wt. of Dry Aggregate from Ignition

3. Calculate the "***Uncorrected Asphalt Content***" to the nearest 0.01% on line "AA" (MAT 6-98) or "R" (MAT 6-100) using the formula:

   MAT 6-98 *line "AA" = (line "Z" / line "Y") x 100*
   or
   MAT 6-100 *line "R" = (line "Q" / line "P") x 100*

$$\textbf{Uncorrected Asphalt Content \%} = \frac{\textbf{Wt. of Asphalt}}{\textbf{Wt. of Dry Aggregate from Ignition}} \times \textbf{100\%}$$

4. Enter on line "BB" (MAT 6-98) or "S" (MAT 6-100) the "***Ignition Asphalt Content Correction Factor***", as determined in ATT-74, Part II Asphalt Content Correction Factor.

5. Calculate the "***Corrected Ignition Asphalt Content***" on line "CC" (MAT 6-98) or line "T" (MAT 6-100) as follows:

   MAT 6-98 line "*Z" = line "AA" + line "BB"*

   Corrected Ignition A.C. (%) = Uncorrected A.C. + Ignition A.C. Correction Factor

   or

   MAT 6-100 line "*T" = line "R" + line "S"*

   Corrected Ignition A.C. (%) = Uncorrected A.C. + Ignition A.C. Correction Factor

3.7 Sieve Analysis

1. Transfer the "***Weight of Dry Aggregate from Ignition***" from the ***"IGNITION DATA"*** section of the form, to the top of the ***"SIEVE ANALYSIS CALCULATIONS***" data section of the form, line "Y" on MAT 6-98, or line "P" on MAT 6-100.

2. Perform a washed sieve analysis on the dry aggregate from ignition, as directed by test procedure ATT-26, Sieve Analysis, 25 000 µm Minus.

IGNITION DATA			
T. TOTAL DRY WT. CORE MIX	(S + (H-I))	g	2085.6
U. WT. OF IGNITION BASKET @ 20°C	Basket No. A	g	3485.1
V. IGNITION BASKET WEIGHT CORRECTION FACTOR			-4.0
W. WT. OF IGNITION BASKET @ 538°C (U + V)	see Note 1	g	3481.1
X. WT. OF DRY AGG. + BASKET @ 538°C	see Note 2	g	5457.2
Y. WT. OF DRY AGG. FROM IGNITION	(X - W)	g	1976.1
Z. WT. OF ASPHALT	(T-Y)	g	109.5
AA. UNCORRECTED ASPHALT CONTENT	(100 Z / Y)	%	5.54
BB. IGNITION ASPHALT CORRECTION FACTOR		%	-0.61
CC. CORRECTED IGNITION ASPHALT CONTENT	(AA+BB)	%	**4.93**

SIEVE ANALYSIS CALCULATIONS

WT. OF DRY AGGREGATE (Y) 1976.1				JOB MIX FORMULA	TOLERANCES FOR THE LOT MEAN FROM THE JOB MIX FORMULA
SIEVE SIZE µm	WEIGHT RETAINED g	WEIGHT PASSING g	PERCENT PASSING %		
25 000	0.0	1976.1	**100**	100	± 5
20 000	0.0	1976.1	**100**	100	± 5
16 000	4.1	1972.0	**100**	100	± 5
12 500	193.5	1778.5	**90**	87	± 5
10 000	375.5	1403.0	**71**	74	± 5
5 000	395.2	1007.8	**51**	53	± 5
2 500					
1 250	217.4	790.4	**40**	42	± 3
630	296.4	494.0	**25**	26	± 2
315	177.8	316.2	**16**	17	± 2
160	108.7	207.5	**10.5**	10.0	± 1.5
80	94.9	112.6	**5.7**	6.1	± 1.5
TARE PAN	4.3				
DD. TOTAL WEIGHT	1867.8	DIFFERENCE	% DIFFERENCE	MAXIMUM DIFFERENCE ALLOWED	
EE. DRY WASH WT. + PAN	3072.2	GG-DD	100 HH / GG		
FF. TARE OF PAN	1202.0				
GG. DRY WASH WT. (EE-FF)	1870.2	**HH.** 2.4	0.13	0.50 %	

4.0 Hints and Precautions

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

2. If ignition oven asphalt contents fluctuate due to varying or high amounts of combustible material in the aggregate, solvent extractions may be required.

3. Use care when loading and unloading the ignition sample baskets into the ignition oven to avoid touching or scraping the hearth plate, chamber sides, heating elements, or the thermocouples.

4. When removing the heated sample basket, or stainless steel 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.

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

6. 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.

7. 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 care.

8 There are a variety of different types of safety cages that can be placed over the baskets once they are removed from the oven. Regardless of the type, they need to be used and in place.

9. **DO NOT** attempt to heat any aggregates mixed with volatile chemicals in the ignition oven.

10. **DO NOT** override the ignition oven door lock.

11. 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.

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