Asphalt Content

Use the following asphalt content test methods for Quality Control, Quality Assurance and Appeal Testing of asphalt mixes.

QUALITY CONTROL

- ATT-12
- AASHTO T-164 or T-287
- ATT-74 Ignition Method

QUALITY ASSURANCE

- ATT-12, Part II, Filterless Extraction and Filterless Centrifuge Method
- ATT-74, Ignition Method

APPEAL TESTING

- ATT-12, Part II, Filterless Extraction and Filterless Centrifuge Method

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1.0 SCOPE

This method covers the procedures for determining the asphalt content of asphalt concrete cores, formed specimens, or loose mix samples using the reflux extraction apparatus and filters.

2.0 EQUIPMENT

Extraction Apparatus
25 000 µm Minus Sieve Analysis Equipment, as per ATT-26, Section 2.0

Electronic Balance - capable of reading to 0.1 g and having an accuracy of at least 0.01% of the sample mass, e.g. for a 2000 g sample weight, the balance must be accurate to 0.2 g. The balance must be operated and calibrated as per manufacturer's recommendations.

drying pans	spoon (stainless steel, 12” long)	metal pail
grocer scoop, large	large mixing pan	thermal gloves
detergent	plastic wash bottle	putty knife
respirators	extraction solvent	eye protection
solvent resistant gloves	grocer scoops (1-large & 1 small)	

Data Sheet: Mix Moisture Content, Extraction and Sieve Analysis, MAT 6-44

3.0 PROCEDURE

3.1 Asphalt Concrete Mix Sample

1. Assemble the equipment as directed in the applicable manufacturers’ equipment manual.

2. Before sampling the mix, fold 6 (or 8, depending on sample size) filter papers using either Method A or B as shown in Figure 1. When folding and creasing the filter papers, ensure that the paper is not torn.

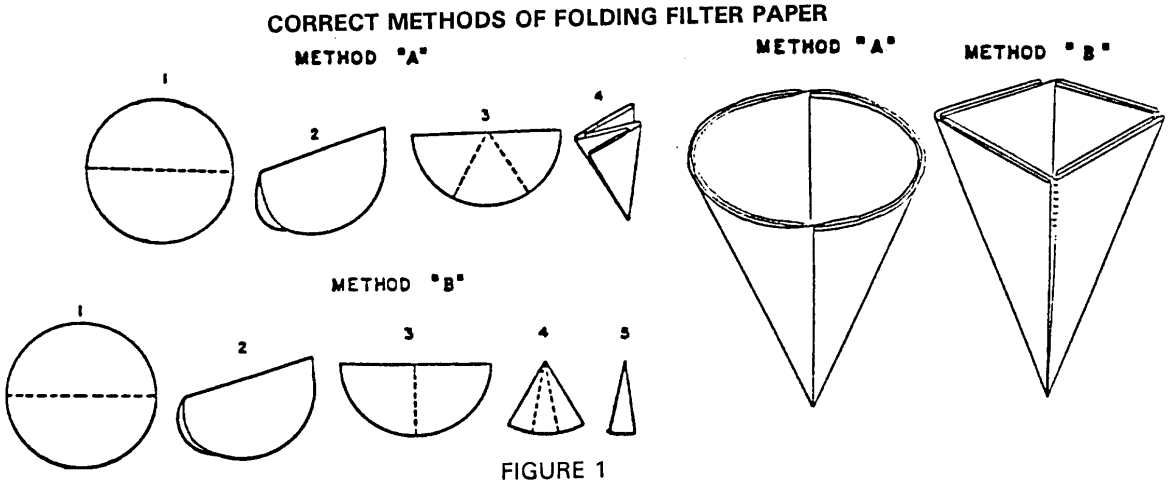

FIGURE 1

3. Label a clean drying pan and the assembled paper filters.

4. Set the paper filters in the pan and oven dry them to a constant dry weight.

5. Record in line "I" the pan number and the “Wt. of Tare Pan + Filters”. The same pan is used to complete the test (as per Section 3.1.3, Step 12).

6. Obtain one pail of representative mix (3/4 full), as directed in ATT-37, SAMPLING MIXES.

7. Dump the mix in a large heated mixing pan and use the heated large grocer scoop to thoroughly mix it.

8. Perform a visual inspection on the mix as directed in ATT-51, VISUAL INSPECTION, Asphalt Concrete Paving Mixtures. Enter pertinent information in the “Sample Appearance” section of the data sheet, as shown in Figure 2.

3.1.1 Moisture Content Sample

1. Label and tare a drying pan to the nearest 0.1 grams. Record the weight and number of the pan in line "D", as shown in Figure 2.

2. Use a heated grocer scoop to place at least 1 000 grams of mix into the tared pan. Ensure the mix is level and evenly distributed over the bottom of the pan.

   If the moisture sample will be used for the extraction test, ensure the mix sample is at least 2 000 grams.

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

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

4. Weigh the pan and mix to the nearest 0.1 g and record as “Wt. of Moist Sample + Pan” on line "A".

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

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

   a) Oven dry the mix sample for at least four hours, then weigh.
   b) Replace the sample in the oven for approximately 1 hour and weigh.
   c) Repeat step (b) until two consecutive weights are the same.

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

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MAT 6-44/13

ASPHALT EXTRACTION

FILTER METHOD

(see ATT-12 PART I)

CONTRACT NO. :	12345	MIX TYPE :	DES. 1	CLASS	16
PROJECT NO. :	Hwy 22:14	TECHNOLOGIST :	B. Good		
DATE SAMPLED :	30-Apr-2013	LOT :	1	SEGMENT:	3

SAMPLE TYPE		SAMPLE APPEARANCE					
		ASPHALT CONTENT		GRADATION		ASPHALT COATING	
FRESH ASPHALT CEMENT MIX	☑	RICH	☐	COARSE	☐	WELL COATED ROCKS	☐
CORED SPECIMEN	☐	NORMAL	☑	NORMAL	☑	SOME UNCOATED ROCKS	☑
MARSHALL SPECIMEN	☐	LEAN	☐	FINE	☐	POORLY COATED ROCKS	☐
EMULSIFIED ASPHALT MIX	☐						
CUTBACK ASPHALT MIX	☐						

MOISTURE CONTENT

A WT. OF MOIST SAMPLE + PAN		2373.2
B WT. OF DRY SAMPLE + PAN		2371.1
C WT. OF WATER	**A - B**	2.1
D WT. OF PAN Pan No. A		1246.5
E WT. OF DRY SAMPLE	**B - D**	1124.6
F MOISTURE CONTENT	**100 x (C / E)**	**0.19**
TIME SAMPLE PLACED IN OVEN		13:15
TIME SAMPLE TAKEN OUT OF OVEN		17:45
DRYING TIME		4:30

ASPHALT CONTENT

G WT. OF MOIST MIX + PAN + FILTERS		3695.9
H WT. OF PAN + FILTERS Pan No. B		1343.6
I WT. OF MOIST MIX	**G - H**	2352.3
J WT. OF DRY MIX	**(100 x I) / (100 + F)** *or* **(K - H)**	2347.9
K WT. OF DRY MIX + PAN + FILTERS		
L WT. OF DRY AGG. + PAN + FILTERS		3564.4
M WT. OF DRY AGGREGATE	**L - H** or **J - H**	2220.8
N WT. OF ASPHALT	**K - L** or **J - M**	127.1
O EXTRACTION ASPHALT CONTENT	**100 x (N / M)**	5.72
P EXTRACTION CORRECTION FACTOR		0.33
Q CORRECTED EXTRACTION ASPHALT CONTENT	**O + P**	**6.05**
TIME EXTRACTION STARTED		13:20
TIME EXTRACTION COMPLETED		17:05
EXTRACTION TIME		3:45

SIEVE ANALYSIS

(M) WT. OF DRY AGGREGATE			2220.8	
SIEVE SIZE	(R) WT. RETAINED	(S) WT. PASSING	% PASSING 100 (S / M)	SPECS. MIN - MAX
25 000	0.0	2220.8	**100**	
20 000	0.0	2220.8	**100**	
16 000	7.4	2213.4	**100**	100
12 500	220.8	1992.6	**90**	80-92
10 000	411.4	1581.2	**71**	70-84
5 000	441.7	1139.5	**51**	50-65
2 500	0.0			
1 250	256.0	883.5	**40**	26-45
630	325.6	557.9	**25**	18-38
315	202.2	355.7	**16**	12-30
160	123.5	232.2	**10**	8-20
80	105.8	126.4	**6**	4-10
SIEVE PAN	6.8			
TOTAL WEIGHT	2101.2	DRY WASH WT. + PAN		3408.0
DRY WASH WT.	2106.4	TARE OF PAN		1301.6
DIFFERENCE	5.2	% DIFFERENCE = (DIFF / DRY WASH WT) x 100		
% DIFFERENCE	0.25	MAXIMUM % DIFFERENCE = 0.5%		

COMMENTS: XXX

ENTER DATA INTO SHADED AREAS

FIGURE 2

8. Weigh the hot sample and record as “Wt. of Dry Sample + Pan”, on line "B".

9. Calculate the “Weight of Water” removed, on line "C", as follows:

Wt. of Water (g) = (Wt. of Moist Mix + Pan) - (Wt. of Dry Mix + Pan)

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

Wt. of Dry Mix (g) = (Wt. of Dry Mix + Pan) - (Wt. of Pan)

11. Calculate the “Moisture Content”, to the nearest 0.01%, on line "F", of the fresh asphalt cement mix using the formula:

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

3.1.2 Extraction Sample Preparation

1. Set the filter papers on one side of the tared drying pan and use a clean heated scoop to place at least **2000 g** of mix on the other side of the pan.

2. Use the putty knife to clean all the mix off the scoop into the pan.

3. Weigh the pan containing the mix and filters and record as “Wt. of Moist Mix + Pan + Filters”, on line "G".

4. Calculate the “Weight of Moist Mix”, on line "I", of the extraction sample as follows:

Wt. of Moist Mix (g) = (Wt. of Moist Mix + Pan + Filters) - (Wt. of Pan + Filters)

5. Set the 6 or 8 extraction cones in a clean drying pan and place one folded paper filter in each of the cones. The drying pan is used to trap any spilled mix.

6. Set the pan containing the mix adjacent to the pan with the cones.

7. Use the spoon to evenly fill each cone with the extraction sample.

8. Assemble the cones in 3 or 4 battery jars, taking care not to spill any mix.

9. In the fume cabinet, use the labelled wash bottle containing chlorinated extraction solvent to rinse any mix stuck to the spoon into the mix pan.

   NOTE: Respirators must be worn when performing steps 9 to 11.

10. Use the wash bottle to flush the contents of the mix pan into the top cone inside a battery jar.

11. Place the condensers on the battery jars and proceed with the Extraction, Section 3.1.3.

3.1.3 Extraction

1. Place a wire gauze on each burner, then centre each jar on the burner.

2. Make sure the condenser is on the battery jar. Open the water tap so that the flow of water keeps the condensers cool.

3. Light the propane burner (or turn on the hot plate). Record the time the extraction was started.

4. Keep each burner on low heat until the battery jar and the chlorinated extraction solvent are hot. A rapid change in jar temperature will cause the jar to crack.

5. Turn the heat up under each jar until solvent vapors start to condense and drip from condensers.

6. Allow the solvent to rise in the cones until the mix is completely immersed.

7. Watch the chlorinated extraction solvent levels and set the burners to ensure that the solvent does not flow over the cone. The solvent level in each jar should be maintained at approximately 50 mm.

8. Adjust the water flow throughout the test to keep the condensers cool.

9. Repeat steps 7 to 8 until the wash from the bottom cones is clear and the aggregate in the bottom cones is clearly visible.

10. When the wash and the chlorinated extraction solvent in the bottom cones is clear, turn off the heat, and allow the apparatus to cool with the water running the condenser.

    NOTE: For very dirty aggregates, the flow of solvent from the bottom cones may appear clear even though asphalt is still being extracted. The paper filters become quite dirty towards the end of the test, impeding chlorinated extraction solvent flow from inside the cones. Chlorinated extraction solvent condensing on the outside of the cones and flowing to the bottom, dilutes the slow stream creating an apparent clear stream. For these materials, continue to reflux until the colour of the solvent in the cones appears clear.

11. Allow the cones to drain completely.

12. Clean the drying pan which was used to weigh the mix and the filter papers, and then place it in the fume cabinet beside the extraction apparatus.

13. When boiling has ceased and the cylinder is cool enough to handle, turn off the water to the condenser. Cool the chlorinated extraction solvent to room temperature, then put on the gloves and respirator, and remove the cones from the jar.

14. Empty the contents of each cone in the drying pan, including the filter papers.

15. Replace the condensers on the battery jars.

16. Record the time the extraction was completed, then calculate the total extraction time.

17. Lift the filter papers up slightly, causing the loose aggregate to fall into the pan.

18. While still in the fume cabinet, gently stir the aggregate in the drying pan to remove some of the chlorinated extraction solvent.

19. Leave the emptied filter papers on top of the aggregate and place the drying pan in the oven set at 130°C ± 5°C. You can now remove your respirator, and place it back into an airtight container.

20. Oven dry the extracted aggregate to a constant weight.

21. Weigh the hot aggregate together with the dirty filter papers. Record as “Wt. of Dry Aggregate + Pan + Filters”, on line "L".

22. Thoroughly brush all the aggregate off the filter papers into the drying pan.

3.1.4 Corrected Extraction Asphalt Content

1. Calculate the “Weight of Dry Mix”, on line "J", using the formula:

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

2. Calculate the “Weight of Dry Aggregate”, on line "M", as follows:

Wt. of Dry Agg (g) = (Wt. of Dry Agg + Pan + Filters) - (Wt. of Pan + Filters)

3. Determine the “Weight of Asphalt”, on line "N", as follows:

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

4. Calculate the “Extraction Asphalt Content”, to the nearest 0.01%, on line "O", using the formula:

$$\textit{Extraction Asphalt Content (\%)} = \frac{\textit{Wt. of Asphalt (g)}}{\textit{Wt. of Dry Agg. (g)}} \times 100$$

5. Enter on line "P" the “Extraction Correction Factor”, as determined in ATT-12, Part III.

6. Calculate the “Corrected Extraction Asphalt Content”, on line "Q", as follows:

Extraction Asphalt Content (corrected) =

Extraction Asphalt Content + Extraction Correction Factor

3.1.5 Wash Sieve Analysis

Perform a wash sieve analysis on the extracted dry aggregate as directed in ATT-26, Sections 3.1.2 and 3.2.

3.2 Reclaimed Asphalt Pavement or Liquid Asphalt Mixes

1. Assemble the equipment and obtain a mix sample as described in Section 3.1.

2. Remove the paper filters from the drying pan and place them in a clean area.

3. Use the heated grocer scoop to place at least 2 000 gram of mix into the tared pan. Ensure the mix is level and evenly distributed over the bottom of the pan.

4. Use the putty knife to clean off any mix adhering to the scoop into the pan.

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

   NOTE: If the drying temperature of cutback asphalt mixes exceeds 165°C the asphalt will be coked, which will result in extended and incomplete extractions. Avoid hot spots in the oven. The best location for drying these samples is in the upper shelf, away from the sides of the oven.

6. When the mix is almost dry, place the filters back in the drying pan, beside the mix. This is to remove any moisture the filters might have picked up while the mix was drying.

7. After the sample has reached a constant dry weight, remove the pan from the oven.

8. Weigh the hot pan with the mix and filters and record as “Wt. of Dry Mix + Pan + Filters”, on line "K", as shown in Figure 3.

9. Calculate the “Weight of Dry Mix”, on line "J", as follows:

   Wt. of Dry Mix (g) = (Wt. of Dry Mix + Pan + Filters) - (Wt. of Pan + Filters)

10. Complete the preparation for extraction by repeating Steps 5 to 11 of Section 3.1.2.

11. Perform the extraction test as directed in Section 3.1.3.

12. Calculate the “Corrected Extracted Asphalt Content” as directed in Steps 2 to 6 of Section 3.1.4.

13. Perform a wash sieve analysis on the extracted aggregate as described in ATT-26, Sections 3.1.1 and 3.2.

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MAT 6-44/13

ASPHALT EXTRACTION

FILTER METHOD (see ATT-12 PART I)

CONTRACT NO. :	12345	MIX TYPE :	DES. 1	CLASS	16
PROJECT NO. :	Hwy 22:14	TECHNOLOGIST :	B. Good		
DATE SAMPLED :	30-Apr-2013	LOT :	1	SEGMENT:	3

SAMPLE TYPE		SAMPLE APPEARANCE					
		ASPHALT CONTENT		GRADATION		ASPHALT COATING	
FRESH ASPHALT CEMENT MIX	☐	RICH	☐	COARSE	☐	WELL COATED ROCKS	☐
CORED SPECIMEN	☐	NORMAL	☑	NORMAL	☑	SOME UNCOATED ROCKS	☑
MARSHALL SPECIMEN	☐	LEAN	☐	FINE	☐	POORLY COATED ROCKS	☐
EMULSIFIED ASPHALT MIX	☐						
CUTBACK ASPHALT MIX	☑						

MOISTURE CONTENT

A WT. OF MOIST SAMPLE + PAN		
B WT. OF DRY SAMPLE + PAN		
C WT. OF WATER	A - B	
D WT. OF PAN	Pan No. A	
E WT. OF DRY SAMPLE	B - D	
F MOISTURE CONTENT	100 x (C / E)	
TIME SAMPLE PLACED IN OVEN		
TIME SAMPLE TAKEN OUT OF OVEN		
DRYING TIME		

ASPHALT CONTENT

G WT. OF MOIST MIX + PAN + FILTERS		
H WT. OF PAN + FILTERS	Pan No. B	1343.6
I WT. OF MOIST MIX	G - H	
J WT. OF DRY MIX	(100 x I) / (100 + F) *or* (K - H)	2087.0
K WT. OF DRY MIX + PAN + FILTERS		3430.6
L WT. OF DRY AGG. + PAN + FILTERS		3358.9
M WT. OF DRY AGGREGATE	L - H or J - H	2015.3
N WT. OF ASPHALT	K - L or J - M	71.7
O EXTRACTION ASPHALT CONTENT	100 x (N / M)	3.56
P EXTRACTION CORRECTION FACTOR		0.11
Q CORRECTED EXTRACTION ASPHALT CONTENT	O + P	**3.67**
TIME EXTRACTION STARTED		13:20
TIME EXTRACTION COMPLETED		16:35
EXTRACTION TIME		3:15

SIEVE ANALYSIS

(M) WT. OF DRY AGGREGATE: 2015.3

SIEVE SIZE	(R) WT. RETAINED	(S) WT. PASSING	% PASSING 100 (S / M)	Des. 1-16 SPECS. MIN - MAX
25 000	0.0	2015.3	100	
20 000	0.0	2015.3	100	
16 000	4.0	2011.3	100	100
12 500	203.6	1807.7	90	80-92
10 000	370.8	1436.9	71	70-84
5 000	411.1	1025.8	51	50-65
2 500	0.0			
1 250	215.6	810.2	40	26-45
630	312.4	497.8	25	18-38
315	177.4	320.4	16	12-30
160	108.4	212.0	11	8-20
80	97.1	114.9	6	4-10
SIEVE PAN	5.7			
TOTAL WEIGHT	1906.1	DRY WASH WT. + PAN		3210.9
DRY WASH WT.	1909.3	TARE OF PAN		1301.6
DIFFERENCE	3.2	% DIFFERENCE = (DIFF / DRY WASH WT) x 100		
%DIFFERENCE	0.17	MAXIMUM % DIFFERENCE = 0.5%		

COMMENTS: xxx

ENTER DATA INTO SHADED AREAS

FIGURE 3

3.3 Cores or Marshall Specimens

An extraction test can be performed on cored or formed specimens. Waxed specimens are not used.

The extraction test is performed on samples of at least 2 000 grams.

Therefore for each sample:

a) Use two field formed Marshall specimens, ideally those compacted for a test series, or

b) If performing quality assurance testing, use the core that was used for the density determination of the segment and additional core(s) taken adjacent to the segment core. The additional cores could be sawed and quartered, and then added to the original material to meet the minimum sample size.

c) If performing appeal testing, more than one core may be submitted for one location. Each set of cores for each location is considered one sample. The cores are combined and the entire sample is processed.

The extraction of cores or Marshall specimens is as follows:

1. Repeat steps 1 to 5 of Section 3.1.

2. Remove the paper filters from the drying pan and place them in a clean area.

3. Place the specimen(s) in the pan, place the pan in the oven set at 130^{o}C ± 5^{o}C and dry the specimen(s) to a constant weight.

4. After the specimen(s) has been in the oven for half an hour, break the specimen(s) up with the putty knife. Clean any material adhering to the putty knife back onto the pan.

5. Repeat steps 6 to 9 of Section 3.2.

6. Complete the preparation for extraction by repeating Steps 5 to 11 of Section 3.1.2.

7. Perform the extraction test as directed in Section 3.1.3.

8. Calculate the “Corrected Extracted Asphalt Content” as directed in Steps 2 to 6 of Section 3.1.4.

9. Perform a wash sieve analysis on the extracted aggregate as described in ATT-26, Sections 3.1.1 and 3.2.

4.0 HINTS AND PRECAUTIONS

1. Fumes from chlorinated extraction solvent are toxic. Perform the extraction test using an exhaust system in a well-ventilated area, since these are toxic substances.

2. Respirators and solvent resistant gloves should be worn when handling chlorinated extraction solvent (e.g., pouring the solvent). Each person should have a personal respirator, safety glasses, and a pair of gloves. The proper respirator for the hazard must be used. Proper use of dust and chemical respirators is discussed in the applicable manufacturers' equipment manuals.

3. Respirators must be stored in airtight containers and away from all fumes so that filters do not accumulate fumes from the air.

4. Chlorinated extraction and cleaning solvent containers must be sealed when not in use. Battery jars containing chlorinated extraction solvent must be kept covered and in a fume cabinet when not in use. This prevents loss due to evaporation and minimizes exposure to the solvent fumes.

5. Review and know the First Aid, Safety Precautions and Storage Guidelines for Chlorinated extraction solvent as outlined in the Material Safety Data Sheet (MSDS), which should be contained in a field lab binder.

6. The wire mesh of the extraction cones should be inspected before testing begins. Dirty and plugged cones will impede the chlorinated extraction solvent flow, greatly increasing the time required to complete the test.

7. Do not allow the cones to overflow during the test. Overflowing will remove mineral matter from the cones, which will be interpreted as asphalt, thereby causing an erroneous high asphalt content.

8. The chlorinated extraction solvent in the battery jars must be changed periodically, in a fume cabinet, and new solvent added.

9. Chlorinated extraction solvent, or approved substitute must be used. Some of the approved substitutes are flammable.
   Solvent substitutes such as Varsol, **must not be used**, as they may **explode.**

10. The extraction aggregate is easier to wash when hot water is used to wash the sample.

11. High water pressure may distort the condensers, which could allow chlorinated extraction solvent vapors to escape, which decreases the efficiency of the refluxing. Use the water tap to control the water flow.

12. In no event should the solvent be used to clean your hands.