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
ATT-12/95, EXTRACTION - Part I, Reflux

1.0 SCOPE

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

2.0 EQUIPMENT

extraction apparatus
20 000 Fm 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
grocer scoop, large
grocer scoop, small
plastic wash bottle
large mixing pan
putty knife
tablespoon
metal pail
respirators
gloves
detergent
grocer scoop, small
chlorinated extraction solvent

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, 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.

Correct Methods of Folding Filter Paper

METHOD "A"

METHOD "B"

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 3/4 full of representative mix, as directed in ATT-37, SAMPLING MIXES.

7. Place the mix in a 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 g. Record the weight and number of pan in line "D", as shown in Figure 2.

2. Use the heated grocer scoop to place at least 1000 g 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 2000 g.

   **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 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 (line "A").

5. Place the drying pan with the mix in the oven set at 130°C ± 5°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.
8. Weigh the hot sample and record as Wt. of Dry Sample + Pan (line "B").

9. Calculate the Weight of Water removed (line "C") as follows:

\[ \text{Wt. of Water (g)} = (\text{Wt. of Moist Mix % Pan}) \times (\text{Wt. of Dry Mix %}) \]

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

\[ \text{Wt. of Dry Mix (g)} = (\text{Wt. of Dry Mix % Pan}) \times (\text{Wt. of Pan}) \]

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

\[ \text{Moisture Content (%)} = \frac{\text{Wt. of Water}}{\text{Wt. of Dry Mix}} \times 100\% \]

### 3.1.2 Extraction Sample Preparation

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

2. Use the putty knife to clean 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 (line "G").

4. Calculate the weight of moist mix (line "I") of the extraction sample as follows:

\[ \text{Wt. of Moist Mix (g)} = (\text{Wt. of Moist Mix % Pan % Filters}) \times (\text{Wt. of Pan % Filters}) \]

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 spilled mix.

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

7. Use the tablespoon 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 wash bottle containing chlorinated extraction solvent to rinse 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 and light the propane burner. Record the time the extraction was started.

3. 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.

4. Open the water tap so that the flow of water keeps the condensers cool.

5. Turn the heat on 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.

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 color 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 place it in the fume cabinet beside the extraction apparatus.

13. Cool the chlorinated extraction solvent to room temperature, 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 jars.

16. Record the time the extraction was completed and calculate the 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. Remove the respirator.

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 (line "L").

22. Thoroughly clean the filter papers into the drying pan.

### 3.1.4 Corrected Extraction Asphalt Content

1. Calculate the Weight of Dry Mix (line "J") using the formula:
   \[
   \text{Wt. of Dry Mix (g)} = \frac{\text{Wt. of Moist Mix}}{100 \text{ %Moisture Content}} \times 100\%
   \]

2. Calculate the Weight of Dry Aggregate (line "M") as follows:
   \[
   (\text{Wt. of Dry Agg. %Pan %Filters}) \times (\text{Wt. of Pan %Filters})
   \]

3. Determine the Weight of Asphalt (line "N") as follows:
   \[
   \text{Wt. of Asphalt (g)} = \frac{\text{Wt. of Dry Mix} \times \text{Wt. of Dry Aggregate}}{\text{Wt. of Dry Aggregate}}
   \]

4. Calculate the Extraction Asphalt Content to the nearest 0.01% (line "O") using the formula:
   \[
   \text{Asphalt Content (\%)} = \frac{\text{Wt. of Asphalt}}{\text{Wt. of Dry Aggregate}} \times 100\%
   \]

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

6. Calculate the Corrected Extraction Asphalt Content (line "Q") as follows:
   \[
   \frac{\text{Extraction Asphalt Content \%}}{\text{Extraction Correction Fact}}
   \]
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 2000 g 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 the mix off 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 (line "K"), as shown in Figure 3.

9. Calculate the Weight of Dry Mix (line "J") as follows:

   \[
   \text{Wt. of Dry Mix} \%\text{Pan} \%\text{Filters} \& \text{Wt. of Pan} \%\text{Filters}
   \]

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

**EXTRACTION TEST (NON-EPS)**

| Project No. | 2214 |
| Distinct | Calgary (4) |
| Pit Name | Springbank |
| Station | 5k 18-024-4-5 |
| Lot or Section No. | 10 |
| Sample or Segment No. | 3 |

**Sample Type**

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<th>Sample Type</th>
<th>Asphalt Content</th>
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<td>Cored Specimen</td>
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<td>WELL COATED ROCKS</td>
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<td>Cutback Asphalt Mix</td>
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**Moisture Content**

| A. Wt. of Moist Sample + Pan | g |
| B. Wt. of Dry Sample + Pan | g |
| C. Wt. of Water | A - B | g |
| D. Wt. of Pan (No.) | g |
| E. Wt. of Dry Sample | B - D | g |
| F. Moisture Content | 100°C/E | % |
| Time Sample Placed in Oven | h-min |
| Time Sample Taken Out of Oven | h-min |
| Drying Time | h-min |

**Sieve Analysis**

| M. Wt. of Dry Aggregate | 815.3 | g |

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</table>

**Asphalt Content**

| Q. Wt. of Moist Mix + Pan + Beaker or Filters | g |
| H. Wt. of Pan + Beaker or Filters (No. A) | 134.3 | g |
| I. Wt. of Moist Mix | Q - H | g |
| J. Wt. of Dry Mix + Pan + Beaker or Filters | 100/(100+F) or K-H | 208.7 | g |
| K. Wt. of Dry Mix + Pan + Beaker or Filters | 100/(100+F) or K-H | 39.36 | g |
| L. Wt. of Dry Agg. + Pan + Beaker or Filters | 335.8 | g |
| M. Wt. of Dry Aggregate | L-H or J-M | 205.3 | g |
| N. Wt. of Asphalt | K-L or J-M | 71.7 | g |
| G. Extraction Asphalt Content | 100 | x | 3.56 | % |
| P. Extraction Correction Factor | 0.11 | % |
| Q. Corrected Extraction Asphalt Content | G + P | 3.67 | % |

**Remarks**

**Technologist:** B. Good

**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 2000 g. 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 130EC ± 5EC 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 the 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. Every effort must be made to have proper ventilation in the field laboratory while the test is being performed.

2. Review and know the First Aide and Safety Precautions for Chlorinated extraction solvent outlined in the Material Safety Data Sheet in a field lab binder.

3. 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.

4. 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.

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

6. Chlorinated extraction solvent or approved extraction solvents must be used. Substitutes such as varsol, must not be used, as they will explode.

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

8. High water pressure will distort the condensers allowing chlorinated extraction solvent vapors to escape which decreases the efficiency of the refluxing. Use the tap to control the water flow.

9. Respirators and gloves should be available for each person performing the test and should be worn when handling chlorinated extraction solvent. Proper use of respirators is discussed in the applicable manufactures equipment manual.

10. Respirators should be stored in plastic bags away from all fumes so that filters do not accumulate fumes from the air.

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