

5.16.16 VOLATILE DISTILLATE CONTENT AND MOISTURE CONTENT OF
BITUMINOUS MIXES (Kansas Test Method KT-16)

a. SCOPE

The methods of test cover the procedures for determining the volatile distillate content and moisture content of bituminous mixtures. KT-16 reflects testing procedures found in AASHTO T 110.

b. APPARATUS

b.1. Vertical, cylindrical metal still.

b.2. Water cooled reflux glass tube condenser jacket not less than 400 mm (15 3/4 in) long with an inner tube 9.5 to 12.7 mm (3/8 to 1/2 in) outside diameter and a beveled tip. The tip should be sanded with sand paper to eliminate the fire polish bead.

b.3. Condenser Traps.

b.3.a. For volatile determination, a well annealed pyrex glass trap conforming to the dimensions of Fig. 1 in AASHTO T 110.

b.3.b. For moisture determination, a well annealed pyrex glass trap conforming to the description and sketches in Fig. 2 of AASHTO T 55.

b.4. Heating device capable of maintaining a distillation rate of from 1 to 5 drops per second.

b.5. Balance of 1 kg capacity readable to within 1.0 g and sensitive to within 0.5 g.

b.6. For **e. ALTERNATE METHOD** apparatus, see KT-11 **b.1.**

c. TEST PROCEDURE

c.1. Determination of volatiles.

c.1.a. Select a sample of bituminous mixture weighing from 200 to 500 g (depending on the mixture), weigh and place in the metal still.

c.1.b. Add 350 mL of water and approximately 3 g of sodium carbonate (Na_2CO_3) and quickly stir into the sample.

c.1.c. Quickly clamp the still cover in place and assemble the still, volatile trap and condenser. The condenser shall be in

a vertical position and the graduated leg of the trap lined up below the condenser.

c.1.d. Apply heat at such a rate that the fluid will begin to reflux in from 5 to 20 minutes after heat is applied and will drip from the condenser at the rate of 1 to 5 drops per second. The neck of the trap may be gently heated initially to preclude condensation.

c.1.e. Continue distillation until three successive readings of the upper and lower levels of the volatile oils, taken at 15 minute intervals, show no increase in the quantity collected.

c.1.f. Remove the heat and allow the apparatus to stand approximately fifteen minutes to permit the solvent to cool and separate.

c.1.g. Read and record the volume of the volatile oil in the trap and determine its temperature by use of an immersion thermometer, or read and record the volume and temperature after allowing the fluid to cool at room temperature and reading a thermometer placed near the trap.

c.2. Determination of Moisture: The procedure for determining moisture is identical to that described for determination of volatiles with the following exceptions: water-free kerosene is used as a solvent (recommend using No. 1 kerosene), the addition of Na_2CO_3 is unnecessary, the maximum time of distillation shall be 1 1/2 hours and a moisture trap is used.

d. CALCULATIONS

d.1. Volatile Content.

d.1.a. Correct the volume of volatiles to 15.6°C (60°F) by use of the proper multiplier taken from Table 7 of the ASTM-IP "Petroleum Measurement Tables," a portion of which is reproduced elsewhere in this manual. The weight of volatiles is determined by multiplying the volume at 15.6°C (60°F) by 0.8, which is the average specific gravity of the distillate obtained by the test method outlined.

Group (See Table 5.17-1)	Specific Gravity
0.....	1.0760 to 0.9665
1.....	0.9659 to 0.8504
2.....	0.8498 to 0.7758

d.1.b. Determine the percent of volatiles by dividing the weight of volatile oils by the weight of asphalt in the mix and multiplying by 100.

d.2. Moisture Content.

d.2.a. The combined weight of aggregate and asphalt in the mix is determined by subtracting the mL (g) of water from the weight of mix placed in the still. The weight of the aggregate in the mix is computed by dividing the weight of aggregate plus asphalt by 100 plus the percent of asphalt and multiplying the result by 100.

d.2.b. The weight of asphalt in the mix is determined by subtracting the weight of aggregate from the weight of asphalt plus aggregate.

d.2.c. The percent of moisture based on dry weight of aggregate is determined by dividing the weight of water by the weight of aggregate and multiplying by 100.

d.2.d. The percent of moisture in the total mix is determined by dividing the weight of water by the weight of aggregate plus asphalt and multiplying by 100.

NOTE a: A set of samples calculations is given below: (KDOT Form No. 680 may also be used.).

Certification Information

Specific gravity of MC cutback.....	0.9587	(1)
Specific gravity of volatile (assumed).....	0.80	(2)
Percent volatiles in cutback-by volume.....	13.0%	(3)
Percent volatiles in cutback-by weight.....	10.8%	(4)

Given (for moisture determination)

Weight of sample for volatile test.....	350.0 g
Percent of MC cutback.....	5.0 %
mL of water collected in trap.....	2.7 mL

(For volatile determination)

Weight of sample for volatile test.....	350.0 g
Volume of volatiles.....	1.6 mL
Temperature of volatiles.....	27°C (80°F)

NOTE b: Item (3) above is determined as follows:

% volatiles = 100-Volume of residue at 360°C (680°F) (percent)

Calculations:

NOTE c: Items (1), (2), (3) and (4) above shall be obtained from an average of the tests conducted at the refinery on asphalt being delivered to the project. The test results are reported on certifications that accompany each load. If item (4) is not shown on the certification, it may be calculated as follows:

The refinery inspector conducts the distillation test using 200 mL of cutback asphalt.

Weight of asphalt = 200(0.958 7) (see (1) above) = 191.7 g
 Volume of volatiles = 200(0.13) (see (3) above) = 26.0 mL
 Weight of volatiles = 26.0(0.80) (see (2) above) = 20.8 g

Percent of volatiles by weight = $\frac{100(20.8)}{191.7}$ = 10.85

Field Test Calculations.

Weight of moisture sample..... 350.0 g
 Water collected..... 2.7 mL
 Weight of aggregate plus asphalt..... 347.3 g

Weight of aggregate = $\frac{100(347.3)}{(100+5.0)}$ 330.8 g

Weight of asphalt = 347.3 - 330.8 16.5 g

Percent of moisture = $\frac{100(2.7)}{347.3}$ 0.78

Percent of moisture = $\frac{100(2.7)}{330.8}$ 0.82

Volume of volatiles in trap at 27 °C (80 °F)..... 1.60 mL
 Vol. of volatiles at 16 °C (60 °F) = 1.60(0.990 1) . 1.58 mL

Volatiles remaining after aeration (g) = 1.58(0.80).. 1.26 g

Percent volatiles remaining after aeration (by weight) =
 $\frac{100(1.26)}{16.5}$ 7.64

Percent volatiles removed (by weight) =
 $\frac{100(10.85-7.64)}{10.85}$ 29.59

e. ALTERNATE METHOD (FOR USE WITH ASPHALT CEMENT MIXES ONLY)

The moisture content of plant mix bituminous mixtures may be determined on the aggregate samples obtained in accordance with KT-1 "Sampling Plant Mix Aggregates" or KT-25 "Sampling Plant Mixed Bituminous Mixtures."

A sample of the hot aggregate or bituminous mixture is obtained directly from the sample container and placed immediately in a previously tared container and the container immediately capped so as to prevent the loss of moisture. The sample size shall be at least 1 000 g.

The tared container and the sample shall be weighed to the nearest 0.1 g after which the sample shall be removed from the container and dried to a constant weight, and weighed to the nearest 0.1 g.

The percent of moisture is calculated as follows:

$$\% \text{ Moisture} = \frac{100(\text{Original Weight of Sample} - \text{Final Weight of Sample})}{\text{Final Weight of Sample}}$$