



Vacuum Extractors

1. Scope

This is to determine bitumen content of hot paving mixtures by use of the vacuum extractor. The aggregate remaining after extraction of the bitumen may be used for sieve analysis. This test is designed for field control work on freshly mixed hot paving mixtures, but may be adapted for other uses.

2. Apparatus

Vacuum extractor complete with vacuum pump, gasket, rubber tubing, filter paper, support plate and funnel ring, similar to that shown in Fig 1. The vacuum extractor is currently available in two sizes, (1) 12" filtering surface using 33 cm. diameter filters and (2) 10" diameter filter surface using 29 cm. filters. The larger extractor has a test specimen capacity of 2000 to 3000 grams, the smaller extractor has a test specimen capacity of 1400 to 1900 grams.

2.1 Filter paper, medium grade, fast filtering of the diameter required to fit the extractor.

2.2 Gas hot plate 3-burner with steel plate cover and thin pad.

2.3 Metal beaker, stainless steel, and nine-quart capacity.

2.4 Two (2) 4000 ml glass Erlenmeyer flasks.

2.5 Glass graduated 500 ml capacity.

2.6 Plastic wash bottle 500 ml capacity, filled with methylene chloride.

2.7 Dial thermometer 50°F to 180°F.

2.8 White enameled drying pan 9" x 16" x 2 ½".

2.9 Mixing spoon 12" long.

2.10 Spatula 9" long.

2.11 Torsion balance 4000 gm capacity and set of weights.

2.12 Stiff bristled brush, 1" wide.

2.13 Diatomaceous silica filtering aid conforming to ASTM D604, Type A (Celite)

Note 1: Use apparatus listed under 2(N), (O), (P), and (Q), only with hard to filter mixes as in method B.

2.14 1000 ml. Erlenmeyer flask.

2.15 4" diameter watch glass.

2.16 Metal tongs, 6" to 8" long.

Reagents:

2.17 Denatured ethyl alcohol (alcohol)

2.18 Methylene chloride

3. Sample Preparation

The test specimen shall be that obtained by a tube sampler and not further reduced in size, or be the end result of splitting or quartering of a large sample conforming to AASHTO T168. The size of the test specimen shall be governed by the nominal maximum size of particle of mineral aggregate in the mixture. The approximate minimum size of test specimen shall conform to the requirements shown in Table 1. Introduce the specimen into the tare metal beaker and weigh to the nearest 0.1 gm. If specimen temperature at this point is above 130°F, it should be allowed to cool to a temperature

of less than that, then pour 200 ml of alcohol on to the specimen. Add approximately 700 ml of methylene chloride, stir occasionally for approximately five minutes or until all asphalt is visually in solution.

TABLE 1: SIZE OF TEST SPECIMEN

NOMINAL MAXIMUM SIEVE SIZE	APPROXIMATE MINIMUM WEIGHT OF SPECIMEN (GM)
No. 4	500
3/8"	1000
1/2"	1500
3/4"	2000
1"	3000
1 1/2"	4000

4. Method A

PROCEDURE

- 4.1 Place a dry tare filter on the vacuum extractor and tighten the wing nuts finger tight. (care must be taken to see that the filter is centered.)
- 4.2 Start the vacuum pump and decant the solvent from the prepared specimen into the extractor then gently pour the specimen into the vacuum extractor, being sure to wash the beaker completely clean with the wash bottle. Gently distribute the specimen evenly over the filter paper with spatula.
- 4.3 When the solvent added under section 4.2 has been vacuumed off, turn off the vacuum pump and open the vacuum valve, then pour enough methylene chloride, approximately 700 ml, to cover the specimen stir gently with spatula until all aggregate has been moved slightly then vacuum off the solvent. This procedure is repeated until the solvent in the inspection tube is a light straw color. (Note: solvent may be slowed for observation by partially opening vacuum valve and reducing vacuum to a few inches.)
- 4.4 Let the vacuum pump run for a few minutes after the last wash, to aid in drying the specimen. Scrape the aggregate away from the side of the funnel ring toward the center of the filter to avoid loss when the ring is removed. Remove the ring and brush the clinging aggregate into the drying pan. Then pick up the filter paper and aggregate by holding the filter paper on opposite sides and raising it straight up. Place the specimen in the tare pan and brush the clinging aggregate from the filter into the pan. The aggregate shall then be dried on the hot plate, bringing it to a temperature of about 130°F in ten minutes. Stir occasionally. **DO NOT LET SPECIMEN REACH OVER 140°F.** When visually dry, sniff cautiously for odor, continue drying and stirring until odor free. Weigh filter and aggregate in pan and record. Let stand five minutes and weigh again. If weight loss is less than 0.01 percent of the specimen weight, the aggregate shall be considered dry. If not dry let stand, stirring occasionally until weight loss is less than 0.01 percent in five minutes. Then weigh and record. Subtract the weight of the filter and pan to determine the weight of the extracted aggregate.

CALCULATIONS

Calculate the percentage of bitumen extracted as follows:

$$\begin{aligned} & \text{Bitumen extracted, percent of gross test specimen weight} \\ & = \frac{S - A}{S} \times 100 \end{aligned}$$

Where:

S= Weight of test specimen

A= Weight of extracted mineral aggregate

Add the retention factor (note 2), previously determined for the job mix, to the percent bitumen extracted and report total as percentage of bitumen in the mix (note 3).

Note 2: see section 8 for procedure for determining the retention factor.

Note 3: procedure as detailed in section 4.4 does not require a moisture correction. If the moisture in the bituminous mixture being tested is over 0.6 percent, then routinely, the amount of moisture shall be determined by standard test procedures. In this case the extracted aggregate shall be dried to a constant weight at 230°F, ± 9.

The percentage of bitumen extracted shall be calculated as follows:

$$\begin{aligned} & \text{Bitumen Extracted, percent of dry mixture} \\ & = \frac{(S-W) - A}{S-W} \times 100 \end{aligned}$$

Where:

S= Weight of test specimen

A= Weight of extracted mineral Aggregate,

W= Weight of water in specimen

Add the retention factor to the percent bitumen extracted and report as the percentage of bitumen in the dry mix.

5. Retention Factor

SCOPE

Certain types of aggregate will retain a small amount of bitumen after being tested by the vacuum extractor; this should be taken into consideration in calculating the final percent bitumen in the mix. The following procedure is used to determine the retention factor.

Note 4: where the retention factor is known to be 0.04 or less it may be disregarded.

PROCEDURE

- 5.1 The test procedure as outlined in the following paragraphs shall be performed separately on at least two specimens of aggregate representative of the material to be used in the mix. Test specimen size shall conform to the requirements of Table 1. The aggregate specimen shall be dried to a constant weight at 275°F, plus or minus five.
- 5.2 Place specimen in a tare metal beaker and weigh to the nearest 0.1 gm.
- 5.3 Immediately add asphalt cement of the amount and type called for by the job mix formula. The asphalt cement shall be preheated to 300°F to 350°F. Calculate the exact percentage of bitumen added to the nearest 0.01 percent.

- 5.4 Mix the bitumen and aggregate by hand until aggregate is thoroughly coated. The mix specimen shall be kept within the specified job- mix temperature range by placing it on the hot plate during mixing. The mixing tool shall remain in the beaker until the specimen is ready to be transferred to the extractor.
- 5.5 Allow the specimen to cool to less than 130°F. Then add alcohol and methylene chloride and stir as in section 3.
- 5.6 Proceed as in section 4, procedure method A, except that the aggregate shall be dried back to a constant weight at 275°F, ± 5.

CALCULATIONS

Calculate the percentage of bitumen extracted and the retention factor as follows:

$$P2 = \frac{S - A}{S} \times 100$$

$$R = P1 - P2$$

Where:

S= Original weight of mix specimen (dry aggregate plus bitumen added)

A= Weight of extracted mineral aggregate

P1= Percent bitumen added to the mix

P2= Percent bitumen extracted from the mix

R= Retention factor

If there is more than 0.05 percentage points between the two tests, run a third test and average any within 0.05 of each other.

6. Method B

SCOPE

- 6.1 This method is to be used on mixes such as those containing hydrated limes that are very slow filtering.
- 6.2 Preparation of sample shall be as given in section 3.
- 6.3 Place a dry tare filter on the vacuum extractor and tighten the wing nuts finger tight.
- 6.4 Weigh 50 gm of oven-dry celite into a 1000 ml Erlenmeyer flask and add 500 ml of methylene chloride. Swirl until celite is completely in suspension.
- 6.5 Immediately pour celite and methylene chloride onto filter, turn on vacuum pump and let run until pad formed by celite is surface dry and begins to crack slightly.
- 6.6 Place watch glass in extractor and gently pour solvent onto it; remove it with tongs and wash with wash bottle, then add the rest of the sample and proceed as in section 4.2, 4.3 & 4.4 under procedure method A, except in order to find the dry weight of the Aggregate, subtract the weight of the filter, pan, and the celite from the total weight.

7. Sieve Analysis (Procedure)

Use the standard method of test for mechanical analysis of extracted aggregate, AASHTO T30. If celite is used as in method B, no correction need be made as celite is all minus No. 200 mesh and will be lost in the wash process.

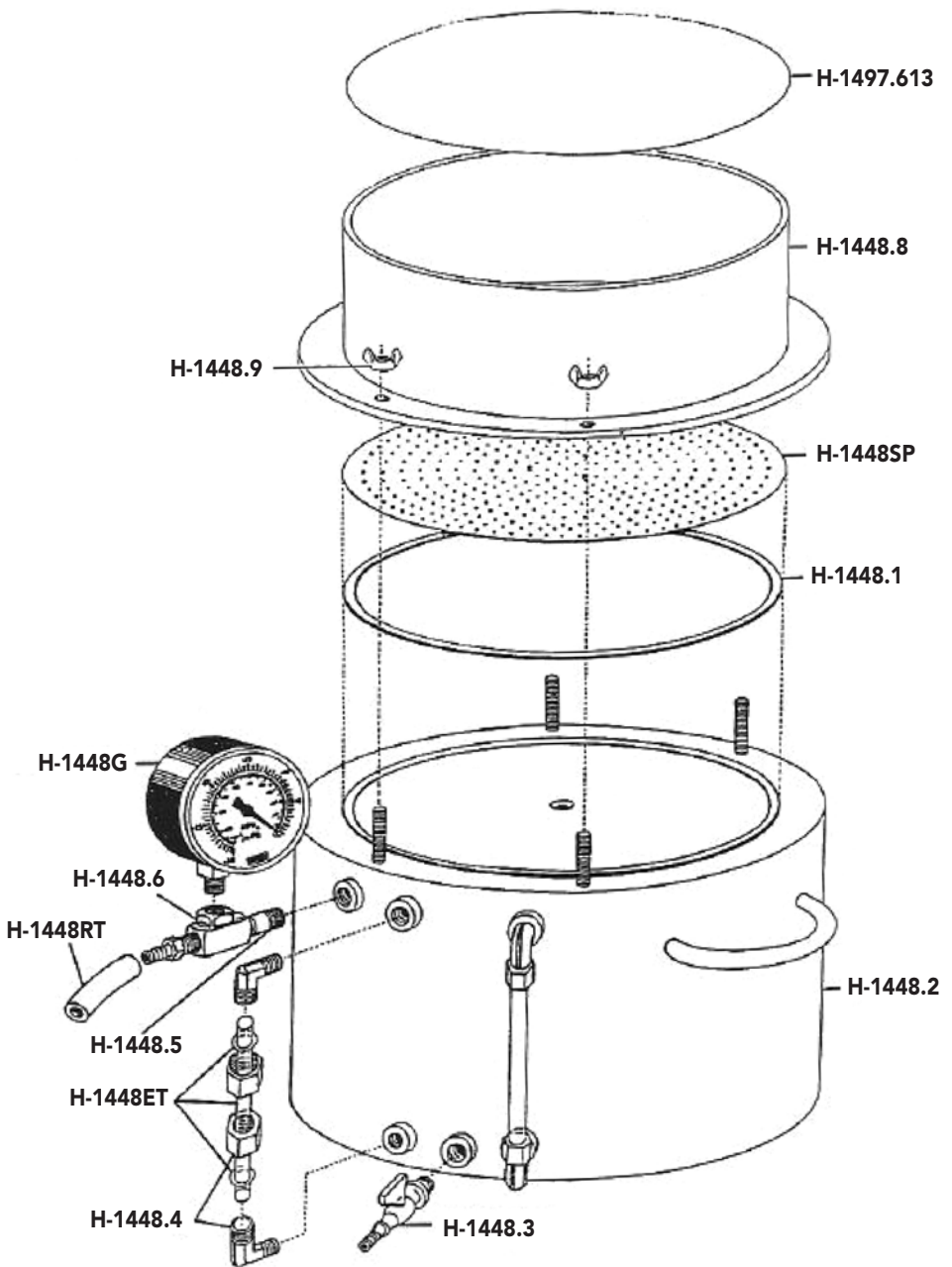


Figure 1: H-1448 parts

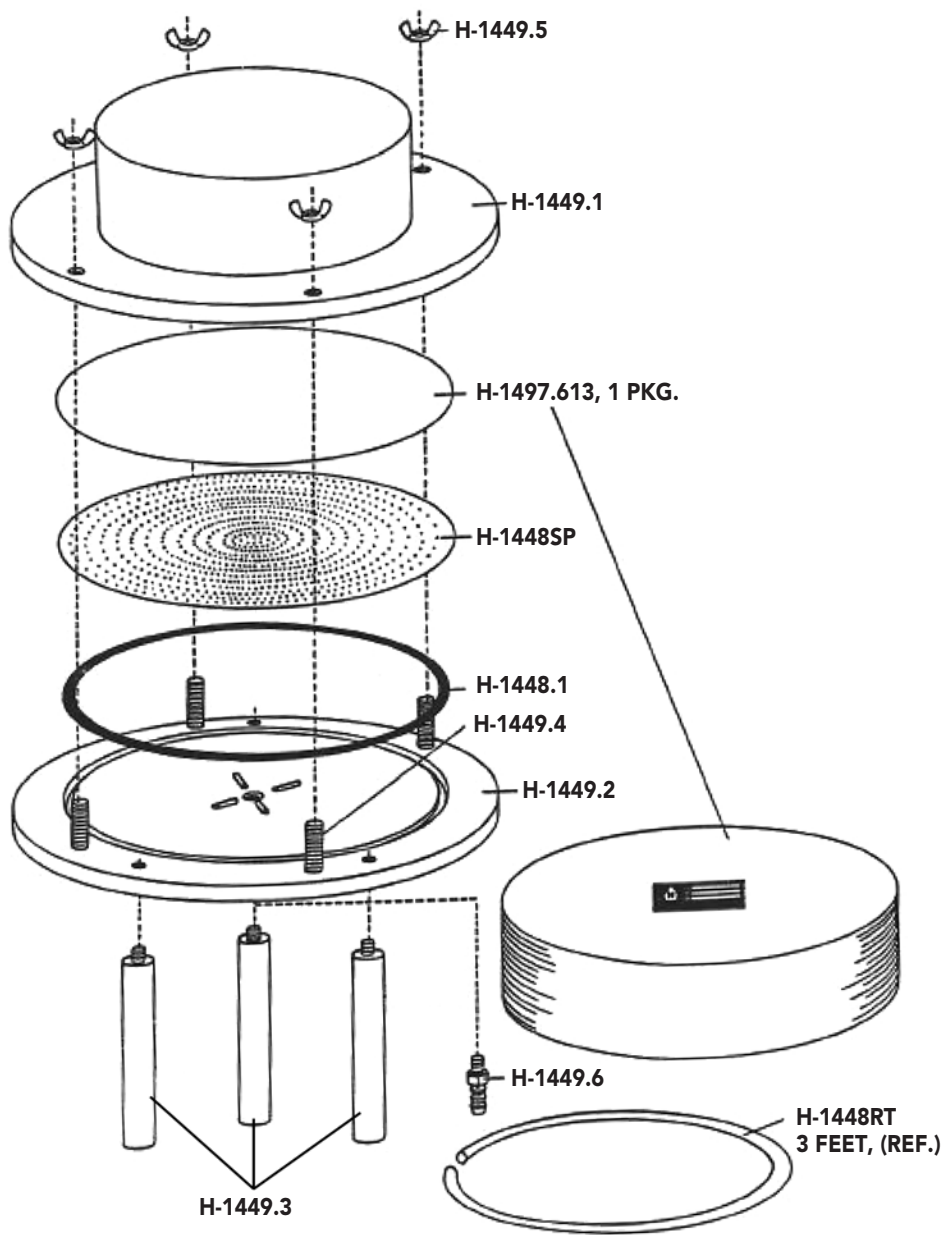


Figure 2: H-1449 parts

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