INSTRUCTIONS

MANUAL

AUTOMATIC EQUIPMENT OF

THE RICE METHOD

Model: T-067N

File No.: TEST- V2.3-EN

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VACUUM PYCNOMETER

I. GENERAL INFORMATION

The **Vacuum Pycnometer** is designed to be used in determining the theoretical maximum specific gravity of bituminous paving mixtures, using the procedure described in ASTM standard test method D 2041 for type F containers. This large capacity (approximately 10 liters) unit can easily handle samples up to 13.2 lbs (6 kg), minimizing segregation effects. Constructed of lightweight polycarbonate, the **Vacuum Pycnometer** has a transparent top for easy visual observations of the vacuum effects.

II. RELATED USER DOCUMENTATION

These operating instructions do not contain all the required information for the standard test method used to determine the theoretical maximum specific gravity and density of bituminous paving mixtures. Please refer to ASTM D 2041 for additional information.

III. CALIBRATION

Calibrate the pycnometer by determining the mass of the container when it is filled with water at a range of temperatures, from 60 to 150°F (15 to 65°C), or as required. Prepare a graph with temperature vs. mass of the pycnometer filled with water for the selected range of temperatures. Designate the mass of the container at 77 ± 0.9°F (25 ± 0.5°C) as "D." Refer to ASTM D 2041 for further assistance in calibrating and graph preparation.

IV. OPERATION

A. Sample Preparation

Follow the procedure outlined in ASTM D 2041 for separating the sample particles, oven-drying the sample, and cooling it to room temperature.

B. Operation

1. Weigh the empty pycnometer without the lower water inlet hose and without the gauge and hose assembly on the top. Designate this weight as "B."

2. Place the prepared sample in the pycnometer and weigh the sample and pycnometer together, designating this weight as "C." The weight of the sample is A = C - B.

3. Install the gauge and hose assembly and connect the aspirator to both the pycnometer and the laboratory water faucet, as shown in Fig. 1.
   Note: Instead of the aspirator, a vacuum pump may be connected directly (through a water trap) to the hose.

4. With the water inlet valve closed, connect the water inlet hose to both the pycnometer and the laboratory water supply, as shown in Fig. 1.

5. To begin operating the aspirator, turn on the water faucet (or vacuum pump) to create a vacuum of at least 10" Hg in the pycnometer.

6. Open the water inlet valve (see Fig. 1) to let water in at a temperature of about 77^{o}F (25^{o}C). Fill the pycnometer up to about an inch (25.4 mm) below the top of the sphere and then close the water inlet valve.

7. Continue applying vacuum and maintain a residual pressure of 1.2" (30 mm) Hg or less for 5 to 15 minutes. During this vacuum period, agitate the pycnometer vigorously by shaking it with both hands at intervals of about 2 minutes to release all the air bubbles.

8. Open the water inlet valve to fill the pycnometer to the very top without leaving any air space. Be careful not to turn off the vacuum. Close the water inlet valve.

9. Using the quick-disconnect, detach the gauge-hose assembly from the top of the pycnometer.

10. If there is any air trapped in the pycnometer, reconnect the aspirator and vacuum gauge (using the quick-connect) and let more water in.

11. Close the water inlet valve.

12. Disconnect the water inlet hose from the pycnometer.

13. Within 10 $\pm$ 1 minutes after step 8, weigh the pycnometer while it is still filled with water (de-aired) and the sample. Record this weight as "E".

14. Remove the lid and drain the water from the pycnometer. Remove the asphalt sample, clean the inside, and clamp the lid on. Re-install the gauge and hose assembly, reconnect the water inlet hose, and refill completely with water following steps 5 to 8.

15. Detach the gauge assembly and the water inlet hose.

16. Weigh the pycnometer filled with water only, within 10 $\pm$ 1 minutes after releasing all of the air bubbles and filling completely per step 8. Record this weight as "D".

    Note: It is recommended that a graph of weight versus temperature for the pycnometer filled with de-aired water be made, so that the value of D can be taken from this graph for any temperature in the laboratory. This will eliminate steps 14 to 16. See Section III Calibration.

V. CALCULATIONS

If the test temperature is within +3° or -5°F of 77°F (+ 1.7° or - 2.8°C of 25°C), the following equation can be used to determine the maximum specific gravity of the sample, with an error of 0.001 points or less due to thermal effects:

$$specific\ gravity = \frac{A}{A+D-E}$$

Where:

A = Mass of the dry sample in air (grams)

D = Mass of container when filled with water at 77°F (25° C) (grams)

E = Mass of container filled with both water and sample at 77°F (25°C) (grams)

Note: If the test temperature differs significantly from the recommended 77°F (25°C), the formula should be adjusted for thermal effect as follows:

$$specific\ gravity = \frac{A}{(A+F)-(G+H)} x \frac{dw}{0.9970}$$

Where:

A = Mass of dry sample in air (grams)

F = Mass of pycnometer filled with water at test temperature (grams)

G = Mass of pycnometer filled with both water and sample at test temperature (grams)

H = Correction for thermal expansion of bitumen (grams)

dw = density of water at test temperature, Mg/m^3

0.9970 = density of water at 77°F (25°C), Mg/m^3

Values of H and dw may be obtained from the ASTM graphs in Fig. 2. For more details, see ASTM D 2041.

VI. TROUBLESHOOTING

A. Pycnometer Not Getting Vacuum

1. Check 'O' ring to make sure it is clean and in good shape. If not, contact service dept. for a replacement 'O' ring.

2. Check to make sure the water inlet valve is on tight.

3. Tighten the stopcock nut (at bottom of stopcock) of the water inlet valve.

B. Air Bubbles Entering from the Water Inlet Valve

1. Check to make sure the water inlet valve is on tight.

2. Tighten the stopcock nut (at bottom of stopcock) of the water inlet valve.

C. Clogged In-Line Filter

Replace the filter assembly.

D. Too Many Air Bubbles in Water

1. Air bubbles come from dissolved air in water. Check for this by opening water inlet valve (keeping the water inlet hose connected to the water supply) after you have gone through Step 8 of the operating procedure. The air bubbles should dissolve back in water at atmospheric pressure.

2. Try filling the pycnometer with boiled water (after it has been cooled).

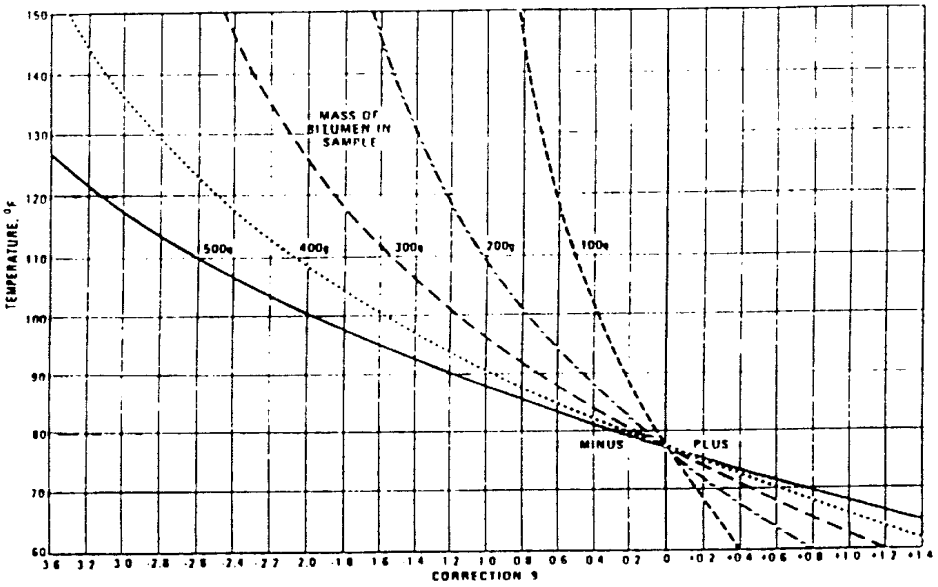
If problem still persists, call Service Department for assistance.

VIII. SPECIFICATIONS

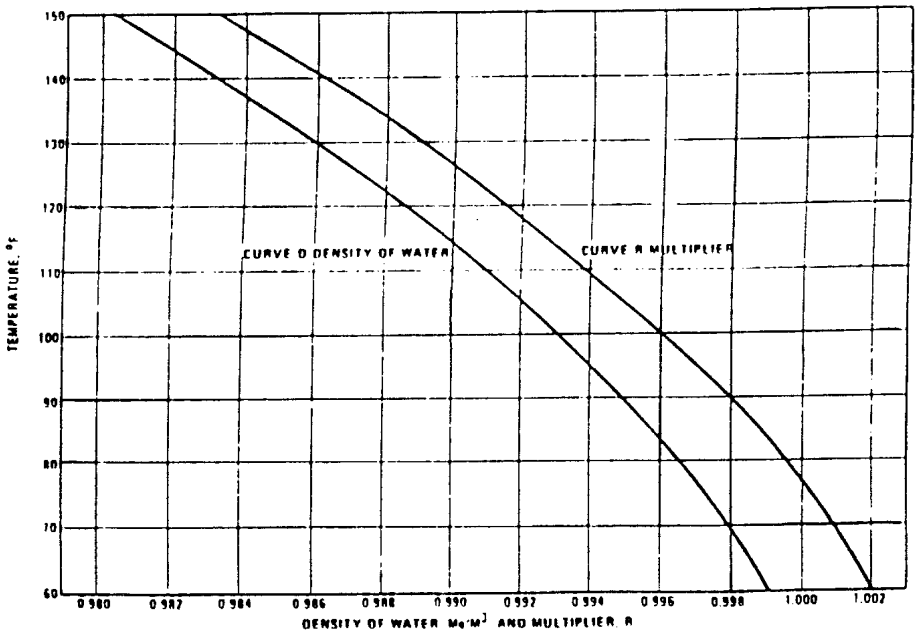
Capacity	Approximately 10 liters; 6 kg (13.2 lbs) sample weight
Construction	Lightweight polycarbonate, with transparent upper half
Gauge	2" (50.8 mm) diameter; 30" x 0.5 " Hg
Aspirator	Plastic; 3/8" pipe thread (included)
Connections	Water inlet valve; quick disconnect for vacuum gauge and hose
Dimensions	10-3/4" (273 mm) o.d. x 16" (406 mm) h.
Weight	Net 8 lbs (3.6 kg)

FIGURE 1

GRAPHS



Correction Curves for Thermal Expansion of Bitumen, II,



Curves D and R