# HDOT TM 2-00

## Standard Test Method for Determining the Loose Density of Sand

### 1. Scope:

**1.1** This test method covers the preparation and determination of the loose density of sand for use with Hawaii Test Method, HDOT TM 1, "Density of Soil In-Place by the Sand-Cone Method".

### 2. Apparatus:

**2.1** Density Apparatus - The density apparatus is described in Hawaii Test Method, HDOT TM 1. The complete apparatus shall consist of the plastic Cone Assembly, Plastic Cylinder and Metal Base Plate. (See Figure 1A.)

**2.2** Volume Measure - The volume measure shall be a cylindrical mold 15 centimeters (6 inches) in diameter and 15 centimeters (6 inches) in height with known volume.

**2.3** Balance - A balance of at least 20 kg (44 pounds) capacity having an accuracy of 5 g (0.01 lb.).

**2.4** Sand - Any clean, dry, free flowing uncemented sand having few, if any, particles passing the 75 ***μm*** (No. 200) sieve or retained on the 1.18 mm (No. 16) sieve.

**2.5** Miscellaneous Apparatus and Supplies - Smooth glass plate approximately 20 cm (8 inches) by 20 cm (8 inches), wax, syringe, thermometer, etc.

### 3. Procedure:

**3.1** Determination of the Volume of the Lower Cone with the Base Plate (See Figure 1B).

**3.1.1** Close the valve and attach the base plate to the lower cone by using wax. (See Note 1).

**NOTE 1:** It may be necessary to warm the base plate to keep the wax from hardening too quickly. Only the minimum amount of wax necessary to make the apparatus water tight shall be used and any excess shall be removed.

**3.1.2** Apply petroleum jelly to the bottom of the base plate and weigh the prepared cone assembly with base plate, and the glass plate.

**3.1.3** Fill the lower cone with water to just below the rim of the base plate. (Be sure valve is closed). Position the glass plate over the base plate leaving about a 3.25 mm

(1/8 inch) opening on one end. Continue to fill the lower cone with water using the syringe until the assembly is completely filled without any air voids. (See Note 2)

**NOTE 2:** It may be necessary to tilt the apparatus to allow the entrapped air to escape.

**3.1.4** Weigh the entire assembly. (Cone Assembly, Base Plate, Glass Plate and Water).

**3.1.5** Determine the temperature of the water. Convert the mass of water to volume $V_w$, in mL, by correcting for temperature as given in Table I. (See Note 3)

**NOTE 3:** For questionable water, a pycnometer should be used to determine its unit mass.

TABLE 1

VOLUME OF WATER PER GRAM BASED ON TEMPERATURE

| Temperature | | Volume of Water |
|---|---|---|
| °C | °F | mL/g |
| 12 | 53.6 | 1.00048 |
| 14 | 57.2 | 1.00078 |
| 16 | 60.8 | 1.00103 |
| 18 | 64.4 | 1.00138 |
| 20 | 68.0 | 1.00177 |
| 22 | 71.6 | 1.00221 |
| 24 | 75.2 | 1.00268 |
| 26 | 78.8 | 1.00320 |
| 28 | 82.4 | 1.00375 |
| 30 | 86.0 | 1.00435 |
| 32 | 89.6 | 1.00497 |

**3.1.6** Repeat the procedure described in paragraphs 3.1.1 to 3.1.5 at least twice or until the difference of two consecutive readings is within 2 mL.

**3.1.7** To convert the volume of water to cubic feet, use the following:

$$V_c = \frac{V_w}{(453.6 \times 62.427)}$$

where:

$V_c$ = volume of Lower Cone and Base Plate, cf
$V_w$ = corrected volume of water, mL
453.6 = conversion factor g/lb
62.427 = conversion factor lb.of water/cf

**3.2** Preparation of the Sand

**3.2.1** Select sand that is clean, uncemented and having few, if any, particles passing the 75 **µm** (No. 200) sieve.

**3.2.2** Air Dry or Oven Dry the sand until the entire lot is completely dry.

**3.2.3** Sieve the entire lot over the 1.18 mm (No. 16) sieve and discard any portion retained on the screen. If an excessive amount of fine material is evident, sieve the lot over the 75 **µm** (No. 200) sieve and discard the portion that passes the screen.

**3.3** Determination of the Loose Density of the Sand. (See Figure 1A).

**3.3.1** Place the Volume Measure on a level and firm base in an area free of external disturbances. (See Note 4)

**NOTE 4:** Vibration or disturbance of the sand during any sand-volume determination will increase the bulk density.

**3.3.2** Slowly pour approximately 5500 g of sand representative of the entire lot into the Plastic Cylinder. Attach the Cone Assembly with valve closed and weigh the entire Density Apparatus without base plate and Volume Measure. (Cone Assembly, Plastic Cylinder and Sand) ($W_1$)

**3.3.3** Position the Base Plate and Density Apparatus over the Volume Measure. Open the valve fully and allow the sand to flow freely into the Volume Measure until it stops.

**3.3.4** Check the Lower Cone for voids or signs of unusual flow. If everything is in order, close the valve sharply.

**3.3.5** Weigh the entire Density Apparatus. (Cone Assembly, Plastic Cylinder and the remaining sand) ($W_2$)

**3.3.6** Compute the loose density of sand as follows:

$$W = \frac{W_1 - W_2}{453.6}$$

$$W_s = \frac{W}{V_c + V_m}$$

where:

$W_1$ = Initial Mass of Density Apparatus and Sand (Cone Assembly, Plastic Cylinder and Sand), g

$W_2$ = Final Mass of Density Apparatus and Remaining Sand (Cone Assembly, Plastic Cylinder and Remaining Sand), g

$W$ = Mass of Sand Used, lb

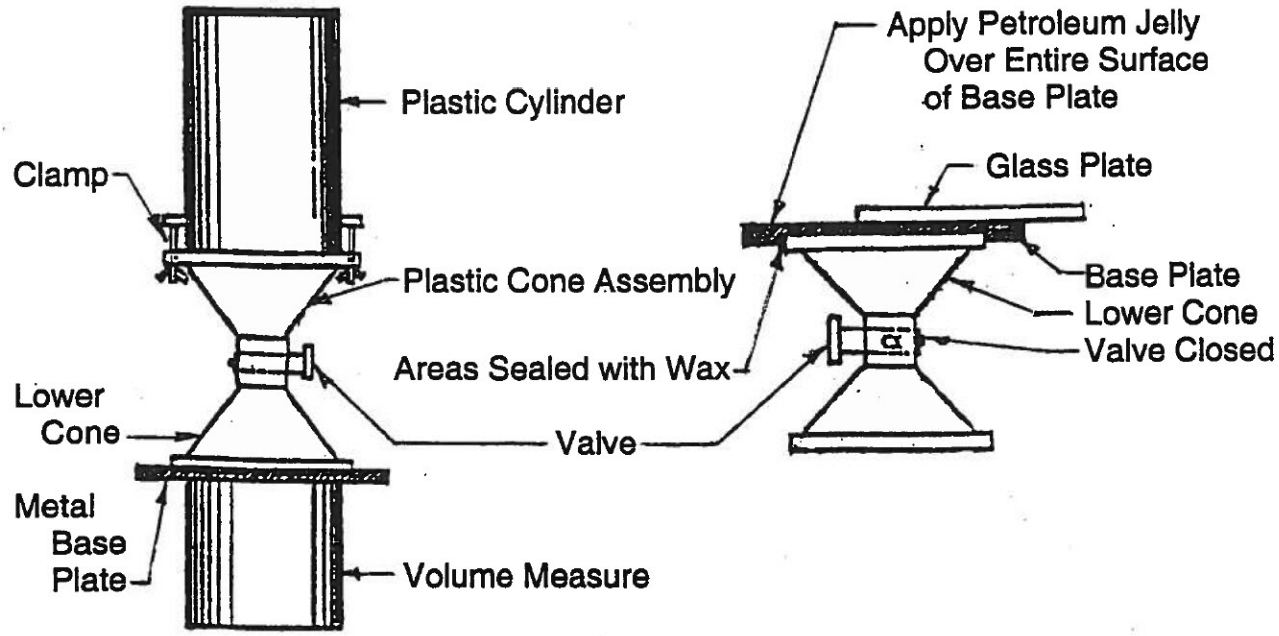
$W_s$ = Loose Density of Sand in lb/cf

$V_c$ = Volume of Lower Cone and Base Plate, cf

$V_m$ = Volume of Volume Measure, cf

453.6 = Conversion Factor, g/lb

**3.3.7** Repeat the procedure using a new batch of representative sand and as described in paragraphs 3.3.1 through 3.3.6 at least twice or until the difference of two (2) consecutive readings are within 0.01 lb/cf.




A. Density Apparatus in position for determining loose density of sand.

B. Cone Assembly inverted with base plate for determining volume of lower cone.

Figure 1