MILITARY STANDARD

TEST METHOD FOR PAVEMENT SUBGRADE, SUBBASE, AND BASE-COURSE MATERIALS

TO ALL HOLDERS OF MIL-STD-621A

1. The following pages of MIL-STD-621A have been revised and supersede the pages listed:

New Page	Date	Superseded Page	Date
v		v	2 June 1966
5		5	22 Dec. 1964
Last page of MIL-STD-621A		Last page of MIL-STD-621A	22 Dec. 1964

2. The following method is to be added:

Method No.	Title	Date
106.	Determination of density of soil in place by the sand-displacement method.	7 October 1968

3. The following is a cumulative list of earlier changes:

The pen and ink changes on page 1 and 2 of Notice 1 dated 2 June 1966 will remain in effect.

FSC MISC

Date	Superseded Page	Date
2 June 1966	3-4	22 Dec. 1964
2 June 1966	8	22 Dec. 1964

ice and insert before the table of contents.

STD-621A will verify that page changes and additions been entered and will destroy page v of Notice 1. ill be retained as a check sheet. This issuance, i pages, is a separate publication. Each notice stocking points until the Military Standard is cancelled.

ALPHABETIC INDEX OF TEST METHODS

Supersedes last page of 22 December 1964

Method 106

DETERMINATION OF DENSITY OF SOIL IN

PLACE BY THE SAND-DISPLACEMENT METHOD

1. SCOPE

1.1 This method of testing is used for determining the in-place density of any type of base course or subgrade.

2. APPARATUS

2.1 Drying oven. Any oven that can maintain a constant temperature of 105° to 110° C. and has sufficient capacity.

2.2 Balance. A balance with 20,000 g. capacity accurate to 1.0 g.

2.3 Sand. Sand composed of clean, hard particles that pass a No. 20 sieve and are retained on a No. 40 sieve.

2.4 Modeling clay. Any commercial-quality modeling clay.

2.5 Sand-density calibration device. A double-cone and cylinder sand-density calibration device similar to the details shown in figure 1.

2.6 Seating ring. A metal ring similar to the details shown in figure 1.

2.7 Small tools. Small miscellaneous tools for digging and taking the sample, shown in figure 2 are: Spatula, chisel, kitchen spoon, hammer, and paint brush.

2.8 Sample containers. Any type of container with a capacity of about 1 gallon or more, having a close-fitting top or lid, and capable of withstanding the heat of a drying oven.

3. TEST PROCEDURE

3.1 Sand calibration. The volume of the cylinder and connecting internal cone up through the valve and the tare weight of the sand-density calibration device must be known before the sand can be calibrated. This may be determined by pouring water into the sand device (in position inverted from that shown in figure 1) until the cylinder, internal cone, and valve are filled, and water extends some distance above the valve. Then close the valve, pour off the excess water, dry the external cone with a cloth, and weigh. Assume that the weight of water in the device in grams is equal to the volume in cubic centimeters. This procedure should be repeated several times, the results averaged, and the volume expressed in cubic feet. The sand is calibrated by pouring it into the external cone with the valve open until the device is filled to above the valve. Then close the valve, pour off the excess sand, and determine the weight of sand remaining. Care must be taken during pouring to keep the level of the sand in the external cone fairly constant and to avoid jarring the device in any way until the valve has been closed. The weight of the sand in the device in pounds divided by the volume in cubic feet equals the calibrated density in pounds per cubic foot. The calibration should be repeated for each test as the density value will change with temperature and humidity.

3.2 Surface preparation. The surface of the soil to be tested should be prepared by brushing away all loose particles so as to leave a reasonably hard surface. No attempt should be made to level the area with a spatula, trowel, or other tool as this disturbs the surface to be tested. The seating ring should be on the surface and any space between the ring and the surface shall be sealed with modeling clay.

3.3 Surface calibration. The ground surface irregularities inside the metal seating ring must be taken into account. To do this it is necessary to know the volume of the space between the surface of the external cone and the surface to be tested. The device, with calibrated sand and the valve closed, is placed on the metal seating ring. The valve is opened and the space under the cone allowed to fill with sand. When the space is filled, the valve is closed and the device with the remaining sand is weighed. The difference in weight is the weight of sand required to fill the space.

3.4 Soil sample. The digging of soil samples in nonplastic, coarse-grained material, so that the walls of the hole remain undisturbed, is rather difficult. Driving of a chisel or other tool with a hammer should be done only when the particles can be loosened in no other way and then only near the center of the hole. The inside of the hole should be kept as free as possible of pockets and sharp obstructions since these affect the accuracy of the test. Coarse-grained materials with plastic fines are less easily disturbed and more easily dug. Samples of fine-grained soils may be removed with the small tools or with an Ivan auger. In all types of materials, care should be taken to remove all loose particles from the hole and to see that such particles are included in the sample. The wet weight of the sample should be determined immediately. The volume of the sample must be 0.05 cubic foot or longer. (Samples of 0.05 cubic foot volume are usually satisfactory for materials with a maximum size of about 1 inch, but increasingly larger samples should be obtained as the maximum size increases).

3.5 Volume and density determination. After the sample has been removed from the hole, the device is again placed on the metal ring. The valve is opened and the sand allowed to fill the hole and space under the cone. The weight of the sand required to fill the hole is determined by subtracting the weight of the sand between the external cone surface, and the original ground surface as found in the surface calibration, from the weight required to fill the hole and the space under the cone. The weight of the sand required to fill the hole divided by the calibrated density of the sand equals the volume of the hole in cubic feet. The dry weight of the sample can be most accurately determined by drying the entire sample in its original container. An alternate, though less desirable, method that may be used involves determining the moisture content of a small specimen of the density sample and correcting the wet weight of the density sample to give the dry weight. The dry density of the material in place is determined by dividing the dry weight of the sample in pounds by the volume of the hole in cubic feet.

4. CALCULATIONS

4.1 The calculations for a typical example and a suggested form for recording the data is shown in figure 3.

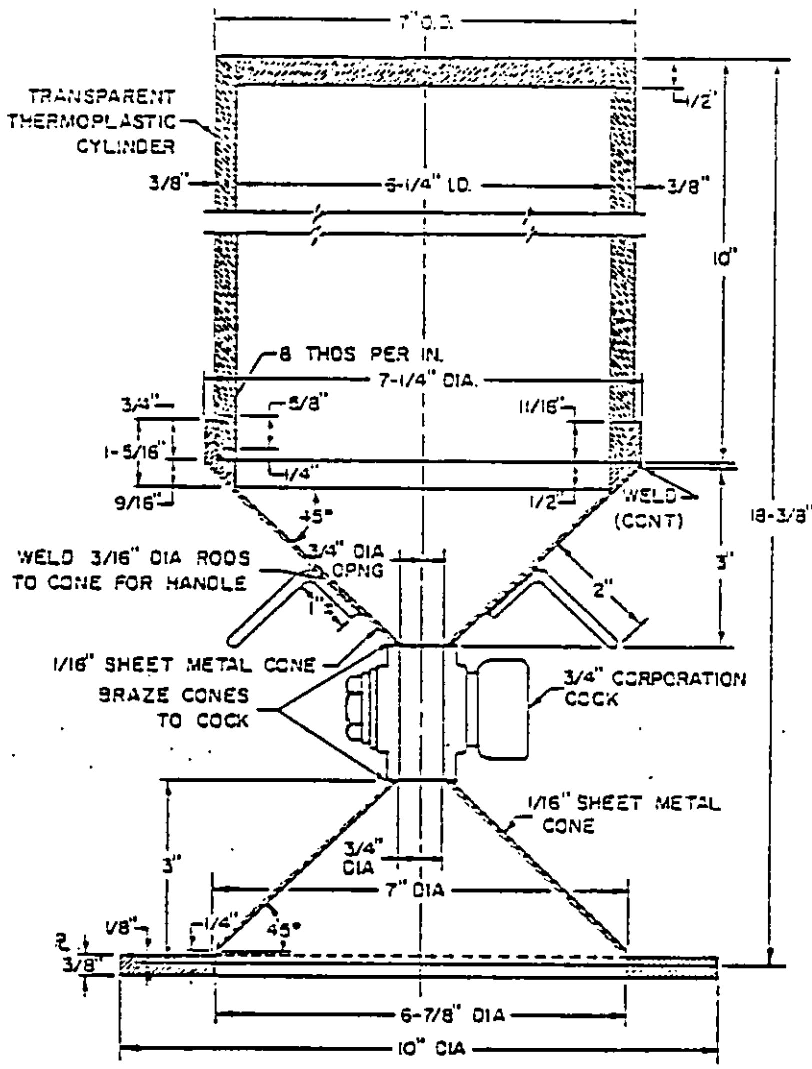


FIGURE 106-1. SAND-DENSITY DEVICE AND SEATING RING

8X1617A

5. DETAILED REQUIREMENTS

5.1 Tests. Tests shall be as specified in the individual test methods.

Custodians:

Army - MS
Navy - YD
Air Force - 01

Review activity:

Army - CE

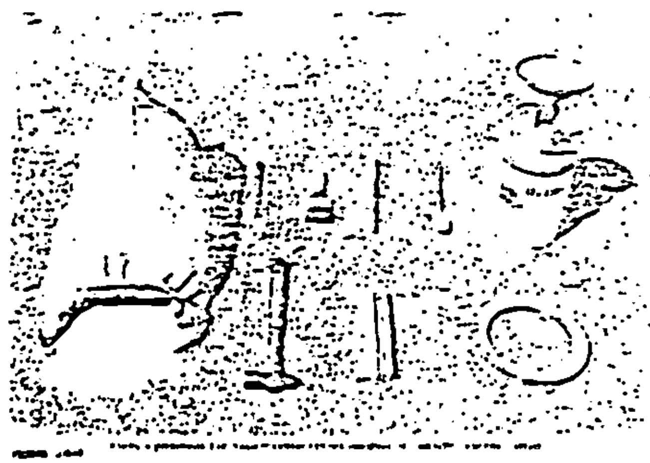
User activity:

Navy - CG

Preparing activity:

Army - ME

Project No. MISC - 0527



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IN-PLACE DENSITY TEST

Sand Density Device and Sealing Ring

STATION	TEST LOCATION PIT 1
MATERIAL CLAY GRAVEL BASE COURSE	DEPTH, IN. 3 DATE 17 MAR 1952

Sand Calibration	Ground Surface Calibration
1. Weight Filled 12,354 g	6. Weight Before 12,354 g
2. Weight Empty 4,294 g	7. Weight After 10,973 g
3. Weight Sand (1-2) 8,560 g	8. Weight Sand (6-7) 1,381 g
4. Volume Container 0.2024 cu ft	
5. Calibrated Dens. $\left(\frac{3 \times 0.0022046}{4}\right)$ 93.2 lb/cu ft	

Hole Volume Determination

9. Weight Before (From 7) 10,973 g
10. Weight After 7,163 g
11. Weight Sand (9-10) 3,810 g
12. Weight Sand Used (11-8) 1,929 g

Density Determination

13. Wet Weight Sample + Container 3,080 g
14. Dry Weight Sample + Container 2,316 g
15. Weight Container 273 g
16. Weight Water (13-14) 164 g
17. Wet Weight Sample (13-15) 2,907 g
18. Dry Weight Sample (14-15) 2,643 g
19. Water Content $\left(\frac{16}{18}\right)$ x 100 6.2 %
20. Wet Density $\left(\frac{17 \times 5}{12}\right)$ 135.9 lb/cu ft
21. Dry Density $\left(\frac{18 \times 5}{12}\right)$ 127.9 lb/cu ft

REMARKS: MATERIAL APPEARED WELL COMPACTED. DENSITY VALUE MAY BE HIGH DUE TO SLIGHT DISTURBANCE TO WALLS OF HOLE.

COMPUTED A D S	CHECKED B E T

FIGURE 106-3. Form

CX1619A

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