

**Standard Method of Test for
Field Determination of Density and Moisture Content of
Nonstandard Materials by Use of the Nuclear Density Gauge**
SCDOT Designation: SC-T-33 (11/11)

1. SCOPE

- 1.1 This method describes procedures for determining the density and moisture content of nonstandard construction materials through the use of the nuclear equipment. The nuclear gauge must be calibrated for the nonstandard material according to SC-CL-18 prior to the use of this procedure.
- 1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENT

- 2.1 SC-CL-18

3. SUMMARY OF TEST METHOD

- 3.1 The total or wet density of the material is determined by placing a gamma source into the material under test. The intensity of radiation detected is dependent upon the density of the material under test. The radiation intensity reading is related to measured wet density by suitable calibration curves or tables. The total water content is determined by placing a neutron source into the material under test. The quantity of fast neutrons is dependent upon the hydrogen content of the water in the material. The quantity of fast neutrons is related to the measured water content by suitable calibration curves or tables.

4. SIGNIFICANCE AND USE

- 4.1 The test method described is useful as a rapid, nondestructive method for the in-place determination of the wet density and moisture content of nonstandard construction materials.

5. APPARATUS

- 5.1 Nuclear Density Gauge, reference standard, scraper plate, drill rod, drill rod extraction tool.

6. TEST SPECIMENS

- 6.1 This test is conducted on in-place embankment materials or mechanically stabilized wall materials.

7. PROCEDURE

- 7.1 Turn PWR/Time switch to the “slow” position for 10 minutes to allow critical circuits to stabilize.
- 7.2 Take moisture and density standard counts (at least 10 feet from any large object and at least 30 feet from another gauge).
 - 7.2.1 Place Standard on dry, solid, flat surface containing not more than 15 percent moisture and at least 100-pcf of density.
 - 7.2.2 Place gauge on standard, being sure scaler end of gauge is toward the raised end of the Standard and seated properly on the recessed surface.
 - 7.2.3 Remove the padlock that locks source rod in “Safe” position.
 - 7.2.4 Place PWR/Time switch in the “slow” position.
 - 7.2.5 Press “Start” button.
 - 7.2.6 Wait 4 minutes after which time the ERR symbol will disappear.
 - 7.2.7 Turn the display switch to “moisture” and record the moisture standard count.
 - 7.2.8 Turn the display switch to “density” and record the density standard count.
 - 7.2.9 Return Standard to case.
- 7.3 If surface is not relatively smooth, use scraper plate to smooth and level test surface (all loose stone should be removed and small voids filled with native fines or sand).
- 7.4 Take moisture and density measurement counts.
 - 7.4.1 Using the drill rod and scraper plate put the drill rod through the extractor tool, then through the scraper plate guide. Secure the scraper plate with one foot; drive the test hole at least 2 inches deeper than the desired test depth.
 - 7.4.2 Remove drill rod by rotating and pulling straight up. Do not loosen drill rod by tapping from side to side with hammer.
 - 7.4.3 Before moving the scraper plate, with foot still securing the plate, take the drill rod and mark around the corners of the scraper plate.
 - 7.4.4 Place the gauge within the scraper plate outline.

- 7.4.5 Release the trigger and lower the source rod into hole to the desired depth of measurement.
- 7.4.6 Gently slide the gauge to the right (scaler end), placing the source rod in firm contact with the sidewall of the hole.
- 7.4.7 Run a one minute test.
- 7.4.8 Upon completion of the one minute test, record the density measurement count and the moisture measurement count.
- 7.4.9 Pull source rod to top notch or "Safe" position, and return gauge to a safe area.

8. CALCULATIONS

- 8.1 Calculate wet density, pcf.
 - 8.1.1 Divide the density measurement count by the density standard count to obtain the density count ratio.
 - 8.1.2 Turn to the proper tables provided with the nuclear gauge and record the wet density, pcf.
- 8.2 Calculate moisture content, %
 - 8.2.1 Divide the moisture measurement count by the moisture standard count to obtain the moisture count ratio.
 - 8.2.1 Turn to the proper tables provided with the gauge and record the moisture content, pcf.
 - 8.2.2 Calculate the dry density using the following equation:

$$\text{Dry Density (pcf)} = \text{Wet Density (pcf)} - \text{Moisture Content (pcf)}.$$

9. REPORT

- 9.1. Report the moisture content of the fill material to the nearest 0.1 percent. Report the maximum dry density to the nearest 0.1 pound per cubic foot. Report on Form No. 300.02 – Density Test Report (Nuclear Gauge).