SAE Inc. Standard No. 107

ASTM G187-05 Modified

ABSTRACT

This test method evaluates the electrical resistivity of conductive powders, such as ConduCrete, under applied loads. The test method is based on the standard test method ASTM G187-05 “Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method” with modifications to provide information about conductive powders under load conditions.

1. INTRODUCTION

1.1 This test method is based on the standard test method ASTM G187-05 “Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method”, with modifications specified in this document to provide information about ConduCrete and other conductive materials in powder form under load conditions.

1.2 The test procedure involves the measurement of the electrical resistance of the powder material through a loading fixture which was designed by SAE Inc. for testing purposes.

2. EQUIPMENT REQUIRED

2.1 Loading fixture: consists of a top brass portion and a bottom brass portion, both being cylindrical columns having flat faces which are perpendicular to the axis of load application. The faces of the columns are held inside a snugly fitting transparent plastic sleeve to contain the powder during application of the load and lowering of the upper platen.

2.2 Programmable DC power supply: for measurement of the resistance of the sample and fixture

2.3 Twelve-ton hydraulic shop press

3. TEST SETUP

3.1 The fixture column has a diameter of 47.61 mm (1.87 inches) which provides a test area of 1780 mm^2. The upper column was measured to have a weight of 3617.95 g, measured before testing on a calibrated balance.

3.2 One loading condition and three tested replicates were tested. Electrical resistance measurements were taken at 0 minutes, 1.5 minutes and 3.0 minutes after the load has been applied.

3.3 The test load is 1780 N (400 lbf / 1000 kPa) on the applied area of 1780 mm^2.

3.4 A "short circuit" resistance was determined as the electrical resistance of the fixture with the platens in direct contact, under the specified load condition.

3.5 This resistance was subtracted from the measured resistance to provide a corrected resistance, of the powder sample itself.

3.6 Resistivity of the material is calculated as follows:

$$p = \frac{AR}{d}$$ *, ASTM G187-05 equation (1)*

where,
p is resistivity, ohm·cm
R is resistance, ohms
A is cross-sectional area, cm^2
D is thickness of the material under load (distance between electrodes), cm

4. PROCEDURE

4.1 Weigh out 10.0 g of the conductive powder to be tested

4.2 Assemble the brass platans/acrylic die fixture (both brass platans in acrylic sleeve).

4.3 To get the "short circuit" resistance of the fixture, place the entire fixture between the platens of the 12-ton hydraulic shop press and connect leads to the DC power supply. Place a nonconductive sheet between the top brass plug and the top platen of the press. Lower the top test platen and apply a given pressure of 1000 kPa, record the resistance and release.

4.4 Remove the sample fixture and the top brass platan and funnel the conductive powder sample into the acrylic sleeve and replace the brass platan. Replace the entire fixture into the press and include the nonconductive sheet.

4.5 Lower the top platen and apply a given pressure of 1000 kPa, record the sample height and release, this is the "set zero" reading. This applied pressure of 1000 kPa equates to a pressure of 145 pounds per square inch on the sample material.

4.6 Following the same test method as above apply a pressure of 1000, hold this force for a given period of time, and record the resistance and height of the sample and release. This reading is the total resistance of the sample and the height of the sample under pressure.

5. CALCULATIONS

5.1 The measured sample height is calculated by subtracting the set zero height from the height of the sample under pressure.

5.2 The measured sample resistance is calculated by subtracting the short circuit resistance from the total resistance.

5.3 Calculation of resistivity: Resistivity is defined mathematically as the product of sample area and resistance divided by sample height:

$$p = \Omega \times \frac{Area}{Height}$$

5.4 Calculate the resistivity by multiplying the measured resistance by the sample area. Divide this product by the measured sample height. Example:

Dimensional Analysis

$$Resistivity\ (p) = ohm\ (\Omega) \times \frac{cm^2}{cm} = ohm \times cm = Resistance \times Length$$

5.5 Using metric units, the final resistivity measurement should be reported in units of “ohm centimeters”.

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