SAE Inc. Standard No. 100
Electrolytic Corrosion Resistance

ABSTRACT

This test method compares the corrosion resistance of bare metal grounding electrodes to SAE's grounding electrodes which consist of metal grounding electrodes encased in a low permeability conductive polymeric surround material. Samples are buried in wet soil and energized with 3 mA for the duration of the test. At the completion of the test the percentage of metal consumed for bare metal grounding electrodes vs SAE's grounding electrodes is calculated.

1. INTRODUCTION

1.1 This test method evaluates the corrosion resistance, and ultimately the lifetime, of grounding electrodes buried in soil.

1.2 The corrosion resistance of bare metal grounding electrodes is compared to the corrosion resistance of metal grounding electrodes encased in SAE surround materials then buried in soil.

1.3 Corrosion studies conducted by the National Bureau of Standards, Naval Civil Engineering Laboratory, and National Electrical Grounding Research Project measured the corrosion rates of grounding rods exposed to field conditions for up to 10 years. All three studies found that galvanized steel ground rods experience significant corrosion when buried in the earth. Their studies demonstrated that galvanized steel grounding rods have a service life of only 10 years.

1.4 SAE surround materials have low permeability to water and protect the encased metal electrodes, thus preventing corrosion from occurring.

1.5 This test method can be used on either lab scale or production sized electrodes.

2. EQUIPMENT REQUIRED

2.1 Programmable DC power supply

2.2 Electronic balance accurate to 0.01 g

2.3 Camera

3. SAMPLE PREPARATION

3.1 Prepare the samples of metal to be protected so that they are approximately 3” long and ¾” wide and form a hole at one end of the sample for connection purposes.

3.2 For each metal to be protected prepare two samples, one to be buried in direct contact with soil and the other to be encased in the SAE product being tested then buried in soil.

3.3 Label each sample and then weigh them on an electronic balance accurate to +/- 0.01 g.

3.4 For both the sample to be buried in direct contact with soil and the sample to be encased in the SAE product being tested, crimp a single barrel 1-hole mechanical lug to one end of a dual-insulated #8 AWG copper wire, approximately one foot long. Bolt the mechanical lug to the sample and then encase the connection in a shrink tube to protect against corrosion.

3.5 Weigh each system (i.e. sample and wire) using an electronic balance.

3.6 Take pictures of each sample so that comparisons can be made after the testing is completed.

3.7 Encase one of the samples in the SAE product being tested by placing the metal in the center of a 4”x8” cylindrical mold and pouring the surround SAE product around the sample. Allow the material to cure for four weeks.

4. TEST SETUP

4.1 After the four week cure of the sample encased in the SAE product being tested is complete start preparation of the sample containers.

4.2 Place each sample into a 5 US-gallon pail and surround with soil (black earth).

4.3 Place a 24” long piece of steel rebar into each pail approximately 6” from the samples.

4.4 One litre of water is added to each pail to ensure that the soil is conductive enough for the test. Sodium sulfate or other electrolytes can also be added to the soil at this stage.

4.5 Connect the pair of samples in a series circuit to an individual channel of a 30 V DC power supply, to ensure an equal current load, see Figure 1 below for an example.

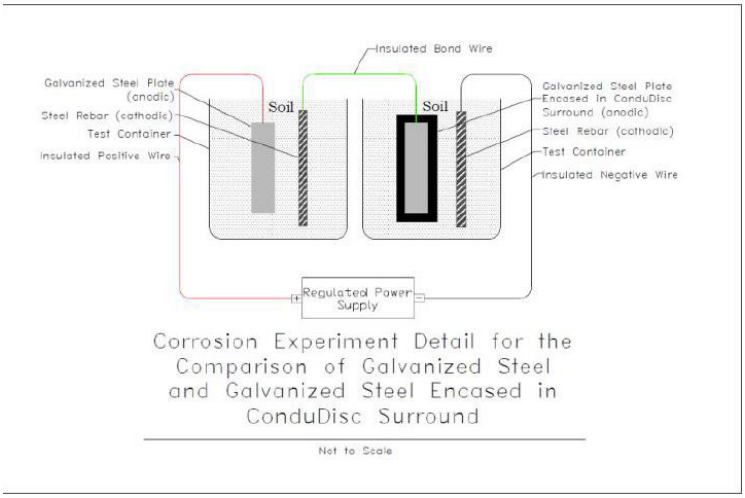

Figure 1: Schematic of the Circuit Configuration

4.6 The DC power supply is set to provide 3 mA of current throughout the duration of the test.

5. PROCEDURE

5.1

5.2 The voltage and current shown on the power supply display are recorded daily. The circuit resistance is calculated by dividing the voltage by the current and

5.3 recorded.

250 mL of fresh water is added to each pail once a week to ensure that the soil

5.4 remains wet. If the soil looks dry additional water can be added.

5.5 Test duration can range from one month to one year.

At the completion of the test the samples are removed from the soil and the

56 encased metal sample is removed from the SAE surround material.

The system mass and the mass of each metal sample is weighed using the

5.7 electronic balance.

Pictures of the samples are taken so that the comparison can be made to the

5.8 samples pre-test.

Note the appearance of the sample and whether the metal has experienced corrosion.

6. CALCULATIONS

6.1

Mass of metal consumed for each sample is calculated using the following formula:

Mass of metal consumed = Initial Mass (g) - Final Mass (g)

6.2

Percentage of metal consumed for each sample is calculated using the following formula:

$$\text{Percentage of Metal Consumed} = \frac{[\text{Initial Mass (g)} - \text{Final Mass (g)}]}{\text{Initial Mass (g)}} \times 100\%$$

6.3

A report is written to summarize the results of the testing and shared with the appropriate parties.

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