APPENDIX A
SOIL RESISTIVITY MEASUREMENT

A-1. Introduction.

Since soil resistivity is a major factor affecting the corrosion rate, the design engineer should know how to measure it. Generally, as soil resistivity decreases, corrosivity increases. In addition, as soil moisture content increases, resistivity decreases. Soil resistivity typically is measured using one or both of two methods: (1) testing onsite with the Wenner four-pin method, and/or (2) taking a soil sample to a laboratory for a soil box resistivity test. It must be stressed that soil resistivity may vary widely within very short distances. Soil resistivity also changes with depth below the ground surface. Thus, if the soil sample method is used, many samples must be taken for an accurate map of soil resistivities in the area. The soil box resistivity test also is much more time-consuming than the four-pin method.

A-2. Wenner four-pin method.

As figure A-I shows, this method is done by placing four pins at equal distances from each other. A current is then sent through the two outer pins. By measuring the voltage across the two inner pins, the soil resistance can be calculated using Ohm's Law (V IR). Soil resistivity can be determined using equation A-1:

$$\text{Resistivity} = 191.5\ RL\ \text{ohm-cm}, \qquad \text{(eq A-1)}$$

where R is the resistance found above and L is the pin spacing in feet. Buried utilities may produce interference when using the Wenner method in congested areas. Therefore, it is important to position the pins perpendicular to the underground pipeline. Placing pins parallel to the pipeline would result in measurements lower than actual resistivity.

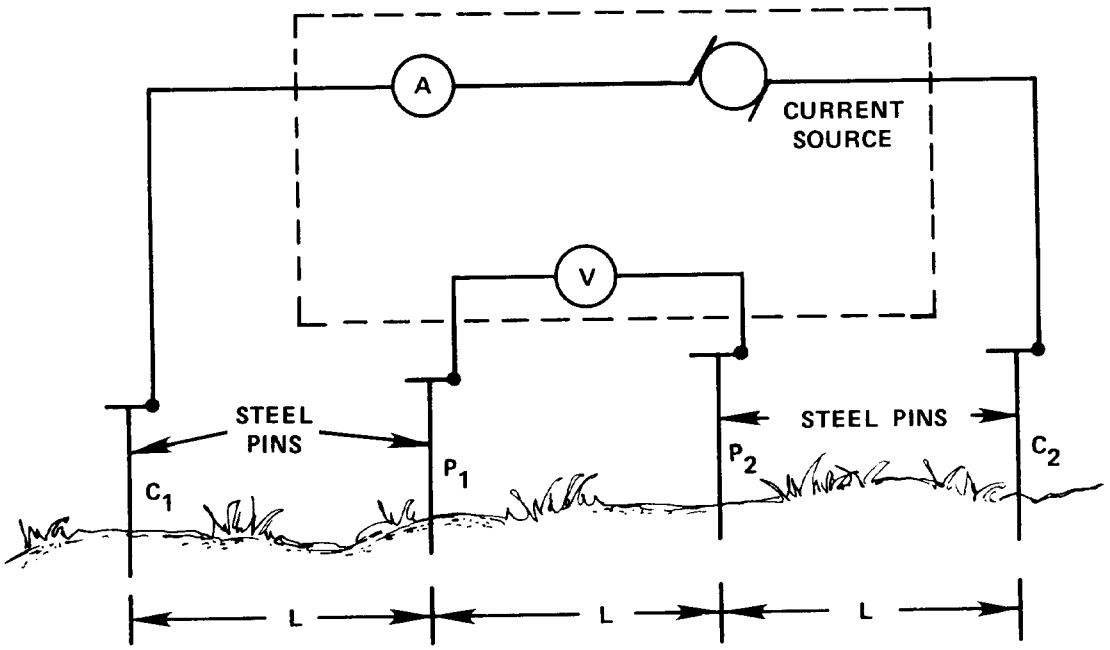

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Figure A-1. Wenner four-pin method for measuring soil resistivity.

A-3. Soil box method.

This resistivity test works on the same principle as the Wenner four-pin test. That is, there are four points of electrical contact with the soil; the current is driven through the two outer points and the voltage drop is measured across the two inner points. In the soil box, however, the outer "points" are the metal end plates of the box, rather than pins. The inner points are pins, just as in the Wenner four-pin method. Figure A-2 gives details of the soil box. Again, for resistance, R=VI from Ohm's Law, but resistivity is now calculated by equation A-2:

$$\text{Resistivity} = R\,\frac{WD}{L}, \qquad \text{(eq A-2)}$$

where W, D, and L are the soil box dimensions (fig A-2).

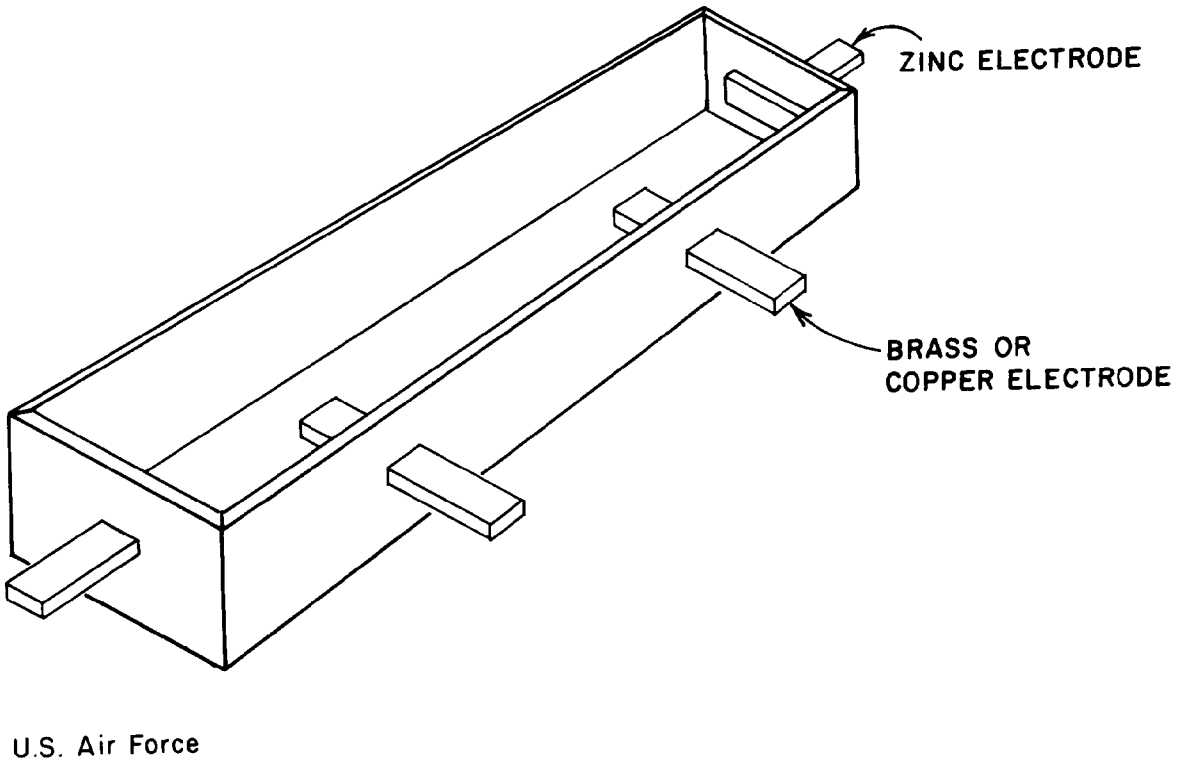

Figure A-2. Soil box for soil resistivity measurements.

A-4. Temperature effect.

Temperature greatly affects soil resistivity at temperatures below freezing. Thus, soil resistivity should not be measured on soil at below-freezing temperatures.