CHAUVIN ARNOUX GROUP
15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Soil Resistivity Lab

Approximating the Ground Resistance of an Electrode System

A pad-mounted set of equipment cabinets will be installed at the instructor's selected location. The pad will be (20 x 20) ft. (See pg. 2 *electrode options – option 1* for additional information.)

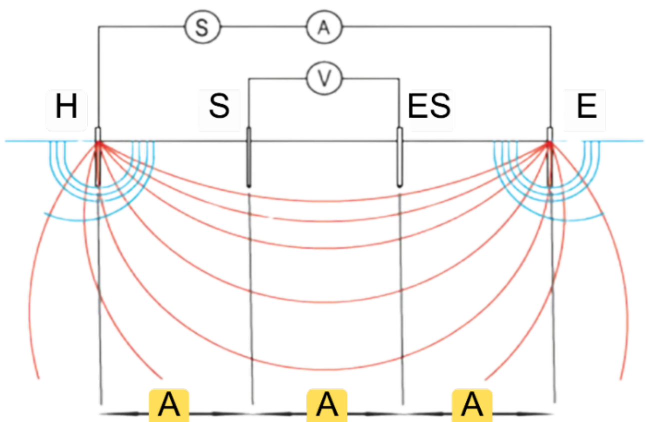
The site design calls for a single 10 ft ¾ dia. electrode (rod) installed in the SW corner

The resistance of the ground electrode system must be: ________ Ω

As part of the initial survey, test the nearby soil at 10 and 20 ft depths and calculate the resistance of the provided plans.

Depth | Spacing:	Resistance - Ω	Soil Resistivity - *Rho (ρ)* Ω - cm
A @ 10 ft:	Ω	Ω - cm
***A @ 20 ft*:**	Ω	Ω - cm

Tip: Use $R_c = 191.5\ x\ A\ x\ R$ **(with A in feet, R is resistance measured) to calculate ohm-cm**



Wenner Test Electrode Arrangement

Option 1: Apparent resistance of 10 ft ground electrode: ______ ohms
Use the **Grounding Nomograph** to calculate the resistance of a single electrode @ 10 ft

If the apparent calculated resistance is too high, what would be the ideal solution from the options below?

Option 2: Single 20 ft ground rod: _____ Ω *(use Option 2 AEMC® Ground Resistance Calculator)*

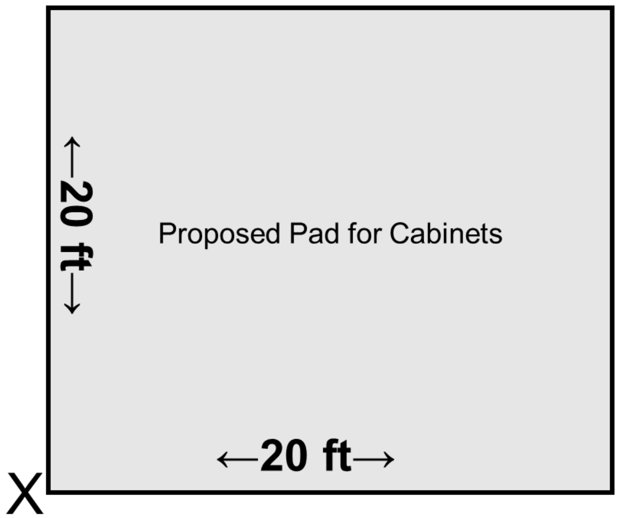
Option 3: Triad of (3) 10 ft ground rods: _____ Ω *(use Option 3 IEEE Correction Factors)*

Option 4: Ring of (4) 10 ft ground rods: _____ Ω *(use Option 4 Multiple Rod Resistance Chart)*

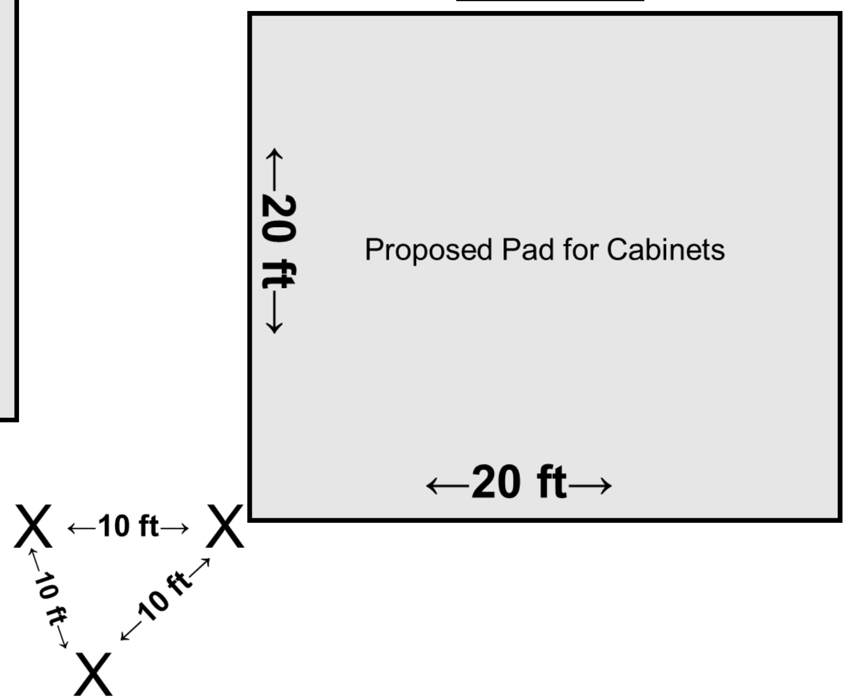
AEMC® INSTRUMENTS
CHAUVIN ARNOUX GROUP
15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Soil Resistivity Lab
Ground Rod Installation Options

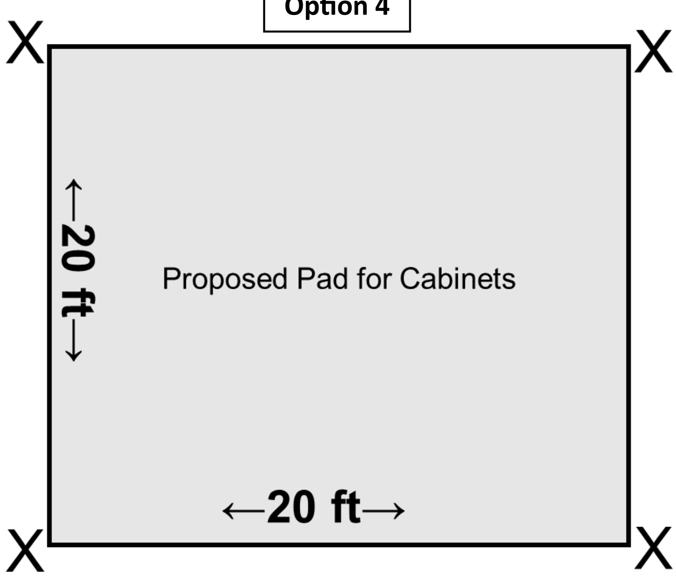
Options 1-2



Option 3



Option 4

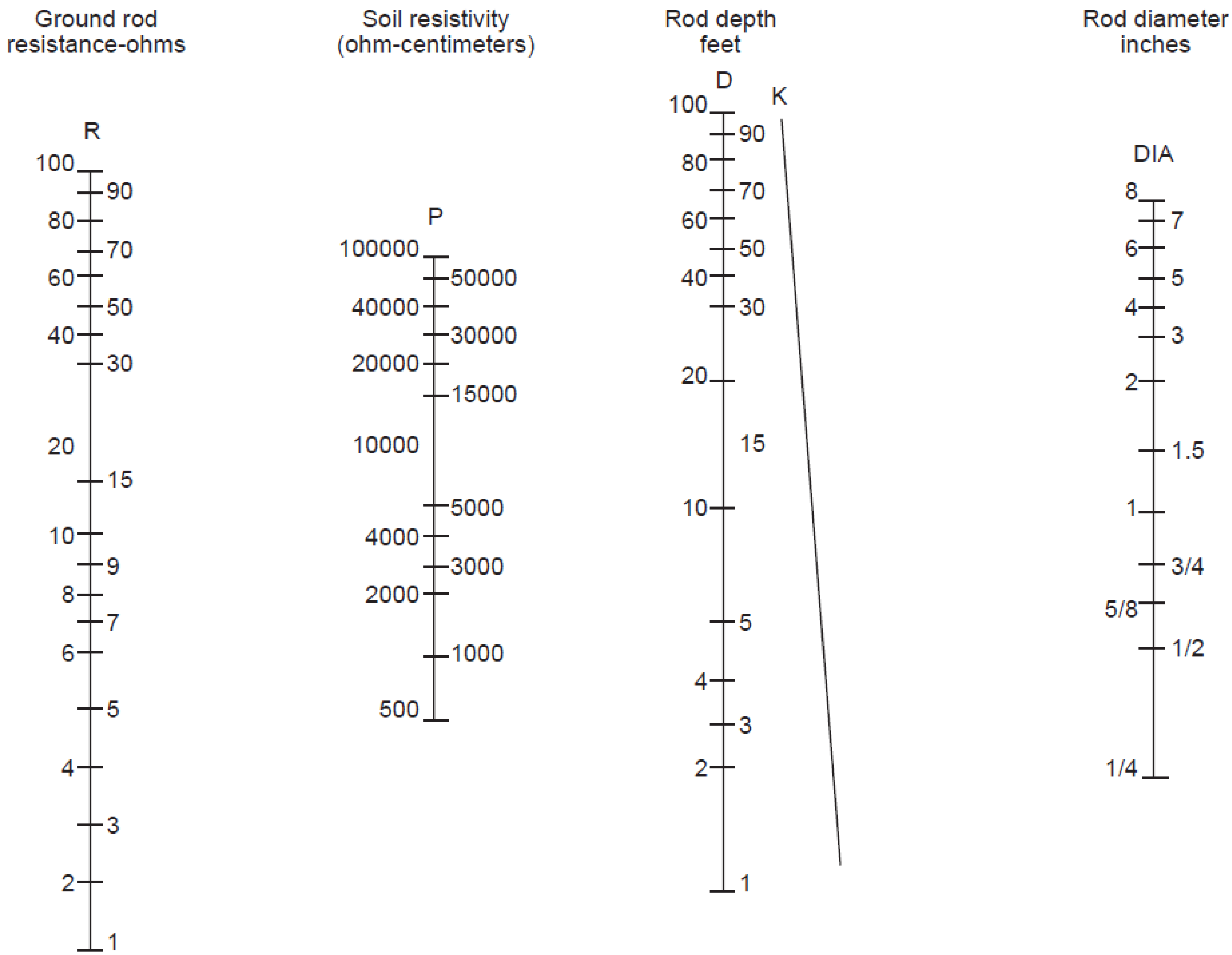


CHAUVIN ARNOUX GROUP

15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Design Option #1: Soil Resistivity Lab

Grounding Nomograph

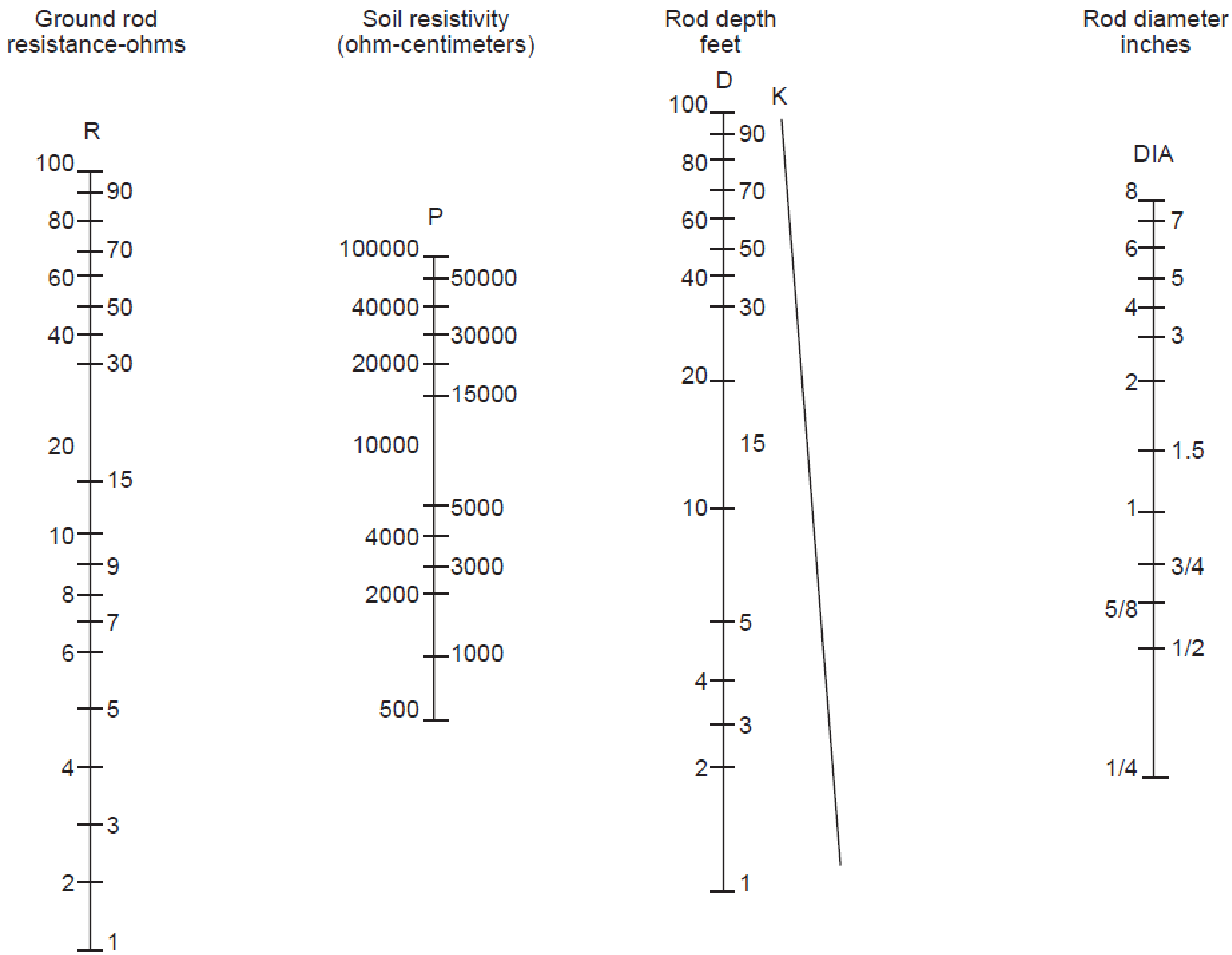


1. Select required resistance on R scale
2. Select apparent resistivity on P scale
3. Lay straightedge on R and P scale, and allow to intersect with K scale
4. Mark K scale point
5. Lay straightedge on K scale point and DIA scale, and allow to intersect with D scale
6. Point on D scale will be the rod depth required for resistance on R scale

15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Design Option #1: Soil Resistivity Lab

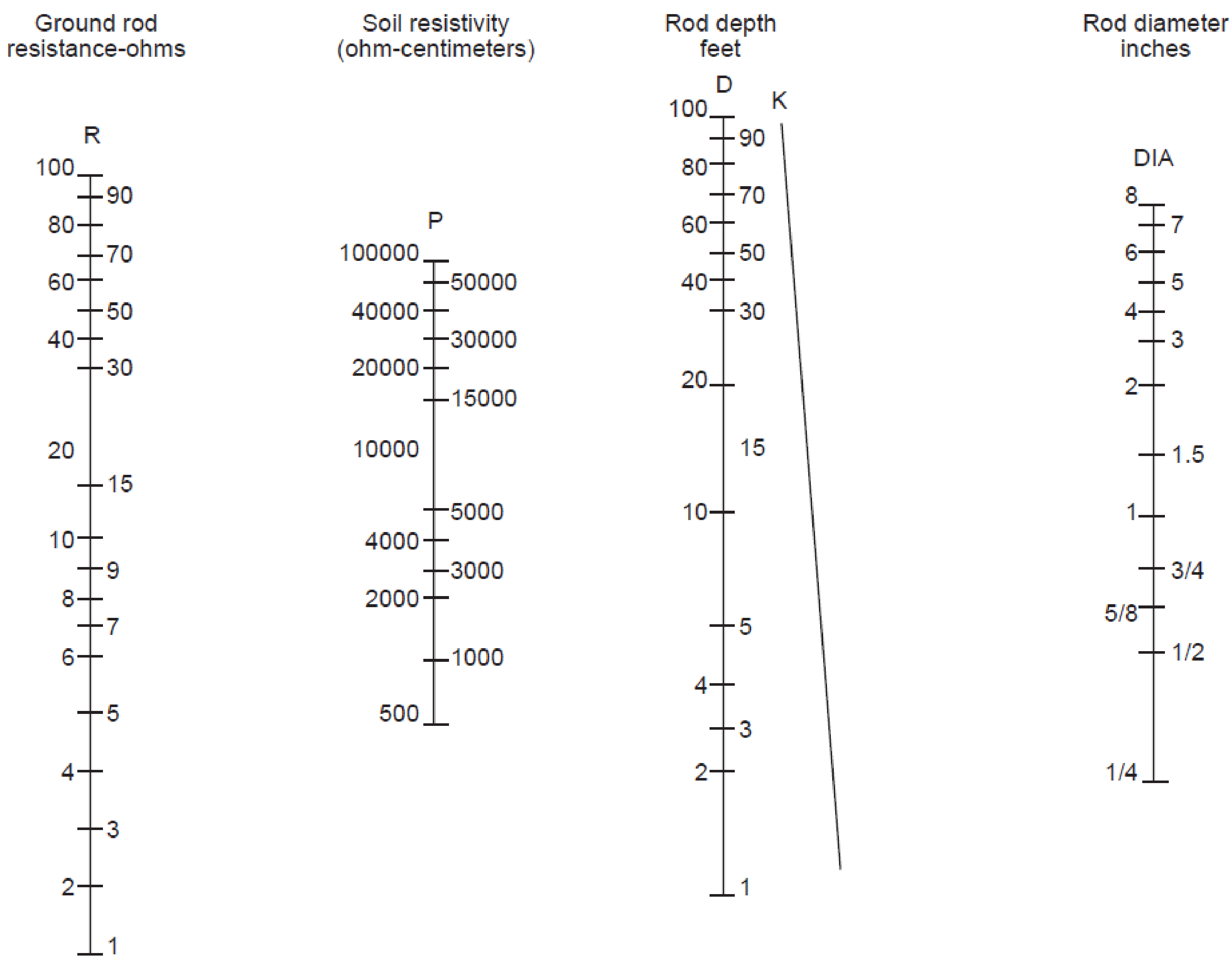
Grounding Nomograph



1. Select required resistance on R scale
2. Select apparent resistivity on P scale
3. Lay straightedge on R and P scale, and allow to intersect with K scale
4. Mark K scale point
5. Lay straightedge on K scale point and DIA scale, and allow to intersect with D scale
6. Point on D scale will be the rod depth required for resistance on R scale

Design Option #1: Soil Resistivity Lab

Grounding Nomograph

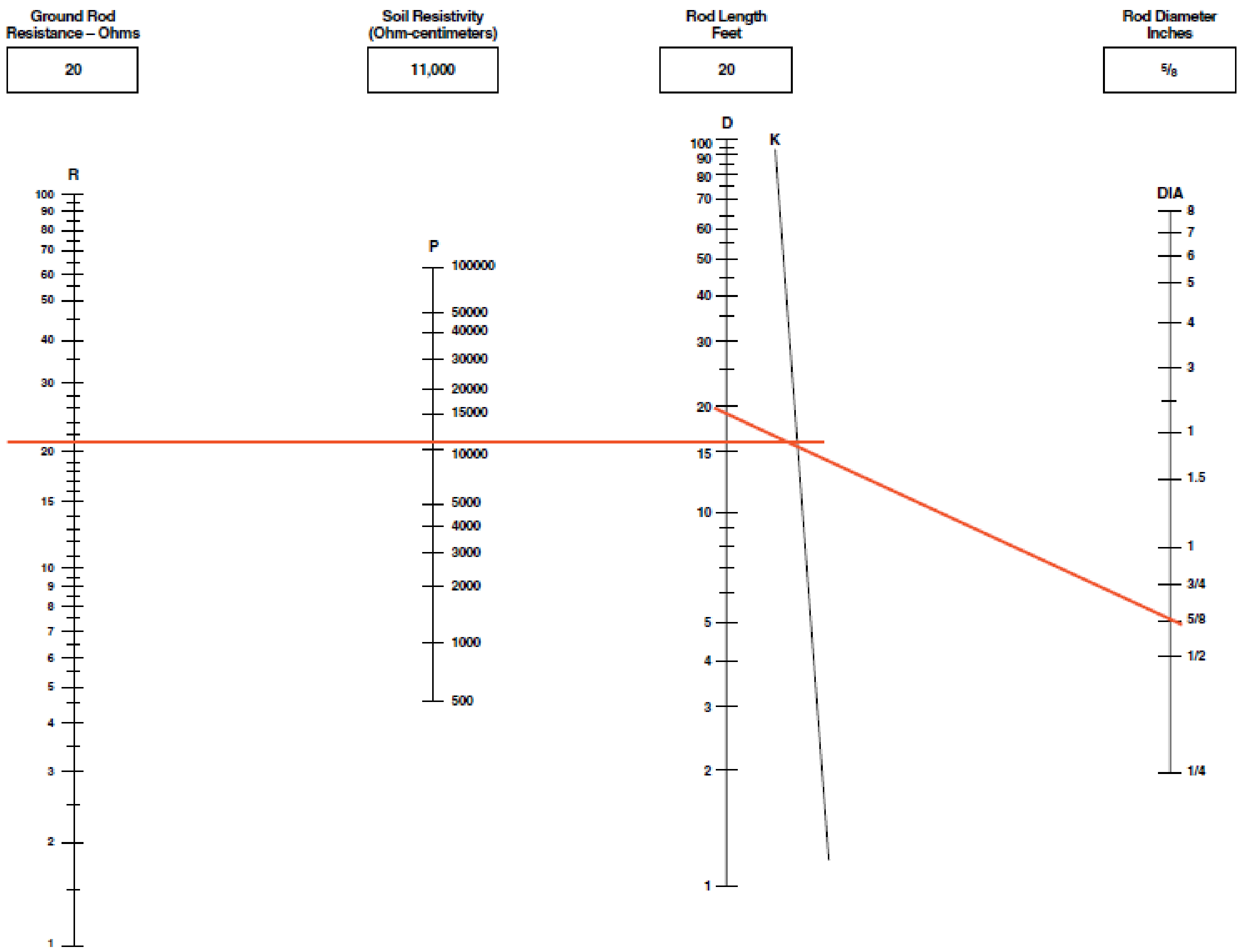


1. Select required resistance on R scale
2. Select apparent resistivity on P scale
3. Lay straightedge on R and P scale, and allow to intersect with K scale
4. Mark K scale point
5. Lay straightedge on K scale point and DIA scale, and allow to intersect with D scale
6. Point on D scale will be the rod depth required for resistance on R scale

CHAUVIN ARNOUX GROUP
15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Design Option #1: Soil Resistivity Lab

Grounding Nomograph EXAMPLE



Represents example of a 20Ω, 5/8"diameter 20 ft ground rod at 11,000Ω-cm soil resistivity

1. Select required resistance on R scale
2. Select apparent resistivity on P scale
3. Lay straightedge on R and P scale, and allow to intersect with K scale
4. Mark K scale point
5. Lay straightedge on K scale point and DIA scale, and allow to intersect with D scale
6. Point on D scale will be the rod depth required for resistance on R scale

Design Option #3: Soil Resistivity Lab

IEEE Correction Factors

Correction Factors for Multiple Rods – IEEE 143	
Number of Rods	**X**
2	1.16
3	1.29
4	1.36
6	1.52
8	1.68
12	1.80
16	1.92
20	2.00
24	2.16

Instructions

1. Calculate the resistance of a single electrode using the Grounding Nomograph or the Grounding Calculator.
2. Divide the resistance by the number of correctly spaced ground rods (3)
3. Multiply the solution by the correction factor.

Example

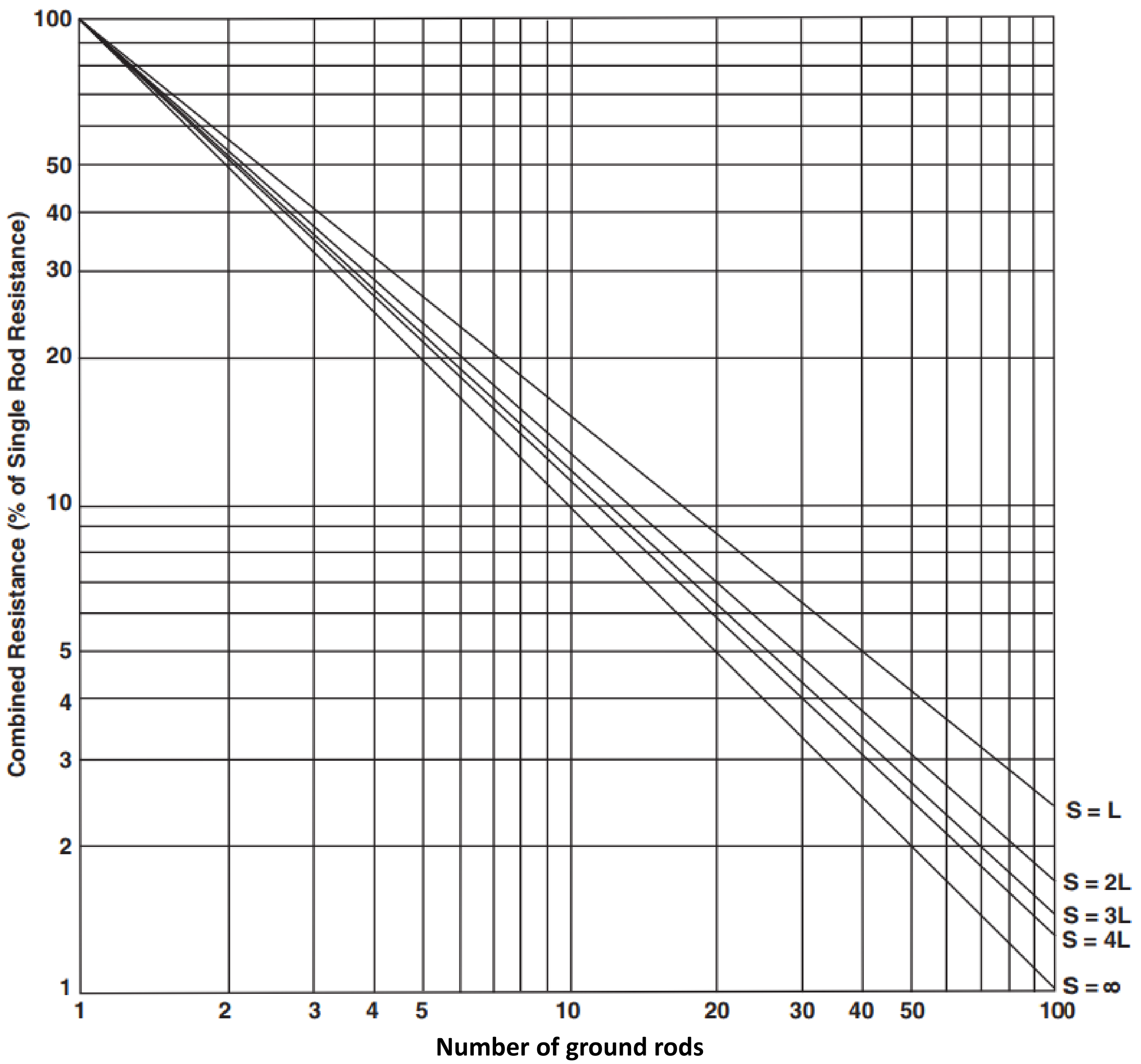
Single rod resistance = **56 Ω**

(6) rods are to be installed with at least 10 ft spacing

$$R_C = \frac{56}{6} = 9.33 \times 1.52 = \mathbf{14.18}\ \Omega$$

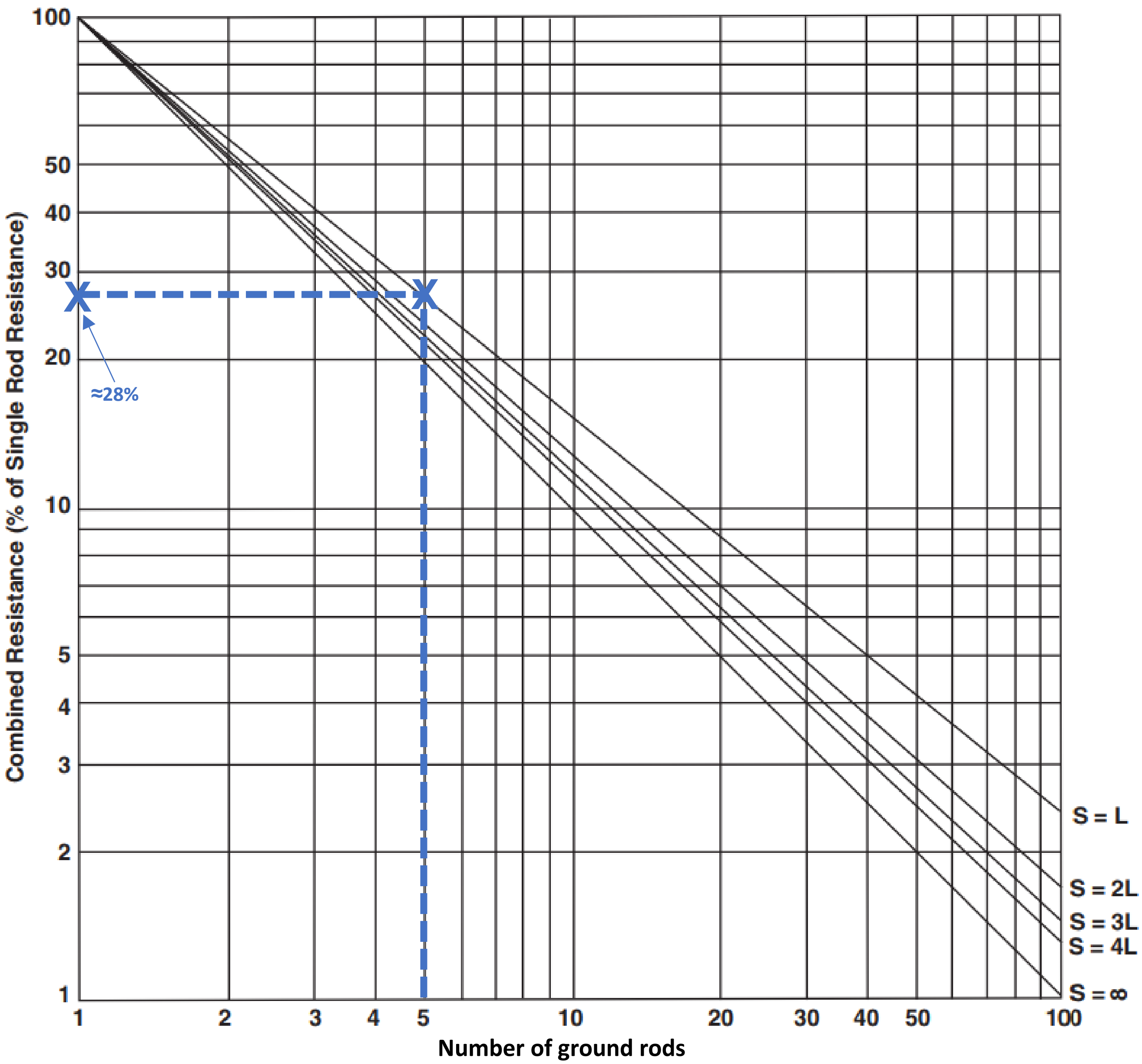
Design #4: Soil Resistivity Lab

Multiple Rod Resistance Chart



Legend
S *= Rod Spacing*
L *= Rod Length*

Design #4: Soil Resistivity Lab
Multiple Rod Resistance Chart — EXAMPLE



Legend
S *= Rod Spacing*
L *= Rod Length*

Example

Calculate the resistance (R_c) of (5) 10 ft rods spaced 10 feet apart

Single 10 ft ground rod = 45 Ω

(5) electrodes spaced ≥ 10 ft

$$\boldsymbol{R_c} = \mathbf{28}\ \%\ \boldsymbol{x}\ \ \mathbf{45}\ \Omega = \mathbf{12.6}\ \Omega$$

AEMC® INSTRUMENTS
CHAUVIN ARNOUX GROUP
15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Fall-of-Potential
Test the Resistance of a Single Ground Rod

1. Use the Full Fall-of-Potential method to test the supplied ground rod. Complete the AEMC® Instruments Fall-of-Potential plot.
2. Use the Simplified F-o-P Worksheet below to complete a validation test on the ground rod.

Simplified Fall-of-Potential Worksheet

Notate the required distances and resistance values

Soil Type
____

Soil Condition
____
____
____

Last Rainfall:
Date______

Electrode Type:
____

Rod Length:
_____

Effective Resistance:
______ Ω

% Accuracy:_____ %

H @ 100% – Distance:______

S @ 72% – Distance:______ **Ω:**_______

S @ 62% – Distance:______ **Ω:**_______

S @ 52% – Distance:______ **Ω:**_______

Direction (N,S,E,W):________

X

Ground Rod

%Accuracy = 100% - %difference

% difference = (difference) / (average) x 100 = (52% - 72%)/(52%+72%/2) × 100

Other Tests for Fieldwork Examples

Install and connect an additional ground rod to lower resistance

Comparison Value: Test both rods at 62 %: __________ Ω

Selective Fall-of-Potential: Test new rod with Selective F-o-P: __________ Ω

Temporarily interconnect the two ground rods to a utility ground

Comparison Value: Fall-of-Potential @ 62 %: __________ Ω

***Clamp-on Resistance*:** Test new rod with the clamp-on: __________ Ω

Clamp-on Resistance: Test the system resistance (both rods) with the clamp-on: ________ Ω

AEMC® INSTRUMENTS
CHAUVIN ARNOUX GROUP
15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Fall-of-Potential
Test the Resistance of a Single Ground Rod

Instrument Mfr. ____________ Name of Operator ______________________________

Model ____________ Location ______________________________ Date ____________________

Serial # ____________ Ground System Type: Single Rod ☐ Rod Depth ____________________ ft

Multiple Rods (Grid) ☐ Longest Diagonal Dimension ________ ft

H Electrode Distance ______________________________ ft

%	Voltage Electrode (S) distance from Ground Rod under Test (E)	Measured Resistance
	FEET	OHMS
100		
90		
80		
72		
70		
62		
60		
52		
50		
40		
30		
20		
10		
0		

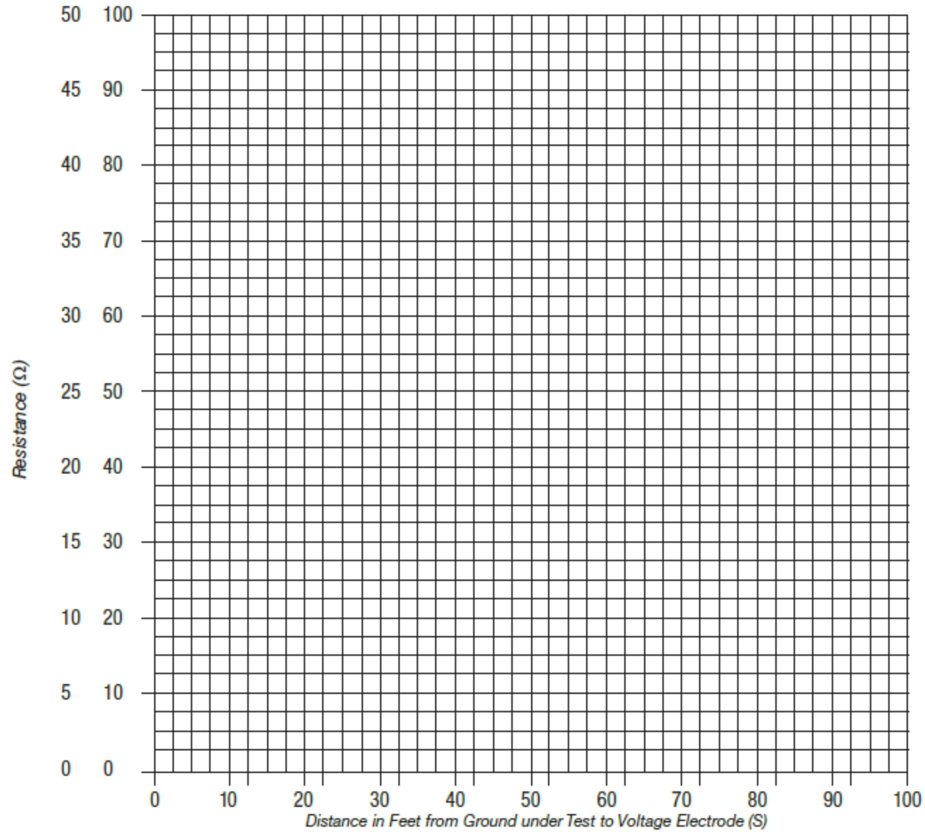
Test Conditions

Temp: __________ Soil: ☐ Moist ☐ Dry

Soil Type

☐ Loam ☐ Sand & Gravel ☐ Shale ☐ Clay ☐ Limestone

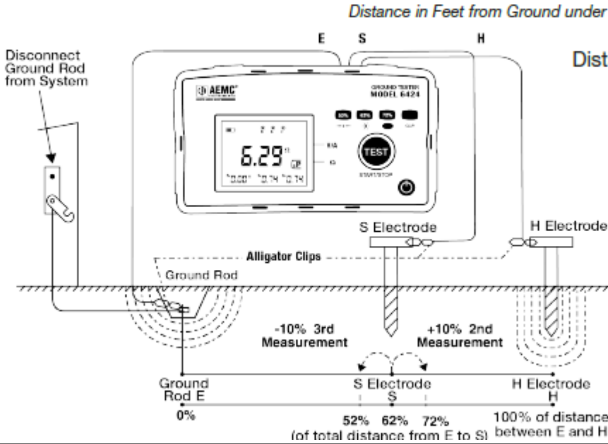
☐ Sandstone ☐ Granite ☐ Slate ☐ Other ____________



Resistance Scale: ☐ 50 ☐ 100

Multiplier: ☐ x1 ☐ x10

Distance Scale Multiplier: x1 x10



15 Faraday Dr • Dover NH 03820 • (800) 749-6434 • www.aemc.com

Fall-of-Potential
Test the Resistance of a Single Ground Rod

Instrument Mfr. ___________ Name of Operator ______________________________________

Model ___________ Location ______________________ Date ____________________

Serial # ___________ Ground System Type: Single Rod ☐ Rod Depth ____________________ ft

Multiple Rods (Grid) ☐ Longest Diagonal Dimension ________ ft

H Electrode Distance ______________________________________ ft

%	Voltage Electrode (S) distance from Ground Rod under Test (E)	Measured Resistance
	FEET	OHMS
100	______	______
90	______	______
80	______	______
72	______	______
70	______	______
62	______	______
60	______	______
52	______	______
50	______	______
40	______	______
30	______	______
20	______	______
10	______	______
0	______	______

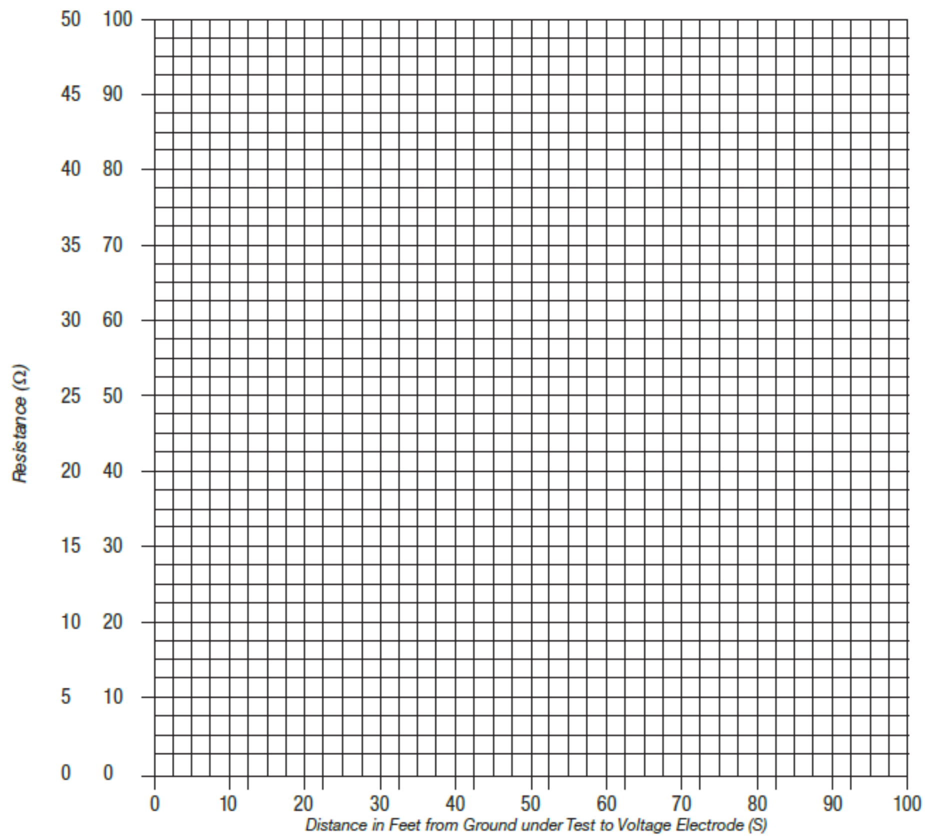
Test Conditions

Temp: __________ Soil: ☐ Moist ☐ Dry

Soil Type

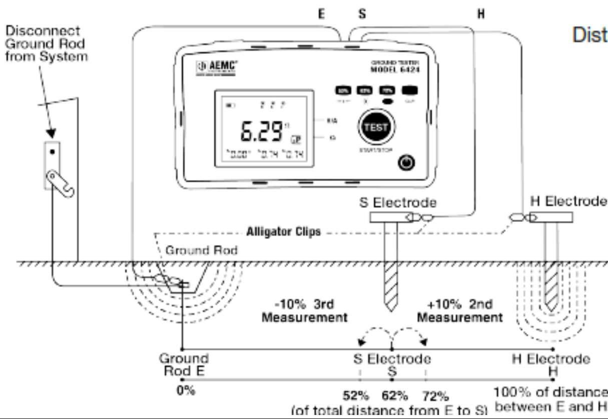
☐ Loam ☐ Sand & Gravel ☐ Shale ☐ Clay ☐ Limestone

☐ Sandstone ☐ Granite ☐ Slate ☐ Other ___________



Resistance Scale: ☐ 50 ☐ 100

Multiplier: ☐ x1 ☐ x10



Distance Scale Multiplier: x1 x10