GROUND FIELD RESISTANCE TESTING

COMPLYING WITH MSHA REGULATIONS

30 CFR 56/57. 12028

- 56/57.12028 Testing grounding systems.
  - Continuity and resistance of grounding systems shall be tested immediately after installation, repair, and modification; and annually thereafter. A record of the resistance measured during the most recent tests shall be made available on a request by the Secretary or his duly authorized representative.

METAL AND NONMETAL ELECTRICAL ACCIDENTS- 1/91 THROUGH 12/95

DURING THIS TIME PERIOD, ELECTRICAL SHOCK CAUSED 19 FATALITIES,

196 INJURIES RESULTING IN TIME LOST FROM WORK

3 PERMANENTLY DISABLING INJURIES

25 INJURIES INVOLVING LOST DAYS AND RESTRICTED DUTY

25 OF THE INJURIES RESULTED IN-

LOST DAYS AND RESTRICTED DUTY

35 INJURIES WHERE THE VICTIMS WERE PLACED ON RESTRICTED DUTY-

CONTRACTOR EMPLOYEES SUFFERED-

4 FATALITIES-

2 PERMANENTLY DISABLING INJURIES-

25 LOST DAYS FROM WORK-

1 DAY LOST WITH RESTRICTED DUTY-

2 RESTRICTED DUTY INJURIES

TEN (44%) OF THE FATALS WERE CAUSED BY-

FAILURE TO DE-ENERGIZE AND LOCK OUT

SEVEN DEATHS (30%) WERE CAUSED BY-

UNGROUNDED CIRCUITS WITH ELECTRICAL FAULTS EXISTING

SIX (26%) WERE A RESULT OF-

MACHINERY CONTACTING OVERHEAD POWER LINES

ELECTRICIANS WERE THE VICTIMS IN 12 OF THE FATALS !

ELECTRICIANS WERE THE VICTIMS IN-

- 3 OF THE PERMANENTLY DISABLING INJURIES
- 74 OF THE LOST DAYS CASES
- 15 OF THE LOST DAYS AND RESTRICTED DUTY CASES
- 17 OF THE RESTRICTED INJURY CASES

PLANT OPERATORS WERE THE VICTIMS IN 4 OF THE FATALS

PLANT OPERATORS ALSO WERE THE VICTIMS IN-

- 1 PERMANTLY DISABLING INJURY
- 62 OF THE LOST DAY INJURIES
- 2 OF THE LOST DAY AND RESTRICTED DUTY INJURIES
- 9 OF THE RESTRICTED DUTY INJURIES

SUPERVISORS WERE THE VICTIMS IN-

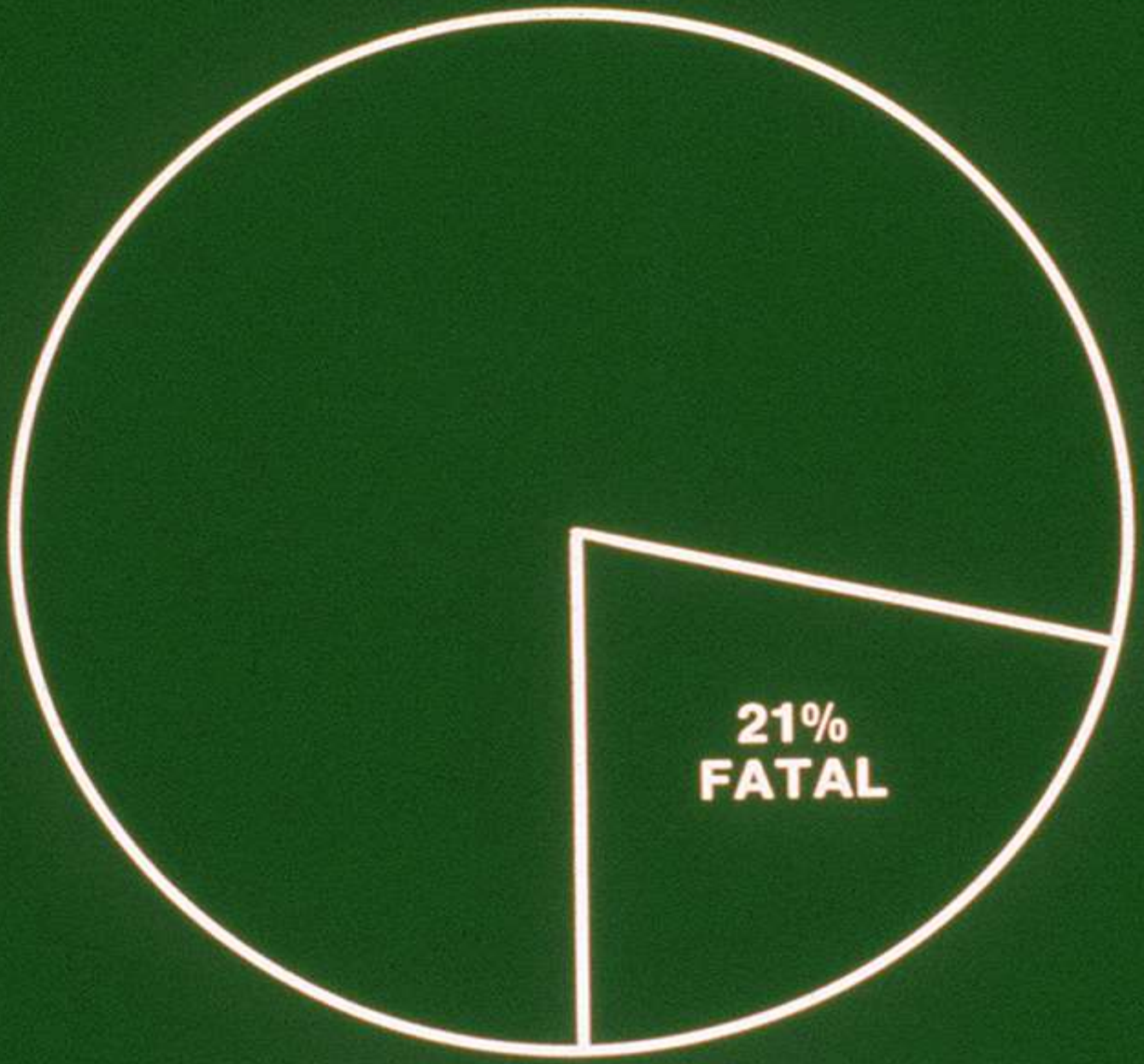
3 OF THE FATAL ACCIDENTS ALONG WITH-

- 1 PERMANTLY DISABLING INJURY-
- 22 LOST DAY IJURIES-
- 2 LOST DAYS AND RESTRICTED DUTY INJURIES-
- 4 RESTRICTED DUTY INJURIES

MECHANICS AND WELDERS WERE THE VICTIMS IN-

2 OF THE FATALITIES ALONG WITH-

- 31 OF THE LOST DAYS INJURIES-
- 3 OF THE LOST DAYS AND RESTRICTED DUTY ACCIDENTS-
- 5 OF THE RESTRICTED DUTY ACCIDENTS



ACCIDENTS RELATING TO
INCORRECT GROUNDING

HOW CAN WE PREVENT THESE ACCIDENTS ?

BY CONNECTING ALL OF THE METALLIC FRAMES TO THE ” GROUND” AT THE POWER SOURCE

WHAT IS “GROUND” ?

- A metallic connection to “earth” which should absorb current without elevating potential

How is that done?

- ?????

BY UTILIZING A SOLID, CONTINOUS, PERMANENT PATH WHILE MAINTAINING ELECTRICAL CONTINUITY

THIS PATH SHOULD NOT CONTAIN ANY HIGH RESISTANCE ELECTRICAL CONNECTIONS

THESE PATHS MUST RETURN TO THE “GROUND BEDS”

What is a ground bed?

A GROUND BED IS SOMETHING (RODS, OR LARGE METALLIC OBJECTS) WHICH SHOULD ABSORB THE CURRENT FROM THE SYSTEM FAULT OR LIGHTNING STRIKES WITHOUT RAISING SYSTEM POTENTIAL

GROUND BED TYPES

- DRIVEN ROD (MADE ELECTRODE)
- PIPE ELECTRODE
- PLATE ELECTRODE
- GROUND GRID

TOTAL GROUNDING SYSTEM

- EQUIPMENT GROUNDING CONDUCTOR-
- The conductor used to connect the metal frames of electrical equipment/devices to the grounding electrode conductor

Grounding electrode conductor

- The conductor that connects the grounding electrode to the equipment grounding conductor

Grounding electrode

- These are usually the driven rod(s) , metal plate, or other effective method usually at the source.

The use of all three gives you the low resistance path to earth that you need for protection.

WHY DO WE TEST?

TO ENSURE THAT A LOW IMPEDANCE PATH EXISTS FOR THE DISSIPATION OF THESE FAULT CURRENTS

HOW DO WE TEST?

BY USING A TESTER THAT HAS BEEN SPECIFICALLY DESIGNED FOR THIS PURPOSE


Earth Tester
(Wolff Balance)
×0.1
×1
×10
RΩ

NOT an ohm meter, or an insulation tester (meggar), or welder

THE MATERIAL CONTAINED IN THIS PRESENTATION IS NOT INTENDED TO COVER COMPLETE GROUNDING THEORY, BUT RATHER TO EXPLAIN A TECHNIQUE FOR ACCURATELY DETERMINING THE EFFECTIVENESS OF A SAFETY GROUND BED.

MEASURING

BED RESISTANCE

MEASURING BED RESISTANCE

VARIOUS METHODS USED

NATURE OF THE PROBLEM

LOCATING THE POTENTIAL ELECTRODE

BY FOLLOWING THE SAFE PROCEDURES AS OUTLINED BY THE MANUFACTURERS

CHECK FOR

VOLTAGE OR CURRENT

IN THE SYSTEM

LOCKOUT AND TAGGING

Disconnect power

Tag Component

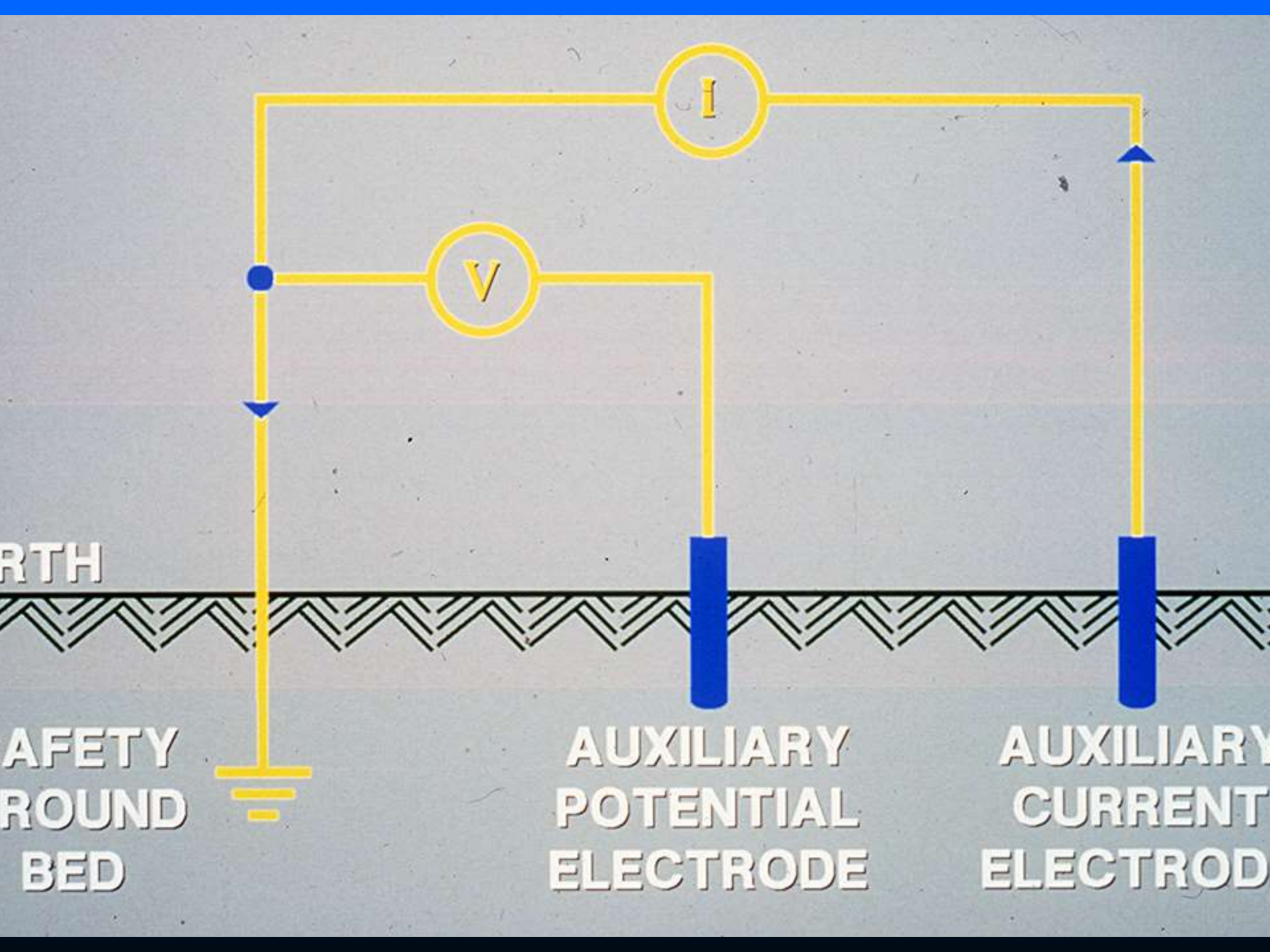
Lock it out

FALL -OF -POTENTIAL METHOD

or

3 POINT MEASUREMENT

THIS METHOD IS ALSO KNOWN AS THE 62% METHOD


I
V
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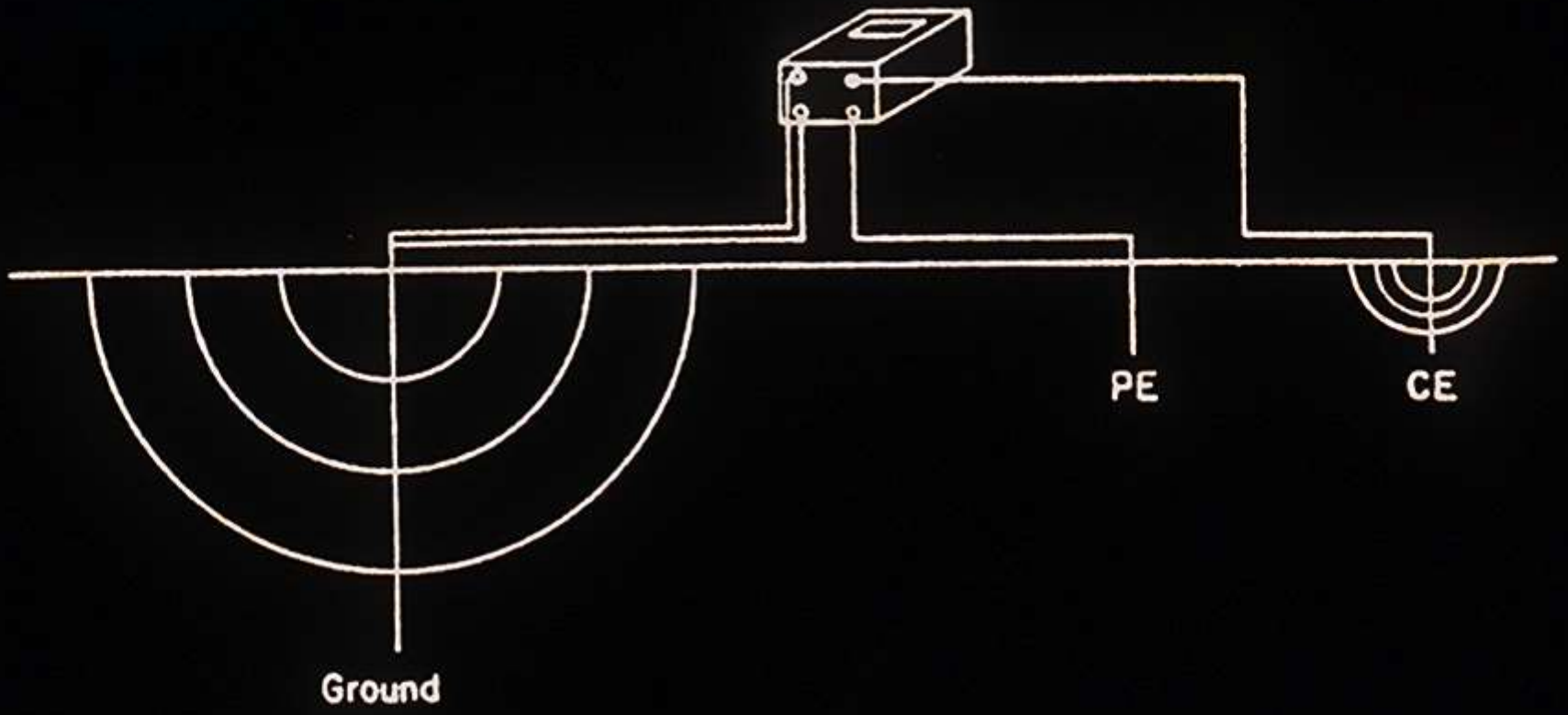
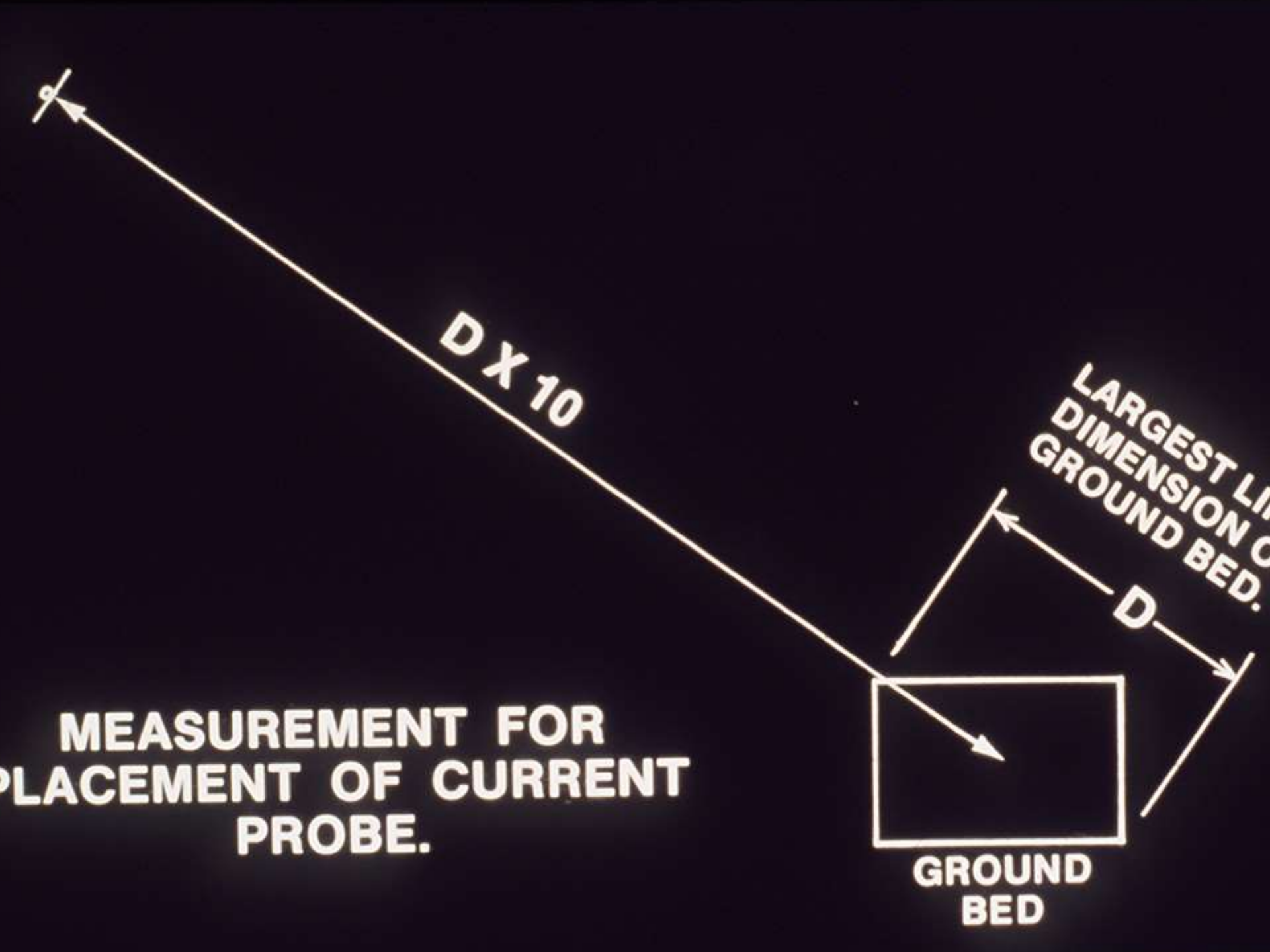
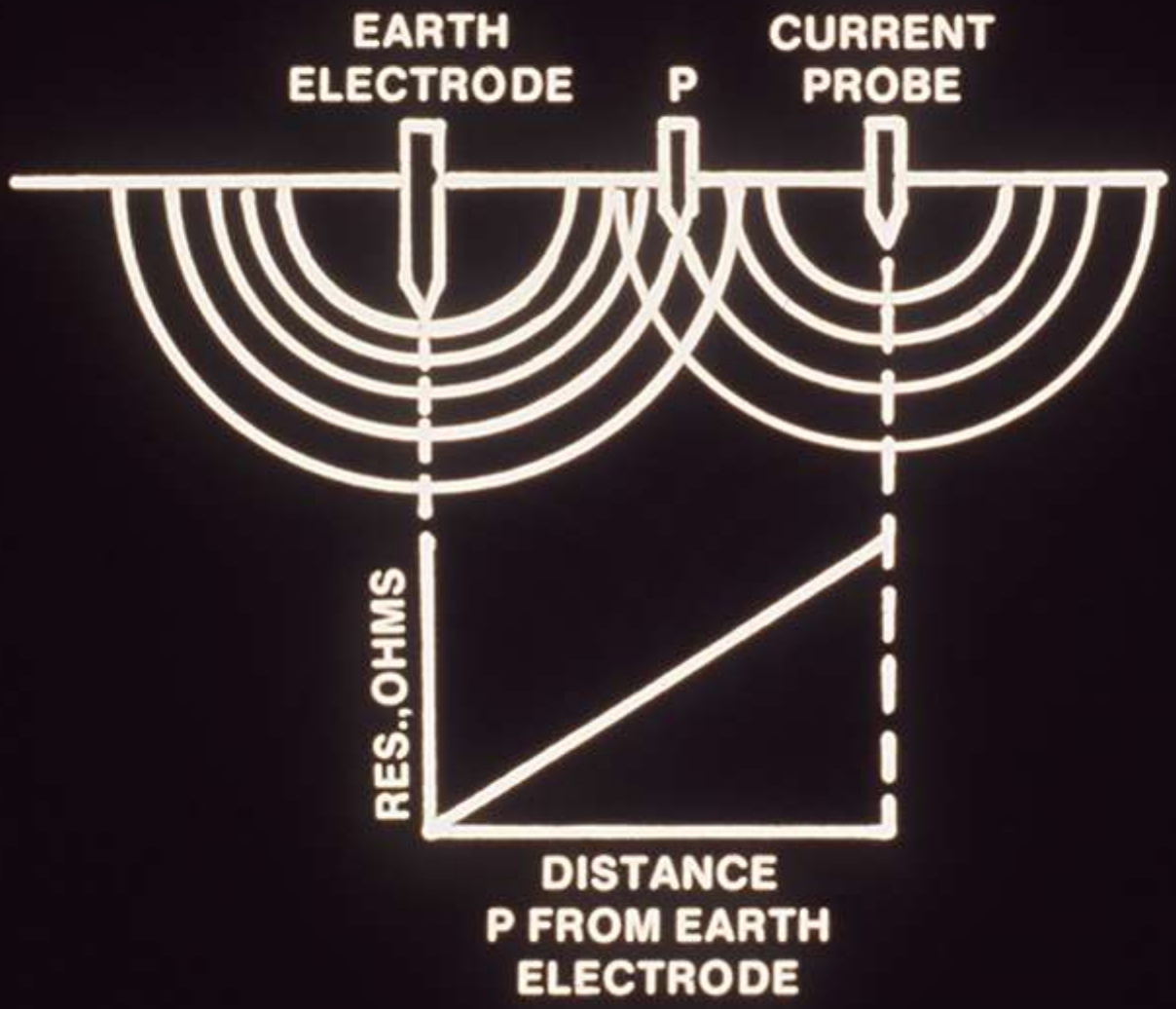
ELECTRODE
AUXILIARY
CURRENT
ELECTROD



Concentric Earth Shells Around the Ground Concentration Being Tested and Around the Current Electrode.



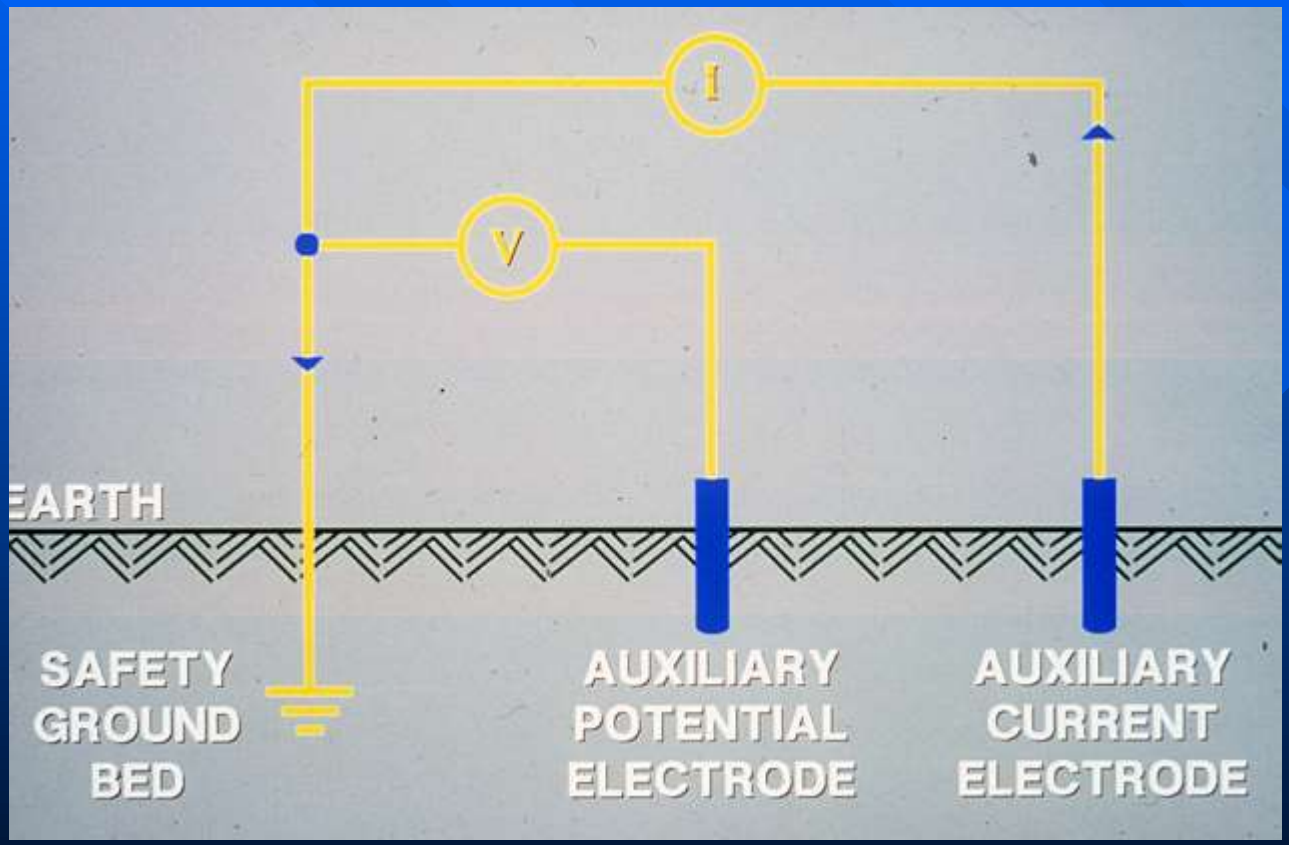
MEASUREMENT FOR
PLACEMENT OF CURRENT
PROBE.


EARTH
ELECTRODE
P
CURRENT
PROBE
RES.,OHMS
DISTANCE
P FROM EARTH
ELECTRODE


140 FEE

HOW DO WE KNOW IF WE HAVE DONE THAT?

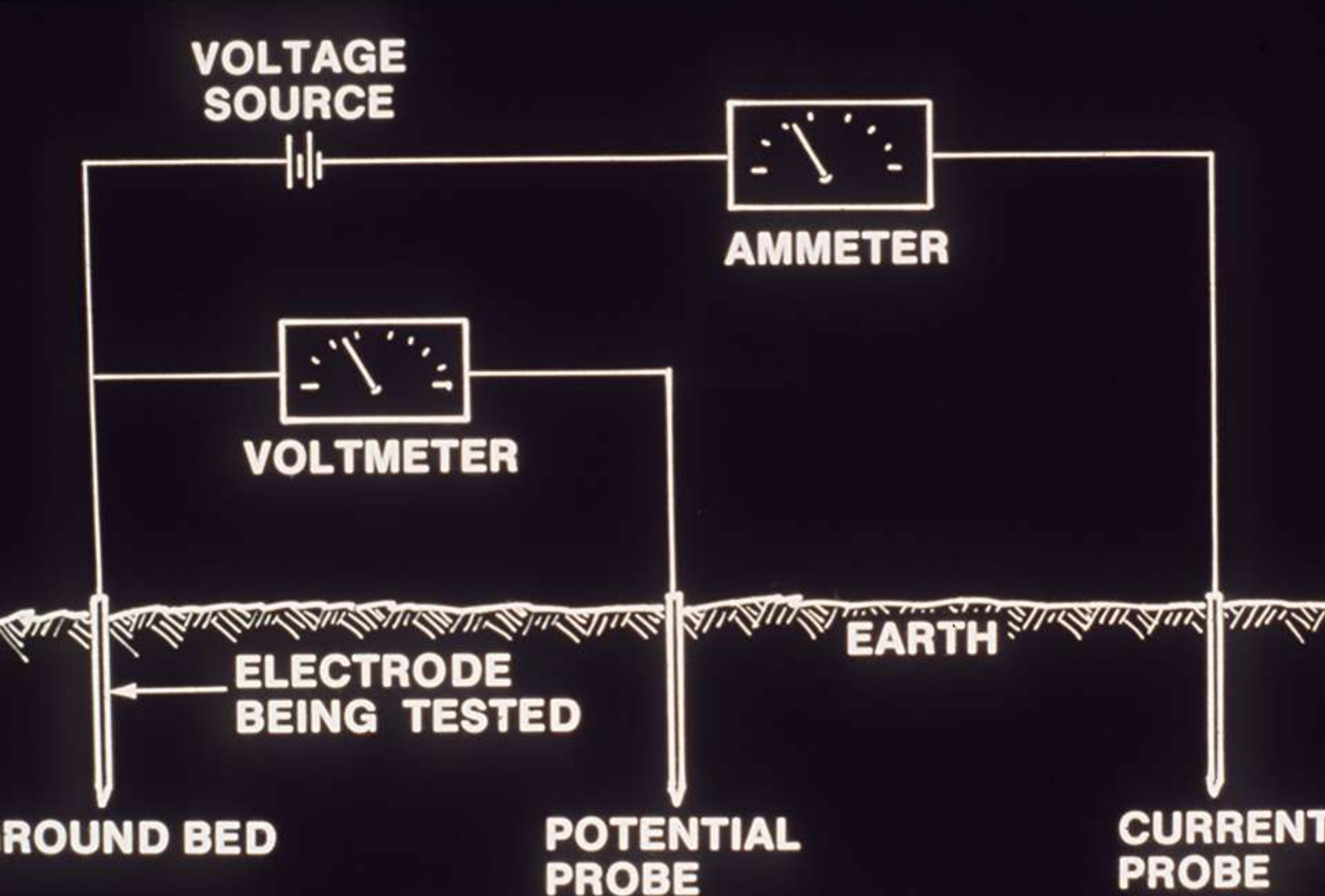
BY MOVING THE ELECTRODE BETWEEN E AND C2 AND TAKING MEASUREMENT READINGS



HOW DOES THE TESTER DO THAT?

THE POTENTIAL DIFFERENCE BETWEEN ELECTRODES (E) AND (C2) IS MEASURED BY A VOLTMETER

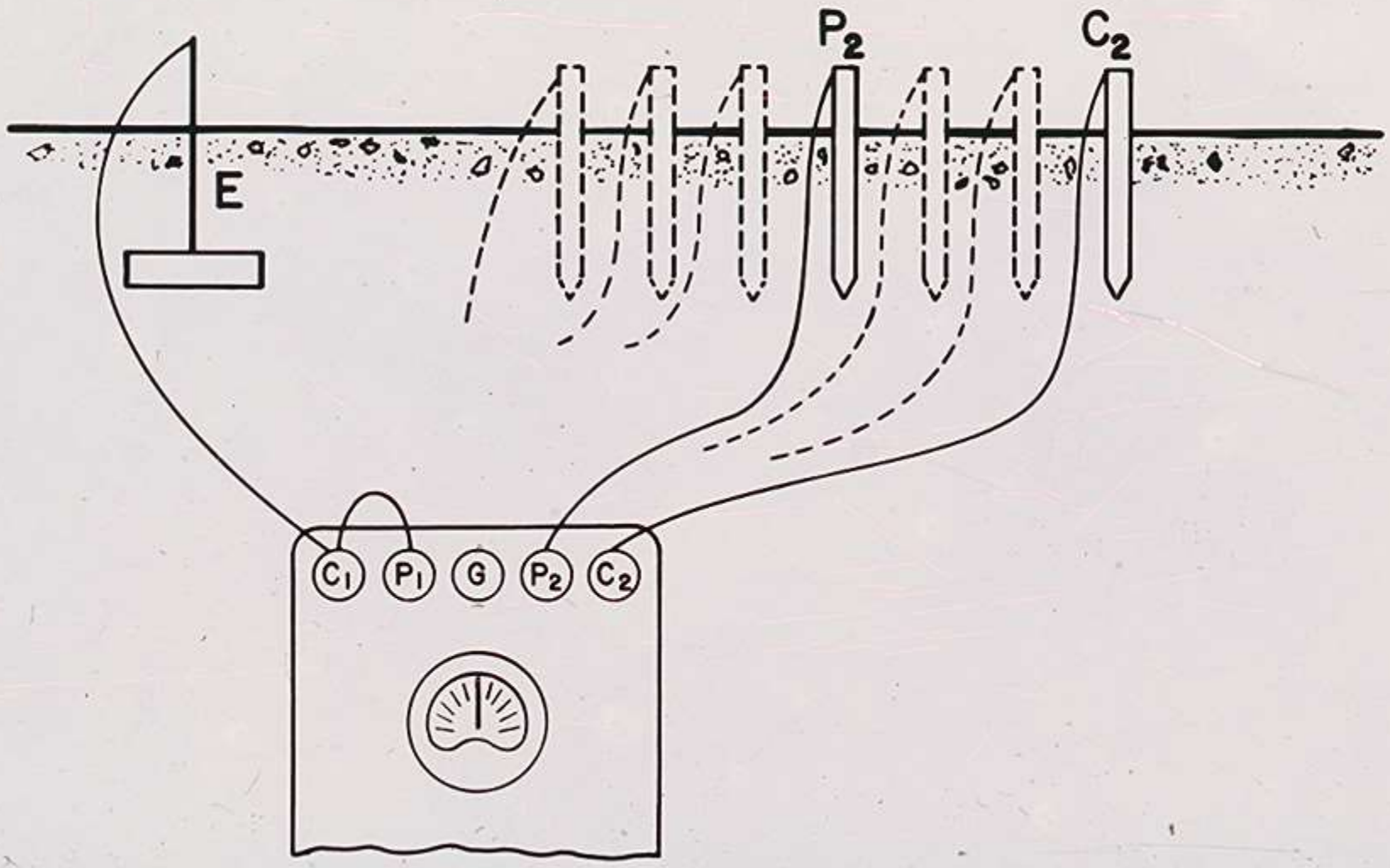
AND THE CURRENT FLOW BETWEEN C2 AND E IS MEASURED BY AN AMMETER



FALL OF POTENTIAL METHOD

IF ELECTRODE P2 IS IN AN EFFECTIVE RESISTANCE AREA, THE READINGS WILL VARY IN VALUE NOTICEABLY

MEASURE P_2 IN SEVERAL LOCATIONS



IF THE ELECTRODE IS LOCATED OUTSIDE OF THE RESISTANCE AREAS, AND IS MOVED BACK AND FORTH, THE READINGS WILL BE MINIMAL

These readings should be close to each other

These readings should be plotted then to show that they lie in a “plateau” or the “62%” area

This graph or curve should ideally show that the readings are 25 ohms or less

GROUNDING SYSTEM RESISTANCE TEST

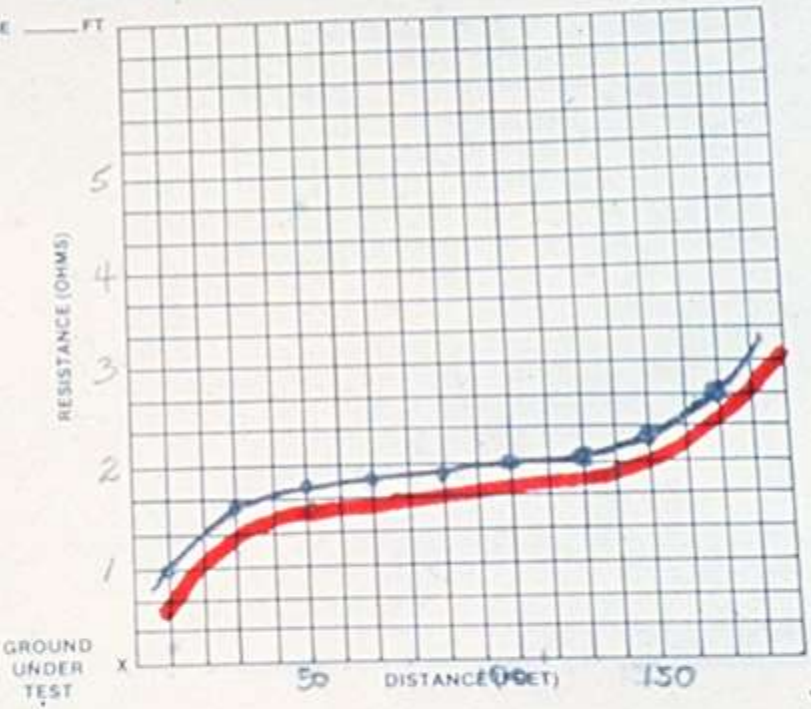
LOCATION JAMES FORK SUBSTATION
SEASON FULL
TYPE SOIL CLAY
SOIL CONDITION DRY ☒ MOIST ☐
DATE 10-15-84
TEMP 75°

TYPE SYSTEM
SINGLE ROD ☐ DEPTH 8 FT
MULTIPLE RODS ☒ LONGEST DIMENSION 10 FT
BURIED STRIPS OR WIRE ☐ LONGEST DIMENSION 20 FT

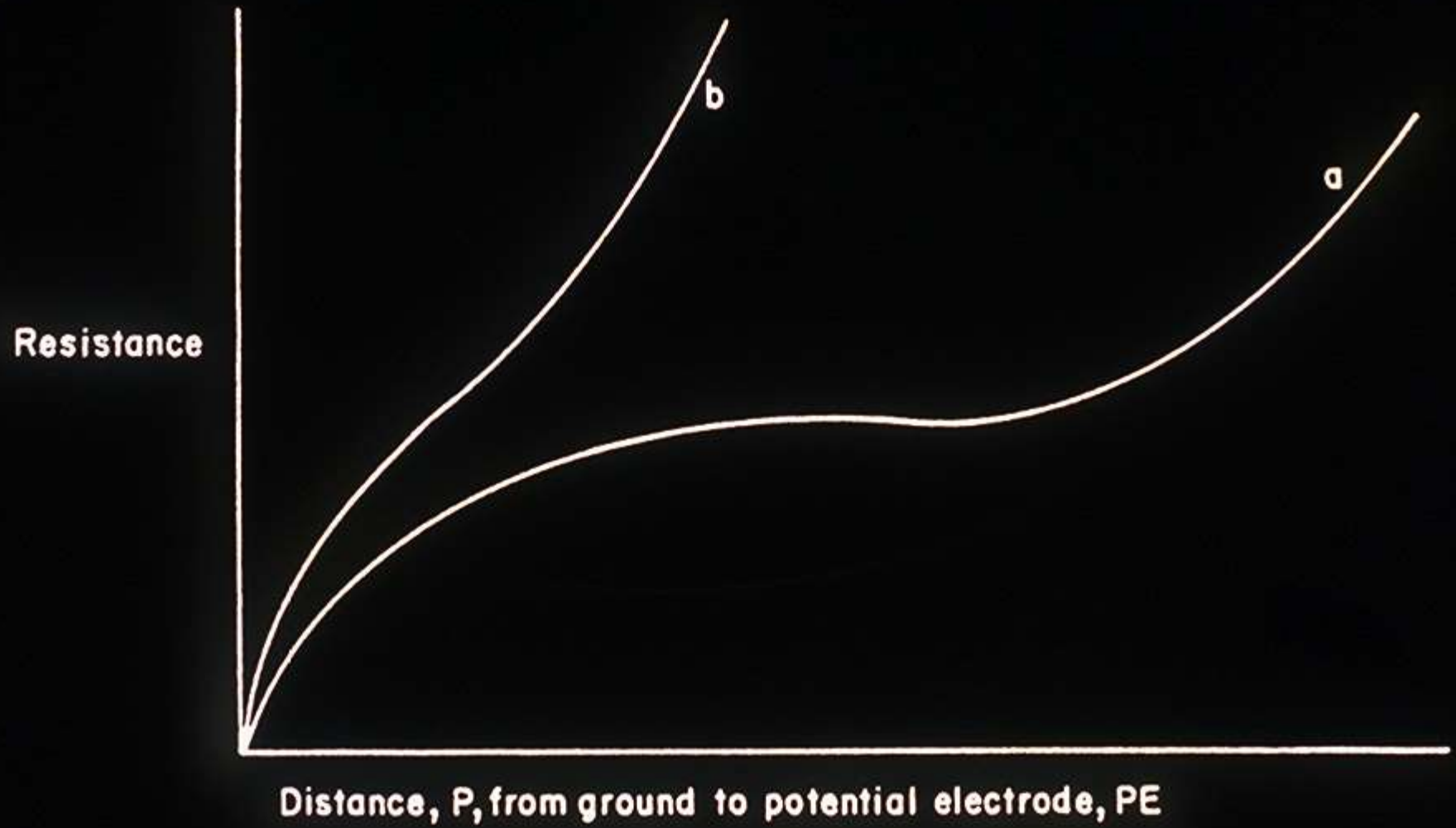
DISTANCE TO AUXILIARY CURRENT ELECTRODE ____ FT

AUXILIARY POTENTIAL ELECTRODE

DISTANCE ____ FT	RESISTANCE ____ OHMS
190	
170	2.4
150	2.2
130	2.1
110	2.0
90	1.9
70	1.8
50	1.8
30	1.6
10	1.0



Remember that the soil conditions, type of electrodes, homogeneity of the soil, and the length of the electrodes all contribute to the spacing of your auxiliary electrodes



Earth Resistance Curves.