

TINKER & RASOR

CORROSION MITIGATION INSTRUMENTATION

P. O. BOX 1667 SAN BERNARDINO, CA 92402

TEL: (909) 890-0700

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PRODUCT INSTRUCTIONS MODEL SR-2 SOIL RESISTIVITY METER

DESCRIPTION:

The Model SR-2 Soil Resistivity Meter is an electronic instrument useful in finding the resistance of soil at various depths.

Uses:

- *New Pipeline Surveys*
- *Direct Assessment Surveys*
- *U.S.T. Surveys*
- *Anode Bed Installations*
- *Geological Surveys*
- *Archeological Surveys*

The instrument may be used with either two (2) or four (4) pins, which are set into soil in a straight line, at equal distances. The Pins are named C1, P1, P2 and C2. Voltages are driven between C1 and C2, while resistance drop is measured between P1 and P2 (4 pin method). In the two-pin method, the resistance drop is measured between C1 and C2 only. The distance between the pins is equal to the depth of the soil resistance.

The four (4) pin method has been standardized by ASTM (astm.org) as Standard G57-95(a), and this method is also described in NACE Internationals, *Peabody's Control of Pipeline Corrosion, Second Edition*, pg. 84. (nace.org)

FEATURES:

Simple Operation, Easy to Use
3 Megohm Range
Data Logger connection
Internal rechargeable battery with Low Battery indicator
Common Pin Spacing multipliers and formula included on lid
Charging Indicator (LED)

APPLICATIONS:

Wenner 4 Pin Method
3 Pin "Fall of Potential"
2 Pin Method
Soilbox (Lab) tests

CONTENTS:

- (1) INSTRUMENT
- (1) 9v BATTERY (replaceable)
- (1) 12v BATTERY (rechargeable)
- (1) BATTERY CHARGER (110v)
 - (1) INSTRUCTION MANUAL

OPTIONS AVAILABLE SEPARATELY:

Model DL-1 Data Logger cable
Test Cables and Reel
Earth Pins

DIMENSIONS:

10 1/2" x 9 5/8" x 4 3/4" (266.7mm x 244.48mm x 120.65mm)

WEIGHT:

6 3/4 lbs. (3.06 Kgs)
8 lbs with domestic packaging (3.63 Kgs)
9 lbs with international packaging (4.08 Kgs)



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PRECAUTIONS:

The Model SR-2 can be used only in non-hazardous locations.

Do not measure across energized circuits. Damage to instrument may occur.

OPERATION:

Find a suitable location in the area where the survey is to be made.

Locate an area that will allow for the desired pin spacing (5', 10', 15', 20', etc) and also allow the operator to make slight adjustments in location to avoid any subsurface impedances such as rocks or foreign materials that do not allow the pins to be inserted into the soil. The soil should be of the same type along the entire path of the pins C1, P1, P2 and C2. Any non-conductive bodies along the surface of the soil, such as frozen soil, rocks and boulders, air pockets, etc, will affect results.

Place the pins in a straight line along the path of the survey. The distance between each pin should be identical. The distance between each pin (Pin Separation) is equal to the depth of the soil resistance as indicated by the Model SR-2. (Wenner 4-Pin Survey standard, ASTM G57-95a, www.astm.org)

Connect cables between each pin and the corresponding terminal on the Model SR-2 panel. C1 and C2 are color coded on the Model SR-2 as BLACK. P1 and P2 are color coded RED. The terminals allow for banana jacks or spade connectors.

WENNER 4 PIN METHOD:

Connect C1 on the SR-2 panel to the first pin, closest to the instrument. Connect C2 on the SR-2 panel to the last pin, farthest from the instrument.

P1 should be connected to the second pin from the instrument, and P2 to the third pin from the instrument.

(Please see diagram 1, below)

2 PIN METHOD: Similar to the 4PIN method described above. Measures the impedance between C1 and C2 only. This method is can be useful in troubleshooting the 4 PIN method. See Troubleshooting guide later in this manual.

After making the connections from the pins to the terminals on the Model SR-2 panel, the instrument is ready for use.

Locate the **RANGE SELECTOR** switch on the Model SR-2 panel. Ensure this switch is moved all the way counter-clockwise (left), so that they white dot on the knob of the switch is pointing towards the arrow labeled **START HERE**. (See picture 1)

NOTE: White dot may not line up exactly with the arrow.

Move the pin selection slide switch labeled **2 PIN 4 PIN METHOD** to the appropriate position. This switch is located just under the terminals area. (See picture 1). When in 4 PIN METHOD position, all four connections will be read (C1, P1, P2, C2). When in 2 PIN METHOD position, P1 will be shorted to C1 and P2 will be shorted to C2.

Push down on the circular area labeled **PUSH TEST**, and hold this button down during the test.

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The Test Indicator LED just above the **PUSH TEST** button will light during testing. If this LED is blinking, the battery is low and will need to be charged within 24 hours. (See **CHARGING** below.)

If the LCD display shows “1_ _ .”, move the **RANGE SELECTOR** switch one position clockwise (right), and hold the **PUSH TEST** button down for 3 seconds. Repeat this procedure, moving the **RANGE SELECTOR** switch one position clockwise each time, and holding the **PUSH TEST** button down for 3 seconds at each position.

When the LCD display shows an actual number, meaning the display changes from 1_ _ . to something like 3.9 or other, this is the result of the resistance of the soil. Do not move the **RANGE SELECTOR** switch any further.

Make note of the number displayed on the LCD meter.

The Wenner 4-PIN Method describes a formula to be used to convert these results into Ohm-cm. This formula is found in the ASTM G57-95(a) standard, as well as the *Peabody's Control of Pipeline Corrosion, 2nd Ed.*, pg. 87.

FORMULA:

The table below shows common distances and the multipliers to use for them.

COLUMN A		COLUMN B		
PIN SEPARATION (m)	MULTIPLIER	PIN SEPARATION (m)	MULTIPLIER	RESULT
5 ft. (1.52m)	957.5	5.2 ft. (1.58m)	1000	(Range Selector) x (Display)
10 ft. (3.05m)	1915	10.4 ft. (3.17m)	2000	(Range Selector) x (Display)
15 ft. (4.57m)	2872.5	15.7 ft. (4.79m)	3000	(Range Selector) x (Display)
20 ft. (6.10m)	3830	20.9 ft. (6.37m)	4000	(Range Selector) x (Display)
25 ft. (7.62m)	4787.5	26.1 ft. (7.96m)	5000	(Range Selector) x (Display)

NOTE: The middle column shows pin separations that are uncommon, but make the math much easier, as the multipliers are round numbers.

SAMPLE EQUATIONS:

Example Formula COLUMN A:

Using 5 ft. Pin Separation

Meter shows 37.9

Range Selector Switch
is in Ohm range (x1)

$(957.5) \times (1) \times (37.9) = 36,289.25 \text{ Ohm-cm}$
or 36.289 K ohm-cm

FORMULA:

$$\rho, \Omega \times \text{cm} = 2 \pi a R \text{ (a in cm)} = 191.5 a R \text{ (a in ft)}$$

R = average resistivity

Example Formula COLUMN B:

Using 10.4 ft. Pin Separation

Meter shows 0.39

Range Selector Switch
is in KOhm range (x1,000)

$(2000) \times (1000) \times (0.39) = 780,000 \text{ Ohm-cm}$
or 780K Ohm-cm

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a = pin separation

$\pi = 3.1416$

Reference: ASTM G57-95(a)

RANGE SELECTOR:

The **RANGE SELECTOR** switch has a lot of important information surrounding it, that the operator must be familiar with to use the Model SR-2.

The important things to know about the area around this switch, are:



RANGE: Ohms, KOhms, MOhms

Which area is the switch in? This information will help the operator in completing the formula for Ohm-cm.

Each position of the switch shows the **RANGE**, as well as the multiplier for that **RANGE**.

OHM= x1

KILOHM= x1,000

MEGOHM= x1,000,000

Always move the **RANGE SELECTOR** switch from left to right (clockwise), stopping as soon as the LCD display is showing an actual number.

Also, do not move from one position to the next faster than 3 seconds. The 3 second wait at each position is necessary to ensure a proper reading. As the operator changes the position of the **RANGE SELECTOR** switch, the instrument is taking reads, and this can have a small delay before the result is shown on the LCD display.

USE WITH A SOILBOX

Tinker & Rasor offers two styles of soilbox: Model SB-1 and SB-2.

Soilbox Model SB-1 conforms to ASTM G-57 standard. Per ASTM G57, section 3.4: when using the 4 Pin method on the SB-1, the multiplier is "1.349". This formula is the Resistance in ohms times the cross sectional area of the box, divided by the inner pin spacing.

When using the 2 Pin method on the Model SB-1, the multiplier is "1".

Soilbox Model SB-2 conforms to AASHTO T-288, Fig. 2. The standard describes the method for determining the multiplier to use in this application: 6.67 cm.

Soilboxes manufactured by a company other than Tinker & Rasor will use a multiplier determined by that manufacturing company. It may be necessary to contact that company to obtain the correct methodology and information.

DATA LOGGER:

The Model SR-2 has a convenient connection port for the Tinker & Rasor Model DL-1 Data Logger.

Connecting the Model DL-1 Data Logger to the Model SR-2, allows the operator to trap resistances within the DL-1 TRAC software.

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When connected, the DL-1 can be started and then stopped with each location where a test is run. The TRAC software will show all the tests that were conducted, with each start/stop data set represented as a unique sequence.

BATTERIES

The Model SR-2 has an internal 12volt, rechargeable battery and a replaceable 9volt battery.

If the internal 12v battery is low, the LED test indicator blink. This LED is located just above the **PUSH TEST** button. If this LED is lit, the instrument needs to be charged.

The battery charger plugs into the panel face of the Model SR-2, just above the **RANGE SELECTOR** switch. A **CHARGING INDICATOR** LED will light when the battery is being charged. The AC battery charger should fully charge the battery on an overnight charge. (8 – 10 hours).

Because the **PUSH TEST** button must be held down to operate, the unit cannot be left on and the battery drain is minimal.

The 9v battery may need to be replaced. The battery is accessed from the outside of the case. As you face the instrument, look on the Right side, below the panel level. You will see a black plastic battery holder. Using a small screwdriver or finger nail in the slot along the bottom, lift up and pull out the battery drawer. Replace the 9v battery, observing polarity.

In older units, up to Serial # 1097, to replace the 9v battery, the panel must be removed from the case. Two screws hold the panel to the case, one each side of the outside of the case (Left and Right). The screws are just below the panel level. Remove the screws and lift the panel off the case. The overlay membrane switch adheres to the case itself, and this will make the panel difficult to remove. Lift up and rotate the panel into the lid of the case. You will see the 9v battery clipped to a bracket. Carefully remove the battery connector and replace battery. Observe polarity when reconnecting the battery connector. Set panel back into place and replace screws.

CHARGING

The Model SR-2 comes with an AC (wall) battery charger. The charger automatically recognizes and uses 110v AC or 240v AC. The charger comes with the standard North American 110v wall plug. An adapter or different (local) cable is required to use with 240v AC.

Input: AC100 – 240V, 50/60Hz

Output: DC14.4V, 1.5A

REPAIR

Tinker & Rasor repair department has a 24-hour turn around on most repairs.

If you need to send an instrument in to our repair department, please visit us online and fill out our Repair Form, or call us for address information.

www.tinker-rasor.com

Info@tinker-rasor.com

WARRANTY:

This instrument is warranted against manufacturer defect for a period of ninety (90) days from purchase date. Please fill out and send in your Warranty Card, found inside the instrument lid.

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SPECIFICATIONS:

- SR-2 resistivity measurement range
 - 4 PIN Method 0.1 Ω to 3.3 M Ω .
 - 2 PIN Method 0.03 Ω to 10 M Ω
- Accuracy of measurements of 10% or better.
- Overload circuit that helps the user to identify the correct measurement range.
- Measurement results displayed on a LCD display.
- Unit operates from a 12V rechargeable battery.
- Soil Resistivity meter can be recorded on DL-1 data logger.
- Has Low Battery Voltage indicator.
- LED charging light indicator.

ACCURACY:

The reading accuracy is $\pm 10\%$ on full range and $\pm 5\%$ on 85% of measurement range, which can be verified by a decade box as required by ASTM G 57 – 95a Standard.

The instrument operates at 97Hz $\pm 10\%$ AC current as defined by the ASTM G 57 – 95a standard to prevent electrode polarization. The internal circuitry is designed in such way that it will reject any common mode noise and external EMI interference.

EXTERNAL REFERENCES:

- ASTM G57-95a Standard can be obtained by visiting www.astm.org.
- AASHTO T-288 a Standard can be obtained by visiting www.transportation.org
- NACE Internationals, "Peabody's Control of Pipeline Corrosion, Second edition", pages 84, 105 can be obtained by visiting www.nace.org

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TROUBLESHOOTING:

PROBLEM	CAUSE	SOLUTION
LCD Meter shows "0000" or a negative number "-1234"	<p>P1 or P2 connection error is the most likely cause.</p> <p>Another possible cause is a condition where the top soil is very dry, and the underlying soil is very wet.</p>	<p>Remove the cable for P1 from the instrument panel. LCD display reading should change. If no change, P1 has a bad connection to the soil.</p> <p>If the reading did change, remove the P2 cable from the instrument panel. LCD display reading should change. If no change, P2 has a bad connection to the soil.</p> <p>If the reading does not change, reset pin P1 in the ground and repeat test. If no change, reset P2 and repeat test. If no change, check connections between cable and pin, and cable on SR-2 for faults.</p> <p>If still no change, try moving all pins to a different line along the survey path. Perhaps moving only three or four inches one way or the other.</p> <p>Adding water around where the pins enter the soil might be useful as well.</p>
LCD Meter shows 1_ _ _ at each position of the RANGE SELECTOR switch	Soil resistance is out of range of SR-2. (Above 3 MOhm resistance)	<p>Move 2 PIN, 4 PIN METHOD switch to 2 PIN. If the LCD display shows 1_ _ _ . At all ranges, the connection for C1 or C2 is bad.</p> <p>Check C1 and C2 as described for P1 and P2 above.</p> <p>If no connection problems, the resistance is out of range (> 10 MOhm on 2 PIN, >3 MOhm on 4 PIN)</p>
LCD meter does not come on when PUSH TEST button is pushed.	9volt battery needs to be replaced.	<p>Locate the two black screws on the side of the instrument case. There is one screw on the left and one on the right of the case, just below the panel.</p> <p>Unscrew and remove each screw.</p> <p>Lift panel up and out of case.</p> <p>There may be some resistance, as the overlay adhesive has a bond with the case around the edge.</p> <p>This should not occur within the first year of operation. If it does, we recommend sending the instrument in to our repair department.</p>

DIAGRAM 1 (WENNER 4 PIN METHOD):

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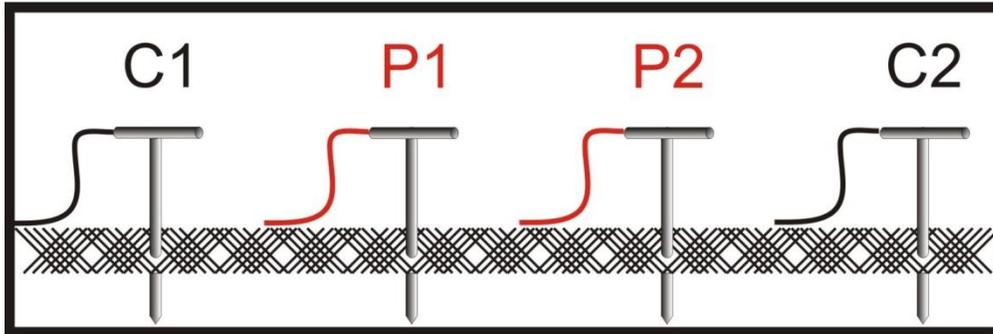
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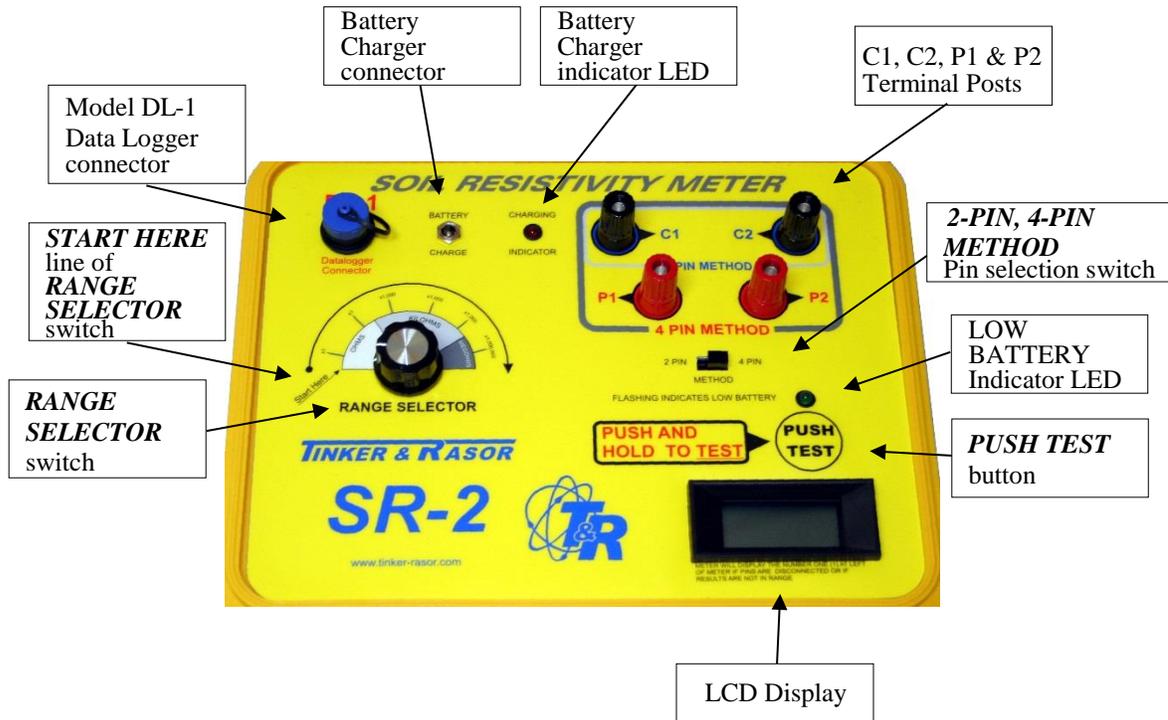
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PICTURE 1:



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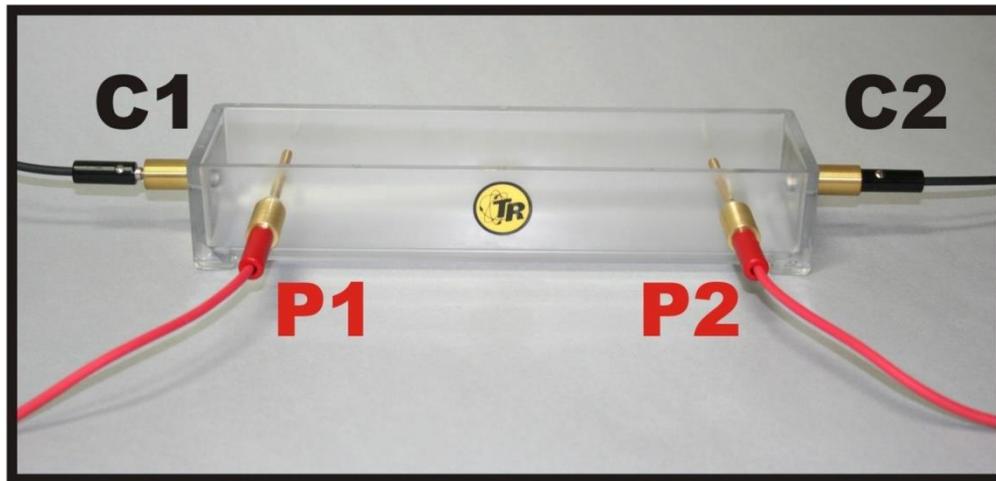
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Connection Diagram for using the Model SR-2 with the Model SB-1 Soilbox.



Model SB-1 multiplier for 4 Pin measurements is 1.349.

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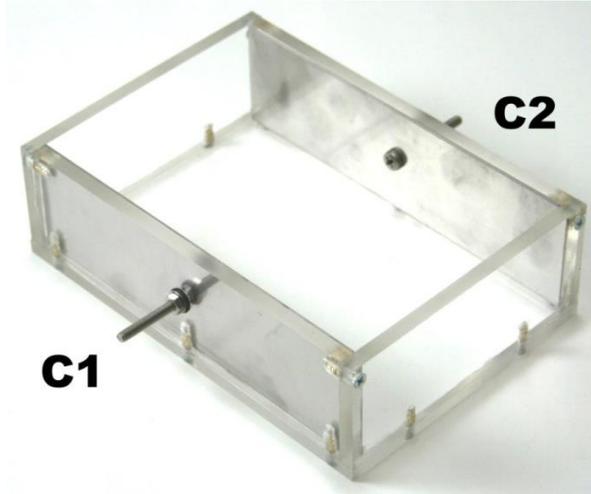
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Connection Diagram for using the Model SR-2 with the Model SB-2 Soilbox



When using this soilbox, the pin selection switch should be set to “2 PIN” method. As shown below. Model SB-2 multiplier per AASHTO T-288 is 6.67 cm

