

## Check out what else you can get from Martindale:

- 17th Edition Testers
- Accessories
- Calibration Equipment
- Continuity Testers
- Electricians' Kits
- Environmental Products
- Full Calibration & Repair Service
- Fuse Finders
- Digital Clamp Meters
- Digital Multimeters
- Labels
- Microwave Leakage Detectors
- Motor Maintenance Equipment
- Multifunction Testers
- Non-trip Loop Testers
- Pat Testers & Accessories
- Phase Rotation Testers
- Proving Units
- Socket Testers
- Thermometers & Probes
- Test Leads
- Voltage Indicators
- Specialist Metrohm Testers (4 & 5kV)
- Specialist Drummond Testers

 Metrohm®

Metrohm products are manufactured by Martindale Electric

Martindale Electric Company Limited  
Metrohm House, Penfold Trading Estate, Imperial Way, Watford WD24 4YY, UK  
Tel: +44(0)1923 441717 Fax: +44(0)1923 446900  
E-mail: sales@martindale-electric.co.uk  
Website: www.martindale-electric.co.uk



© 2011 Martindale Electric Company Ltd.  
Registered in England No. 3387451. E. & O.E. Rev3 LITE1612

# E1612 EARTH TESTER

## INSTRUCTION MANUAL



 Metrohm®



**GENERAL SAFETY INFORMATION:** Always read before proceeding.

#### Warning

These instructions contain both information and warnings that are necessary for the safe operation and maintenance of this product. It is recommended that you read the instructions carefully and ensure that the contents are fully understood. Failure to understand and to comply with the warnings and instructions can result in serious injury, damage or even death.

In order to avoid the danger of electrical shock, it is important that proper safety measures are taken when working with voltages exceeding 30V AC RMS, 42V AC peak or 60V DC.

This product must only be used by a competent person capable of interpreting the results under the conditions and for the purposes for which it has been constructed. Particular attention should be paid to the Warnings, Precautions and Technical Specifications. Always check the unit is in good working order before use and that there are no signs of damage to it. Do not use if damaged.

Where applicable other safety measures such as use of protective gloves, goggles etc. should be employed.

Please keep these instructions for future reference. Updated instructions and product information are available at: [www.martindale-electric.co.uk](http://www.martindale-electric.co.uk)

**REMEMBER: SAFETY IS NO ACCIDENT**

#### MEANING OF SYMBOLS:



Equipment complies with relevant EU Directives



Caution - risk of danger and refer to instructions



Caution - risk of electric shock



Equipment protected by double or reinforced insulation (Class II)



End of life disposal of this equipment should be in accordance with relevant Local Directives



Earth (ground)

 **Metrohm**<sup>®</sup>

Specification

E1612

Earth Tester

#### Accuracy:

**Earth Resistance:**  $\pm 2\%$  rdg  $\pm 3$ dgts

**Earth Voltage:**  $\pm 2\%$  rdg  $\pm 3$ dgts

#### Temperature & Humidity:

**Operating:** 0°C ~ 50°C 80% R.H

**Storage:** -10°C ~ 60°C 80% R.H

**Altitude:** up to 2000m

**Power:** 8 x 1.5V LR6/AA batteries

**Auto Off time:** Approx 2¼ minutes

**Dimensions:** 250(L) x 190(W) x 110(D) mm

**Weight:** Approx 1430g (batteries included)

#### Safety:

Conforms to BS EN 61010-1 CAT IV 300 V

Class II Double Insulation

Pollution Degree: 2

Test Leads supplied conform to BS EN 61010-031 CAT III 600V, 2A

**EMC:** Conforms to BS EN 61326

**Includes:** set of test leads with integral crocodile clips (red 15m, black 10m, yellow 10m and green 5m), carrying case. set of 4 x spikes, shoulder strap, 8 x 1.5V Alkaline batteries LR6/AA, spare F100mA 250V 5 x 20mm fuse, instructions.



Specification  
E1612  
Earth Tester



#### Measuring Ranges:

**Earth Resistance:**  $2\Omega$  /  $20\Omega$  /  $200\Omega$  /  $2k\Omega$

**Earth Voltage:** 0-300V AC

**Measurement Frequency:** 820 Hz

#### Earth Resistance Resolution:

**$2\Omega$  range:** 0.01 $\Omega$

**$20\Omega$  range:** 0.1 $\Omega$

**$200\Omega$  range:** 1 $\Omega$

**$2k\Omega$  range:** 0.01k $\Omega$

**Earth Voltage Resolution:** 1 V

## MEASUREMENT CATEGORY DEFINITIONS

**Measurement Category II (CAT II)** is applicable to test and measuring equipment connected directly to utilization points (socket outlets and similar points) of the low-voltage MAINS installation.

**Measurement Category III (CAT III)** is applicable to test and measuring equipment connected to the distribution part of the building's low-voltage MAINS installation.

**Measurement Category IV (CAT IV)** is applicable to test and measuring equipment connected at the source of the building's low-voltage MAINS installation. This part of the installation is expected to have a minimum of one level of over-current protective devices between the transformer and connecting points of the measuring circuit.

**Test Equipment Without A Rated Measurement Category (O)** is applicable to testing and measurement of circuits not connected directly to the MAINS supply. If test and measurement equipment does not have a CAT marking then it should be regarded as a maximum of 50V rating unless otherwise specified.

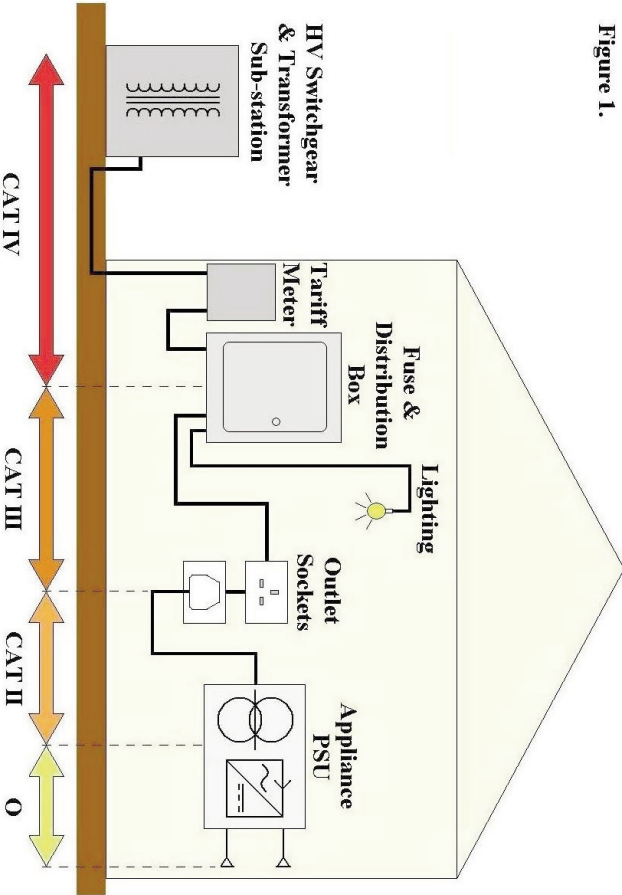


Figure 1.

**5. WARRANTY AND LIMITATION OF LIABILITY**

This Martindale product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is 2 years and begins on the date of receipt by the end user. This warranty extends only to the original buyer or end-user customer, and does not apply to fuses, disposable batteries, test leads or to any product which, in Martindale's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation, handling or storage.

Martindale authorised resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Martindale.

Martindale's warranty obligation is limited, at Martindale's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to Martindale within the warranty period.

This warranty is the buyer's sole and exclusive remedy and is in lieu of all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose. Martindale shall not be liable for any special, indirect, incidental or consequential damages or losses, including loss of data, arising from any cause or theory.

Since some jurisdictions do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any part of any provision of this warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision or other part of that provision.

Nothing in this statement reduces your statutory rights.

#### 4.4 Cleaning

The unit may be cleaned using a soft dry cloth. Do not use moisture, abrasives, solvents, or detergents, which can be conductive.

#### 4.5 Repair & Service

There are no user serviceable parts in this unit other than those that may be described in section 3. Return to Martindale Electric if faulty. Our service department will quote promptly to repair any fault that occurs outside the guarantee period.

Before the unit is returned, please ensure that you have checked the unit, batteries, use, leads and poor connections.

#### 4.6 Storage Conditions

The instrument should be kept in warm dry conditions away from direct sources of heat or sunlight, and in such a manner as to preserve the working life of the unit. It is strongly advised that the unit is not kept in a tool box where other tools may damage it.

**Thank you for buying one of our products. For safety and full understanding of its benefits please read this manual before use. Technical support is available from 01923 441717 and support@martindale-electric.co.uk.**

### CONTENTS

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Inspection	1
1.2	Description	1
1.3	Accessories	1
1.4	Battery Installation	1
<b>2</b>	<b>Product Specific Safety Information</b>	<b>2</b>
2.1	Precautions	2
<b>3</b>	<b>Operation</b>	<b>4</b>
3.1	General	4
3.2	Description of Terminals	4
3.3	Description of Press Buttons	4
3.4	Display and LED Indications	5
3.5	Preliminary Lead Check	5
3.6	Earth Voltage Measurement	5
3.7	Earth Resistance Measurement	6
<b>4</b>	<b>Maintenance</b>	<b>14</b>
4.1	Battery Replacement	14
4.2	Fuse Replacement	14
4.3	Calibration	14
4.4	Cleaning	15
4.5	Repair & Service	15
4.6	Storage Conditions	15
<b>5</b>	<b>Warranty</b>	<b>16</b>
	<b>Specifications</b>	

## 1. INTRODUCTION

### 1.1 Inspection

Examine the shipping carton for any sign of damage. Inspect the unit and any accessories for damage. If there is any damage then consult your distributor immediately.

### 1.2 Description

The E1612 is an earth resistance tester with the following features:

- Microprocessor controlled with advanced safety features
- Large LCD display
- Earth resistance auto ranging, 0-2 kΩ in 4 ranges
- Earth voltage measurement: 0-300Vac
- 2, 3 & 4 pole test modes selectable.
- Auto power off
- Indoor and outdoor use

### 1.3 Accessories

The following accessories are supplied with the E1612:


- Set of test leads with integral crocodile clips (red 15m, black 10m, yellow 10m and green 5m)
- Carrying case
- Set of 4 x spikes
- Shoulder strap
- 8 x 1.5V Alkaline batteries LR6/AA
- Spare F100mA 250V 5 x 20mm fuse
- Instructions

### 1.4 Battery Installation

Refer to Section 4.1 (Battery Replacement) for the battery installation instructions for the E1612.

## 4. MAINTENANCE


### 4.1 Battery Replacement


 To avoid shock or injury, disconnect the earth resistance tester from any external circuits and remove the test leads before proceeding.

The battery compartment is underneath the unit and can be accessed by undoing the 2 screws. Fit 8 new 1.5V LR6/AA batteries. Replace the battery cover and screws.

**Note:** Do not mix old and new batteries.

### 4.2 Fuse Replacement

 To avoid shock, injury or damage to the earth resistance tester, disconnect it from any external circuits or components and remove the test leads and batteries before proceeding.

 Replace only with the fuse specified.

The fuse is inside the battery compartment. The battery compartment is underneath the unit and can be accessed by undoing the 2 screws. Replace only with the original type F100mA 250V 5 x 20mm fuse. Replace the battery cover and screws.

### 4.3 Calibration

To maintain the integrity of measurements made using your instrument, Martindale Electric recommends that it is returned at least once a year to an approved Calibration Laboratory for recalibration and certification.

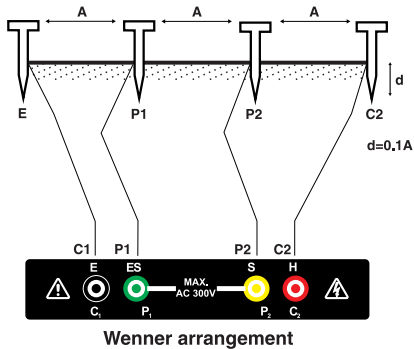
Martindale Electric is pleased to offer you this service. Please contact our Service Department for details.

Email: [service@martindale-electric.co.uk](mailto:service@martindale-electric.co.uk)

Tel: 01923 650660

whether there are distinct layers of soil or rock and this gives an idea of their respective resistivities and depth.

**Figure 9**



## 2. PRODUCT SPECIFIC SAFETY INFORMATION

### 2.1 Precautions

This product has been designed with your safety in mind, but please pay attention to the following warnings and cautions before use.

#### **Warning**

Before use check the unit for cracks or any other damage. Make sure the unit is free from dust, grease and moisture. Also check any associated leads and accessories for damage. Do not use if damaged.

#### **Warning**

Do not use if the battery/fuse cover is not fitted.

#### **Warning**

When this unit is used in combination with test leads, the measurement category of the combination is the lower measurement category of either this unit or the test leads used. Likewise if test lead accessories such as crocodile clips are also used, the measurement category will be the lowest measurement category in that combination.

#### **Warning**

Always test this unit on an appropriate proving device or a known voltage source before using it to determine if a hazardous voltage exists in a circuit to be tested.

#### **Warning**

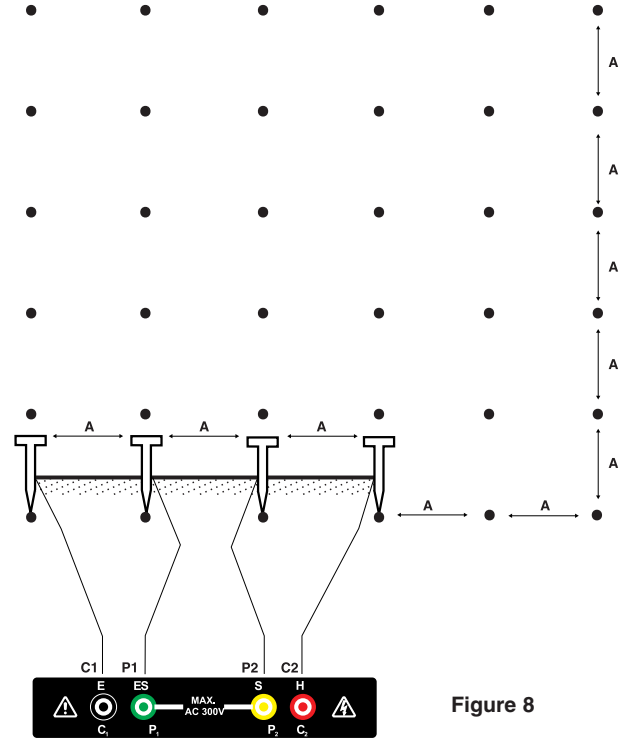
When using the integral lead/crocodile clip set provided always keep your fingers behind the crocodile clip finger guards.

**⚠ Warning**

Measuring a voltage that exceeds the specified limits of the unit may damage the unit and expose the operator to a shock hazard. Always check the unit's specified limits before use.

**⚠ Caution**

Avoid severe mechanical shock or vibration and extreme temperature.



**Figure 8**

**Finding the region of lowest resistivity**

This gives approximately the average soil resistivity to the depth 'A'. If the spacing and depth of the test spikes are maintained and further readings are taken as shown in the diagram below, the region of lowest resistivity can be found over a given area. Extra sets of readings taken with different test spike spacing's give a set of resistivities which, when plotted against spacing, indicate

For most purposes the current spike should be placed 30 to 50m from the earth electrode under test. The potential spike should be inserted in the ground at 62% of this distance, measured from the earth electrode and in a straight line with the earth electrode and current spike. For greater accuracy an average reading can be calculated by moving the current spike C2 10m either side of its original position, also moving the potential spike P2 relative to the earth electrode to maintain 62% of the distance between the earth and current electrodes, and making further measurements.

### Soil Resistivity

The techniques for measuring soil resistivity are essentially the same whatever the purpose of the measurement, i.e. finding the best site to sink an electrode, geophysical prospecting or archaeological surveys. However the interpretation of the recorded data can vary considerably, especially where soils with non uniform resistivities are encountered. The added complexity caused by non uniform soils is common, and in only a few cases are soil resistivities constant with increasing depth. Earth resistivity not only varies with the type of soil but also with temperature, moisture content, salt content and compactness. Therefore it is essential that the soil resistivity is checked prior to siting an electrode and periodically thereafter.

The most common method of measuring earth resistivity is the equally spaced or Wenner Arrangement (see next page). With this method the electrodes are arranged in a straight line, equally spaced at intervals 'A' and driven to a depth not exceeding 0.1A. The tester is operated and a resistance measurement taken. The soil resistivity  $\rho$  can be calculated from the formula  $\rho=2\pi AR$  where 'A' is the distance between the test spikes and R is the resistance reading.

## 3. OPERATION

### 3.1 General

For safety and measurement accuracy only the lead set supplied with the E1612 should be used.

The measured results may be influenced by induction if measurements are made with the test leads twisted together. When making connections they should be separated.

If **Battery: Low** is displayed on the LCD after the E1612 has been turned on, or at any time during use, replace the batteries as (see section 4.1).

### 3.2 Description of Terminals

E / C1	Terminal for the earth electrode (black test lead).
ES / P1	Terminal for the probe placed nearest to the earth electrode (green test lead).
S / P2	Terminal for a probe (yellow test lead).
H / C2	Terminal for the auxiliary earth electrode (red test lead).

### 3.3 Description of Press Buttons

2P	Selects 2 pole earth resistance measurement mode.
3P	Selects 3 pole earth resistance measurement mode.
4P	Selects 4 pole earth resistance measurement mode.
ACV	Selects AC voltage measuring function to check earth voltage.
ON/OFF	Turns on/off the E1612.
TEST/STOP	Starts and stops earth resistance and earth voltage measurements.

### 3.4 Display and LED Indications

Battery: Low	Indicates the batteries need to be replaced. (See 4.1). The battery level in volts is normally indicated.
Rc/Rc Error	Check the auxiliary earth spikes are connected correctly.
Rp	The Rp LED indicates an earth resistance > 2kΩ. The LCD will display > 2kΩ.
Vp Error	When making a '4P measurement', if the LCD shows 'Vp Error' short circuit C1 (black) and P1 (green).

### 3.5 Preliminary Lead Check

Prior to use it is advisable to check the integrity of the test leads. This is accomplished as follows:

Connect the P1 (green) and P2 (yellow) potential leads to their respective sockets on the E1612 and short them together. On the E1612 press ON/OFF to turn the unit on, press 2P and TEST/STOP. If the LCD displays Rc Error, a potential lead is open circuit.

Connect the C1 (black) and C2 (red) current leads to their respective sockets on the E1612 and short the P1, P2, C1 and C2 leads together. On the E1612 press 4P and TEST/STOP. If the LCD displays Rc Error, a current lead is open circuit.

### 3.6 Earth Voltage Measurement

Connect the test leads as shown in figure 2 or on the inside of the E1612 lid. On the E1612 press ON/OFF to turn the unit on, press ACV and TEST/STOP. The earth voltage will be displayed.

**Note:** An earth voltage greater than 10V may result in errors in the earth resistance measurement. Make sure that the earth voltage is less than 10V.

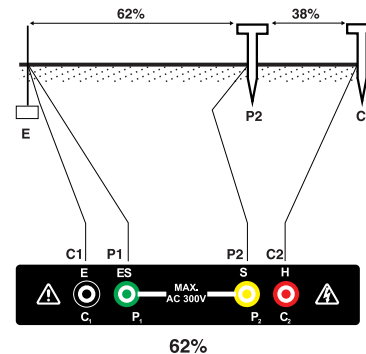
**⚠️ AFTER COMPLETION OF TESTING ENSURE THAT THE EARTHING CONDUCTOR IS RECONNECTED**

### The 62% Rule

The measurement technique is essentially the fall of potential method. If the readings using the method differ beyond the required accuracy then the 62% rule can be used. The 62% rule states that the true resistance of the earth electrode is equal to the measured resistance when the potential spike is positioned 62% of the distance between the earth electrode and the current spike, away from the earth electrode. This rule only applies when the earth electrode and both the current and potential spikes are in a straight line, the soil is homogeneous and the earth electrode has a small resistance area.

Bearing in mind these limitations this method can be used on small earth systems consisting of single rod or plate and on medium systems using several rods. The connections and layout for the 62% rule are shown below.

Figure 7



The distance between the test spikes is important. If they are too close together, their resistance areas will overlap. In general, reliable results may be expected if the distance between the electrode under test and the current spike is at least ten times the maximum dimension of the electrode system, e.g. 30m for a 3m long electrode.

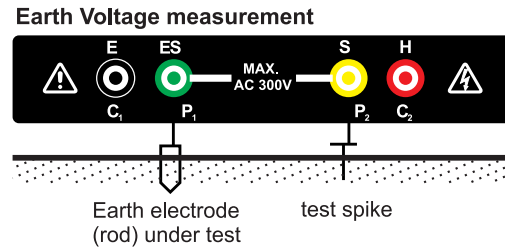
Three readings are taken; firstly the potential spike initially midway between the electrode and current spike, secondly at a position 10% of the electrode-to-current spike distance back towards the electrode and finally, at a position 10% of the distance towards the current spike.

By comparing the three readings, a percentage deviation can be determined. This is calculated by taking the average of the three readings, finding the maximum deviation of the readings from this average in ohms, and expressing this as a percentage of this average.

The accuracy of the measurement using this technique is typically 1.2 times the percentage deviation of the readings. It is difficult to achieve a measurement accuracy better than 2%, and inadvisable to accept readings that differ by more than 5%. To improve the accuracy of the measurement to acceptable levels, the test must be repeated with a larger separation between the electrode and the current spike.

If the temporary spike resistance is too high, measures to reduce the resistance will be necessary, such as driving the spikes deeper into the ground, or watering with brine to improve contact resistance. In no circumstances should these techniques be used to temporarily reduce the resistance of the earth electrode under test.

Figure 2



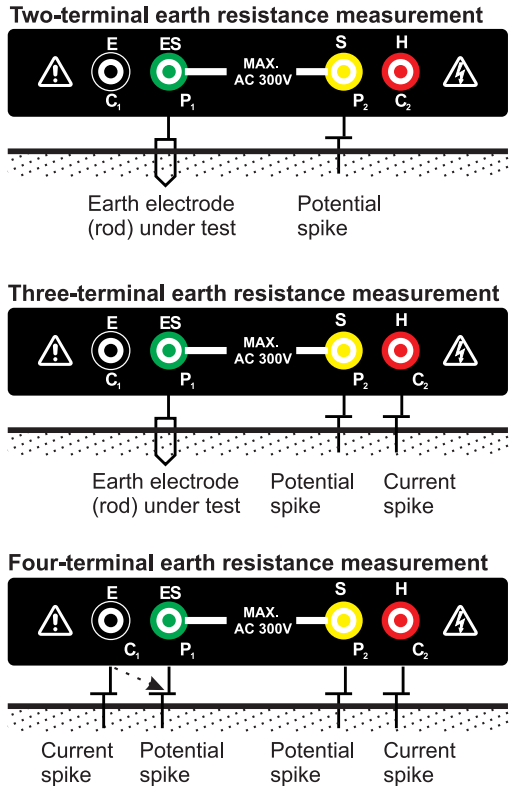
### 3.7 Earth Resistance Measurement

Connect the test leads as shown in figures 3, 4 and 5 or the inside of the E1612 lid for the earth resistance measurement type being made (2P, 3P or 4P). Also refer to IEE guidance note 3 for the positioning of spikes.

Press 2P, 3P or 4P to select the measurement type, then TEST/STOP. The earth resistance will be displayed.

**Note:** When making a '4P measurement', if the LCD shows 'Vp Error', short circuit C1 (black) and P1 (green).

Figure 3, 4 and 5



IEE Guidance note 3 specifies the method for testing the resistance of earth electrodes, "before this test is undertaken, the earthing conductor to the earth electrode must be disconnected either at the

electrode or the main earthing terminal to ensure that all the test current passes through the earth electrode alone. This will leave the installation unprotected against earth faults."

 SWITCH OFF SUPPLY BEFORE DISCONNECTING THE EARTH.

The test requires the use of two spikes (electrodes) and is carried out in the following manner:

Connection to the earth electrode is made using terminals C<sub>1</sub> and P<sub>1</sub> of a four terminal earth tester. To exclude the resistance of the test leads from the resistance reading, individual leads should be taken from these terminals and connected separately to the electrode as shown. If the test lead resistance is insignificant, the two terminals may be short-circuited at the tester and connection made with a single test lead. Connection to the temporary spikes is made as shown on the next page.

Figure 6

