AECT 12

Smart Earth Clamp Tester

CONTENT

Precautions for Use

Thank you for purchasing this Clamp earth resistance tester of Agam from Shanti Instruments. In order to better use for the product, please be certain:

----Read this user manual carefully.

----Comply with the operating cautions presented in this manual.

- Under any circumstances, user should pay special attention to safety.
- Pay attention to the measuring range and operating environment specified in this tester. Do not clamp and test power line.
- Pay attention to the text labeled on the panel and backplane of the meter.
- Before boot up, withhold the trigger once or twice to ensure the jaws are closed well.
- In booting up, do not withhold the trigger, nor clamp any wires.
- In normal boot up, display "OL Ω" symbol, and then clamp and test the measured object.
- The clamp contact surfaces must be kept clean, cannot rubbed with caustics and coarse material.
- Avoid any impact onto this meter, especially the Jaw contact surface.
- In dangerous/hazardous site, it is strongly recommended to not use this meter
- It is normal that the meter clamp will have some buzzing sound in measuring resistance, pay attention to the difference from alarm "beep, beep, beep -" sound.
- Please take out the batteries if the meter will not be used for a long time.
- Disassembly, calibration, and repair of this tester must be performed by authorized personnel.

1. Introduction

AECT 12 Clamp Earth Resistance Tester is widely used in the grounding resistance measurement of the power, telecommunications, meteorology, oilfield, construction and the industrial and electrical equipment. In the measurement of a grounding system with loop, does not require breaking down the grounding down lead, and no need the auxiliary grounding electrode. It is safe, fast and simple in use. The tester can measure ground faults which cannot be measured by traditional methods. It can be used in applications where traditional methods cannot measure, because the AECT 12 clamp grounding resistance meter measures the combined value of grounding body resistance and grounding lead resistance.

AECT 12 Clamp Earth Resistance Tester is a

- Breakthrough in self-test fast booting, start immediately into the test.
- Breakthrough relay self-test mode, using the most advanced processing algorithms and digital integration technology.
- New design, panel operation with 6 buttons, better performance.
- Increase sound and light alarm function, with "beep-beep-beep" alarm sound. Increase the interference signal recognition indicator function, with "beep-beep-beep" indicator
- Measurement range: 0.01Ω-1500Ω
- Stored data 99 Units
- Lower power consumption, Maximum operating current less than50mA.

2. Specification

2.1. Model Details

Model AECT 12	Jaw size (mm)	Resistance Range (Ω)	Storage	Alarm
	Φ65×32	0.01-1500	99sets	1-199Ω

2.2. Ranges & Accuracy

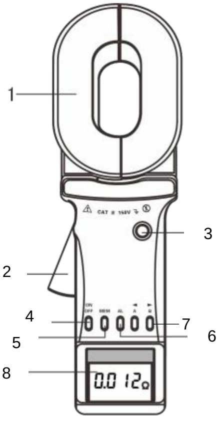
Mode	Range	Resolution	Accuracy
Resistance	0.010Ω-0.099Ω	0.001Ω	±（1%+0.1Ω）
	0.10Ω-0.99Ω	0.01Ω	±（1%+0.1Ω）
	1.0Ω-49.9Ω	0.1Ω	±（1%+0.5Ω）
	50.0Ω-99.5Ω	0.5Ω	±（1.5%+0.5Ω）
	100Ω-199Ω	1Ω	±（2%+1Ω）
	200Ω-395Ω	5Ω	±（5%+5Ω）
	400-590Ω	10Ω	±（10%+10Ω）
	600Ω-880Ω	20Ω	±（20%+20Ω）
	900Ω-1500Ω	30Ω	±（25%+30Ω）

2.3. Specifications

Resistance Range	0.01Ω-1500Ω
Resistance Resolution	0.001Ω
Data Storage	99 groups
Audio - light alarm	"beep--beep--beep --" alarm sound. Press “AL” key to turn on and off
Alarm Critical Value Setting Range	Resistance:1-199Ω
Power	6VDC (4 PCS alkaline dry battery)
Working Temp	-20℃-55℃；10%RH-90%RH
LCD Screen	4-bit LCD digital display， 47mm(L) × 28.5mm(W)
Jaw Size(mm)	Long-jaw 65mmX32mm
Open Size of Jaw(mm)	Long clamp 32mm
Weight	Long jaw 1100 g (including battery)
Meter Size	Long jaw:285mm(L)x85mm(W)x56 mm(H)

Protection Level	Double insulation
Structure	Clamp CT
Shift	Automatic shift
External Magnetic Electric field	＜40A/m；＜1V/m
Single Measurement Time	0.5 s
Resistance Measurement Frequency	＞1KHz
Measured Current Frequency	50/60hz automatically

3. Meter Structure



3.1. Long Clamp Jaw: 65mmx32mm

3.2. Trigger: control the draw open and close

3.3. HOLD Key: Lock / Release display / Storage

3.4. ON/OFF Key: Boot Up / Shutdown /Quit /Clear Data

3.5. MEM Key: Data Access / Clear Data

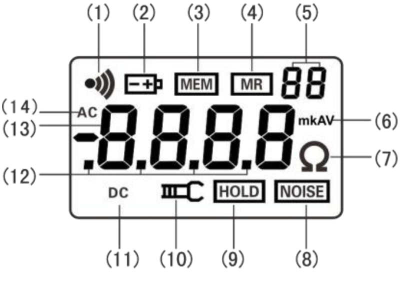
3.6. AL Alarm Function Key: Alarm Open / Turn Off / Alarm Critical Value Setting

3.7. Resistance Measure Switch Key Ω /Right Arrow Key

3.8. Liquid Crystal Display (LCD)

4. Liquid Crystal Display

4.1. LCD Screen



4.1.1. Alarm symbol

4.1.2. Low battery voltage symbol

4.1.3. Full data storage symbol

4.1.4. Data access symbol

4.1.5. 2-Digital No. of data storage unit

4.1.6. Current 、voltage unit symbol

4.1.7. Resistance unit symbol

4.1.8. Noise signal symbol

4.1.9. Data lock symbol

4.1.10. Open jaw symbol

4.1.11. Direct current symbol

4.1.12. Metrication decimal point

4.1.13. 4-digit LCD figures display

4.1.14. AC Symbol

4.2. Description of Special Symbols

4.2.1. Jaw opening symbol: This symbol is displayed when the jaw is opening. At this point, trigger may be artificially withheld, or the jaw has been seriously polluted. It cannot continue to measure.

4.2.2. "**Er**" Boot error symbol: May be withheld the trigger when boot up or the jaw have open.

4.2.3. Low battery voltage symbol: when the battery voltage is lower than 5.3V, the symbol will show. At this time, it cannot guarantee accuracy of the measurement. It should be replaced the battery.

4.2.4. "**OL Ω**" Symbol indicates that the measured resistance has exceeded upper limit range of the meter.

4.2.5. "**L0.01Ω**" Symbol indicates that the measured resistance has exceeded lower limit range of the meter.

4.2.6. Alarm symbol: When the measured value is bigger than the setting alarm critical value, the symbol will flash. The meter issue by intermittent "beep--beep –beep--" sound.

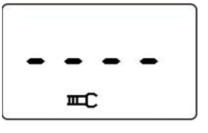
4.2.7. **MEM** Full data storage symbol: storage data is full of 99 units, it cannot continue to store data. **MEM** symbol will flash.

4.2.8 **MR** Data access symbol: display in accessing data, at the same time display the serial number of the stored data.

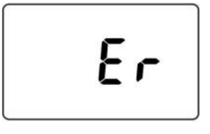
4.2.9. **NOISE** symbol: This symbol flashes when the grounded circuit with a large interference current in testing. The meter emits "beep--beep--beep--" prompt sound. The accuracy of the test cannot be guaranteed at this time.

4.3. Examples Illustrated

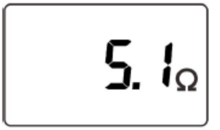
4.3.1. -- Jaw is in open state, and cannot measure



4.3.2. -- Boot up error instructions Er (Error)



4.3.3. -- Measured loop resistance is less than 0.01Ω



4.3.4. -- Measured loop resistance is 5.1Ω

4.3.5. -- Measured loop resistance is 2.1Ω

--Lock the present measurement value: 2.1Ω

--Auto storage as the 08 group of data

4.3.6. -- Reading stored data of group No.26

-- Measured loop resistance is 0.028Ω

4.3.7. -- Reading stored data group No.8

--Measured resistance is 30.0Ω

--This data was measured in a larger signals interference

5. Operating Method

5.1. Start Up

	In booting, user cannot withhold the trigger ,cannot open jaw, and cannot clamp any wires
	After boot up and display “OL Ω”, then withhold the trigger, open jaws and clamp the measured wire
	Before booting up, the trigger should withhold one or two times to ensure the jaws are well closed.
	In booting, must be sure to keep the natural static state of the Meter; do not overturn the Meter, nor impose any external force on the clamp. Otherwise, the accuracy of measurement cannot be guaranteed.

Press **ON/OFF** key, and the meter switches into boot-up state, automatically test's LCD at first and display all symbols as figure 1. Then after automatic calibration boot-up will display "OLΩ" and automatically enters the resistance measurement model as figure 2

2. If automatic calibration does not happen in normal boot up, the Er symbol displays which means meter will display error in boot up as figure3:

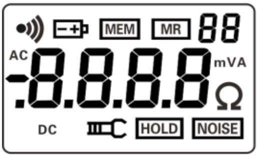


Figure1

Figure2

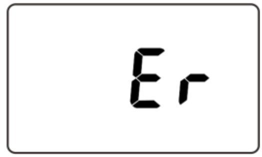


Figure3

Boot up error need to inspect the problem and then reboot it up.

If there was not an **OLΩ** appearing after auto-inspection, but a larger resistance value displayed, as shown in figure 4; But the test loop detection can still get correct result. This shows that the meter has a larger error only in measuring the large resistance (e.g. more than 100Ω), whereas in measuring the small resistance, and can still keep the original accuracy, users can be rest assured in use.

Figure4

5.2. Shutdown

After the meter is switched on, press **ON/OFF** Key to shut down.

After the meter is started up, 5 minutes later, the LCD screen enters flashing state, and would automatically shut down after the flashing state is sustained for 30 seconds to reduce battery consumption. Press **ON/OFF** key in flashing state which delays the shutdown and keep it working.

In **HOLD** state, it is required to first press **HOLD** key or Power key to quit from the **HOLD** state, then press **ON/OFF** key to shut it down.

In state of setting alarm critical value, user should first to press **ON/OFF** key or **AL** key for 3 secto quit from the state, then press **ON/OFF** key to shut it down.

5.3. Resistance Measurement

After the booting and auto-inspection, display "OL Ω" and will be able to proceed with resistance measurement. At this point, press the trigger and open the jaws, clamp the measured loop, reading and getting the resistance value.

If user thinks it necessary, the test can be done with the test ring as shown in the following figure. It shows value should be consistent with the normal value on the test ring (5.1 Ω).

(User uncertainty the meter could normal work or not, could refer and judge with this method). The normal value on the test rings is the value at a temperature of 20 °C

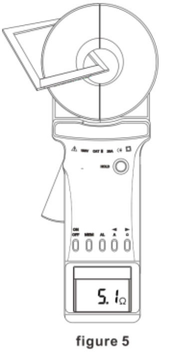


figure 5

It is normal to find the difference of 1 unit between the show value and the nominal value. E.g.: If the nominal value of test ring is 5.1 Ω, it would be normal with showing 5.0 Ω or 5.2 Ω.

Display "OL Ω", indicate that the measured resistance value exceeded the upper limit range of Meter, refer figure 3.

Display "L0.01Ω", indicate that the measured resistance value exceeded the lower limit range of Meter, refer figure 6.

Figure 6

Flashing display symbols •))), go with intermittent "beep--beep--beep--" sound, indicate that the measured resistance exceeds alarm critical value of the resistance.

In **HOLD** state, it is required to press **HOLD** key to quit the **HOLD** state, then continue to measure.

In **MR** state, it is required press **MEM** key to exit the **MR** state, then continue to measure.

In setting Alarm Critical Value state, user need to press the **ON/OFF** key or press the **AL** key for 3 seconds and exit from Alarm Critical Value state, then continue to measure.

5.4 Data Lock/Release/Storage

In test meter, press **HOLD** key to lock the present display value and display **HOLD** symbol.

This lock value is automatically numbered and stored as a set of data. Then press **HOLD** key to

release locking, **HOLD** symbol would disappear and return to measurement state. By repeating the above operations, it can store 99 sets of data. If the memory is full, the **MEM** symbol will flash display.

As indicated in figure 9, lock the measured resistance 0.016Ω, and save it as data unit No.1. As indicated in figure 10, lock the measured current 278mA, and save it as data unit No.99.

If the storage is full, the **MEM** symbol flashes.

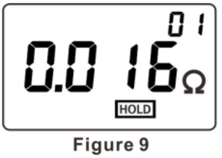


Figure 9

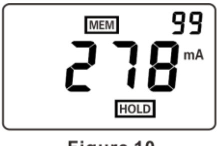


Figure 10

In the data reading mode, user should press **MEM** key to quit from data reading, and then lock and save data.

In setting Alarm Critical Value state, press the **ON/OFF** key or press the **AL** key for 3 seconds, to quit from alarm critical value state, then it can lock and store the data.

Switching on after shutdown will not lose the saved data.

5.5. Data Access

Press **MEM** key to enter into reading data storage mode and the default display 01 set of data, as shown in figure 11 will appear. Then press the right arrow keys to read the data stored and press the left arrow key, scrolling down to the data stored. If there is no stored data, display shown in Figure 12 appears.

Figure 11

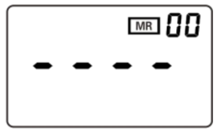


Figure 12

In setting alarm critical value state, press the **ON/OFF** key or press the **AL** key for 3 seconds, quit from alarm critical value state, then press **MEM** key to enter data storage mode.

5.6. Alarm Setting

In the meter, press **AL** key to turn on or shutdown alarm function.

In meter, press **AL** key for 3 secs and enter into the setting function of alarm critical value. At this point, the highest-digit begins to flash. First set the highest digit as indicated in figure 13 and figure 14. Press **AL** key to switch from high to low digits. As the current figure flashes, press left or right arrow key to change the figures of "0, 1…9 "; After setting all the digits,press **AL** key for 3 seconds to confirm the alarm critical value current setting. Successful setting would open alarm function, and then automatically return to the measurement mode. If the load is greater than the alarm critical value, the instrument will flash and display alarm symbol, and emit intermittent

“beep--beep--beep--" sound.

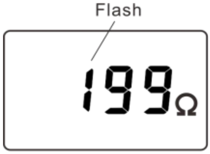


Figure13 The threshold setting of resistance alarm

In setting process, press **ON/OFF** key to quit from alarm critical value setting function, returning to measurement state, and it will not change the previous setting value.

In data reading, press **MEM** key to quit from data reading state, then can set alarm critical value operation.

5.7. Alarm Critical Value Check

In test mode, press down **AL** key for 3 seconds and enter into the alarm critical value checking, which will flash highest digit number. Tthe value check each time is that setting in the last time. Press **AL** key 3 seconds or **ON/OFF** key to quit from the check state and return to the measurement state.

Figure 15

As figure 15, the alarm critical value of resistance set in the last time was 20Ω.

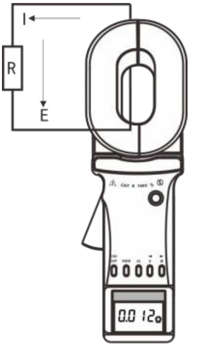
5.8. Clear Data

In data reading mode, press **MEM**+**ON/OFF** combination key, it automatically clears all the stored data. After clearing, it shows as Figure 12. The data can't be restored after clear.

6. Measurement Principle

6.1. Resistance Measurement Principle

The basic principle of **AECT** in the measurement of resistance is to measure the loop resistance, as shown in the figure. The jaw part of the Meter is comprised of voltage coil and current coil. The voltage coil provides excitation signal. It will induce a potential E on the measured loop.



Under the action of electric potential E will have a current in the circuit to be tested, The Meter will measure E & I.

The measured resistance R can be obtained by the following formula.

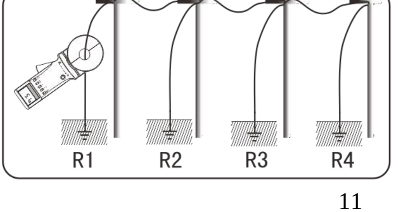
$$R = \frac{E}{I}$$

7. Earth Resistance Measurement Methods

7.1. Multi- point Grounding System

As for the multi-purpose grounding system (such as electricity transmission tower grounding system, grounding cable communications systems, certain buildings, etc.), they usually pass the overhead ground wire (cable shielding layer) connected to form a grounding system.

As the Meter is in the above measurement, its equivalent electric circuit is shown in the figure below fig:



Where: R_1 is the predicted grounding resistance.

R_0 for all other equivalent resistance after the tower grounding resistance in parallel.

Although strictly on the theoretical grounding, because of the existence of so-called "mutual resistance”, $\mathbf{R_0}$ is much smaller than R_1. Therefore, it can be justified to assume $\mathbf{R_0}=0$ from an engineering perspective. In this way, the resistance we measured should be R1.

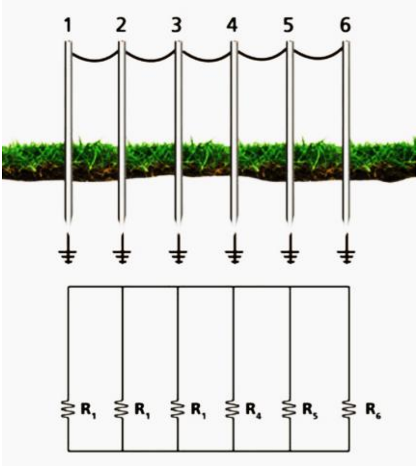
Times of comparing tests in different environments and different occasions with the traditional method proved that the above assumption is entirely reasonable.

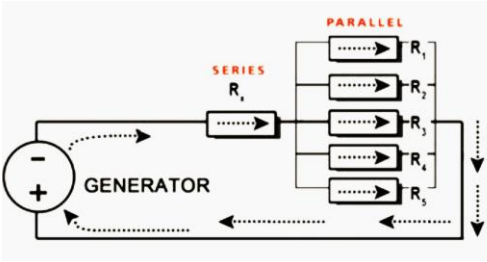
The important thing to remember with clamp testing is that clamp ground testers effectively make loop resistance measurements. Clamp measurements are loop measurements. For the clamp method to work there must be a series- parallel resistance path

The following figure shows a pole ground configuration, one of the most effective applications of the clamp ground tester. Figure shows– Pole ground configuration

The circuit diagram for this configuration follows

(based on a clamp ground tester being clamped around pole 6):





The clamp ground tester is clamped around one of the electrodes and then measures the resistance of the entire loop. The remaining ground electrodes are all in parallel, and, as a group, are in series with the ground electrode being measured. **If the clamp tester is clamped around pole #6**, the measurement of the resistance of the entire loop would be calculated using the following equation:

$R_{loop} = R_6 + (1/ (1/R_1 + 1/R_2 + 1/R_3 + 1/R_4 + 1/R_5))$

For six similar ground electrodes with a resistance of **10 Ω each**, the measurement of the total loop resistance would be:

$R_{loop} = 10 + (1/ (1/10 + 1/10 + 1/10 + 1/10 + 1/10))$

$R_{loop} = 10 + (1/ (5/10))$

$R_{loop} = 10 + 2$

$\mathbf{R_{loop} = 12\ \Omega}$

The measurement of the loop resistance is relatively close to the resistance of the ground electrode being tested. If there were 60 similar ground electrodes with a resistance of **10 Ω each**, the measurement of the total loop resistance would be:

$\mathbf{R_{loop}} = 10\ \Omega + 0.17\ \Omega = 10.17\ \Omega$

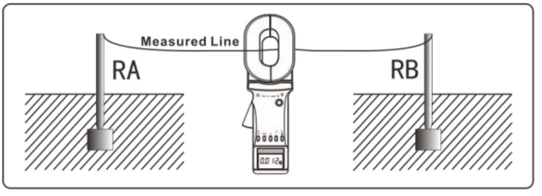
So larger the number of earth rods connected in parallel, the better is the result.

7.2. Single-Point Grounding System

From the measuring principle, **AECT** 12 Meter can only measure the loop resistance, the single-point grounding is not measured. However, users are able to use a testing line very near to the earth electrode of the grounding system to artificially create a loop for testing. The following presented is two kinds of methods for the single-point grounding measurement by use of the Meter. These two methods can be applied to the occasions beyond the reach of the traditional voltage-current testing methods.

7.2.1. Two-Point Method

As shown in the figure below, in the vicinity of the measured grounding body $R_{A,}$ find an independent grounding body of better grounding state R_B (for example, near a water pipe or a building). R_A and R_B line will connect to each other using a single testing line.



As the resistance value measured by the Meter is the value of the series resistance from the testing line and two grounding resistances.

R_T=R_A + R_B + R_L

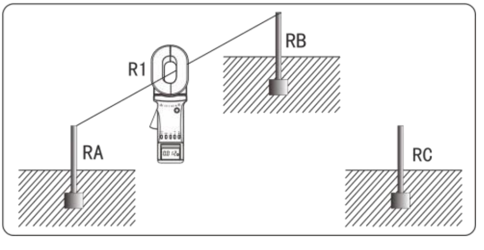
Where: R_T is the resistance value measured with the Meter.

R_L is the resistance value of the testing line. Meter can measure out the resistance value by connecting the test lines with both ends. So, if the measurement value of the Meter is smaller than the allowable value of the grounding resistance, then the two grounding bodies are qualified for grounding resistance.

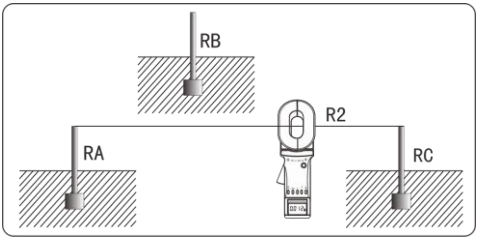
7.2.2. Three-Point Method

As shown in the figure below, in the vicinity of the measured grounding body $R_{A,}$ find two independent grounding bodies of R_B and $R_{C.}$

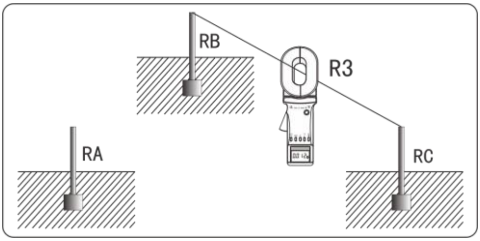
First, connect the R_A and R_B with a test line; use the Meter to get the first reading R_1.



Second, connect with the R_C and R_A , as shown in the following figure. Use the Meter to get the second reading R_2.



Third, connect with the R_B and R_C, as shown in the following. Use the Meter to get the third reading R_3.



In the above three steps, the reading measured in each step is the value of the two series grounding resistance. In this way, we can easily calculate the value of each grounding resistance:

From: R1=RA+RB R2=RB+RC R3=RC+RA We

get: RA=（R1+R2-R3）÷2

This is the grounding resistance value of the grounding body R_A. To facilitate the memory of the above formula, these three grounding bodies scan be viewed as a triangle; The measured resistance is equivalent to the value of the resistance values of the adjacent edges plus or minus resistance value of the opposite sides, and divided by 2.

As the reference points, the grounding resistance values of the other two grounding bodies are:

RB=R1-RA RC=R3-RA

8. Field Application

8.1. Application in power system

8.1.1. Transmission line tower grounding resistance measurement

Normally, the tower of transmission line connects to the earth to form multi point grounding system, using AECT 12 clamp meter to clamp the grounding line. Meter can measure the grounding resistance of the branch circuit.

8.1.2. Transformer neutral point grounding resistance measurement

There are two situations for transformer to connect the grounding line: Earth to form multi point grounding resistance; single point grounding measurement for single point grounding.

When measuring, if the meter shows "L 0.01Ω" it can be because there are two or more grounding line of transformer connected underground. At this time, user should release the redundant grounding line and just remain one.

8.1.3. The application in power station, power substation

AECT 12 clamp meter can use to test the situation of contact and connect of circuit. With the help of one test line, it can be used to test the connection situation of equipment in sub-station and the grounding system. In sub-station grid earthing is available, by choosing proper connecting point earth resistance can be measured.

8.2. Application in telecommunications system

8.2.1. The measurement of the grounding resistance of machine room in the building

The machine room of telecommunication system is normally in the upper deck of the building. Connect the fire hydrant and the pole being measured by one testing line, then using the meter test the testing line.

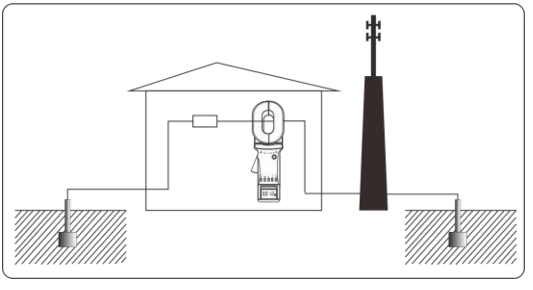
The value of meter=resistance of machine room + the resistance of testing line + the grounding resistance of fire hydrant.

If the grounding resistance of fire hydrant is very small, then:

The grounding resistance of machine room ≈ value of meter - resistance of testing line.

8.2.2. The measurement of grounding resistance of machine room and the launch tower

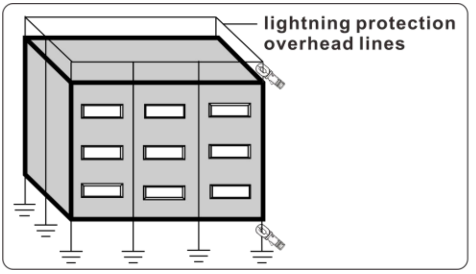
It normally form two point grounding system when machine room and launch tower connect to ground, as shown below:



If the value of meter is lower than the allowable value of grounding resistance, then the grounding resistance of machine room and the launch tower is valid. If the value is greater than allowable value, please measure by single point grounding method.

8.3. Application in lightning protection system of building

If the grounding pole of the buildings is independent with each other, the measurement of grounding resistance of each grounding pole as below:



9. Notes of Earth Resistance Measurement

9.1. Users sometimes may compare measurement of AECT 12 meter with traditional voltage-current method, there can be difference sometimes; to solve this situation, users should pay attention to the problems mentioned below:

When the tested grounding body is not separated from the grounding system in traditional voltage-current method then the measured grounding resistance is the parallel value of all grounding resistances.

It is useless to measure the parallel value of all grounding body resistances, because the purpose of measuring ground resistance is to compare it with an allowable value specified in the relevant standards to determine whether the ground resistance is qualified or not.

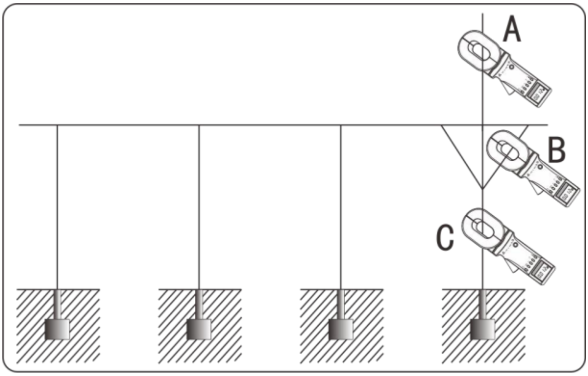
As mentioned, the result measured by AECT 12 clamp meter is the grounding resistance of each branch, which is the grounding resistance of a single grounding body when the grounding wire is in good contact. Obviously, in this case, test with the traditional voltage-current method and AECT 12 clamp meter, their measurement results are not comparable at all, since the subjects are not the same, it is quite normal for the results to be significantly different.

9.1.1. The grounding resistance measured by the AECT 12 clamp meter is the composite resistance of the grounding branch. It includes the contact resistance, the lead resistance and the grounding body resistance of the branch to the common ground wire. However, the measured value is only the grounding body resistance under the condition of grounding system separation by traditional voltage and current method.

Obviously, the measurement value of the former is larger than that of the latter. The value size of the difference reflects the value size of the contact resistance between the branch and the common ground wire.

9.2. Selection of measurement point

In some grounding system, like the picture show below, should chose a correct point for measurement, or will get different result.



In measuring at A point, the measured branch does not form a circuit, the meter display “**OL Ω**”, should change the measuring point.

In measuring at B point, the measured branch forms the circuit of metallic conductor, the meter display “**L 0.01Ω**” or a very small resistance value of metallic circuit, should change the measuring point.

In measuring at C point, the measurement value is the grounding resistance value under the branch.

10. Accessories

Earth Tester	1 PCS
Test Ring	1 PCS
Meter Case	1 PCS
Manual / Qualification Certificate	1 SET

10.1.1.

The company is not responsible for other losses caused by use. The contents of this user manual cannot be used as a reason to use theproduct for special purposes. The company reserves the right to modify the contents of the user manual. If there are any changes, no further notice will be given.

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