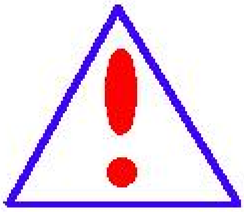
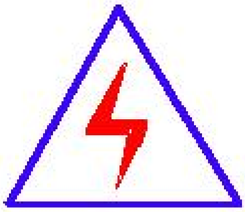
Dear Client,

Thank you for purchasing our UHV-540 Zinc Oxide Lightning Arrester Characteristic Tester. Please read the manual in detail prior to first use, which will help you use the equipment skillfully.



Our aim is to improve and perfect the company's products continually, so there may be slight differences between your purchase equipment and its instruction manual. You can find the changes in the appendix. Sorry for the inconvenience. If you have further questions, welcome to contact with our service department.



The input/output terminals and the test column may bring voltage, when you plug/draw the test wire or power outlet, they will cause electric spark. PLEASE CAUTION RISK OF ELECTRICAL SHOCK!

◆ SERIOUS COMMITMENT

All products of our company carry one year limited warranty from the date of shipment. If any such product proves defective during this warranty period we will maintain it for free. Meanwhile we implement lifetime service. Except otherwise agreed by contract.

SAFETY REQUIREMENTS

Please read the following safety precautions carefully to avoid body injury and prevent the product or other relevant subassembly to damage. In order to avoid possible danger, this product can only be used within the prescribed scope.

Only qualified technician can carry out maintenance or repair work.

--To avoid fire and personal injury:

Use Proper Power Cord

Only use the power wire supplied by the product or meet the specification of this produce.

Connect and Disconnect Correctly

When the test wire is connected to the live terminal, please do not connect or disconnect the test wire.

Grounding

The product is grounded through the power wire; besides, the ground pole of the shell must be grounded. To prevent electric shock, the grounding conductor must be connected to the ground.

Make sure the product has been grounded correctly before connecting with the input/output port.

Pay Attention to the Ratings of All Terminals

To prevent the fire hazard or electric shock, please be care of all ratings and labels/marks of this product. Before connecting, please read the instruction manual to acquire information about the ratings.

Do Not Operate without Covers

Do not operate this product when covers or panels removed.

Use Proper Fuse

Only use the fuse with type and rating specified for the product.

Avoid Touching Bare Circuit and Charged Metal.

Do not touch the bare connection points and parts of energized equipment.

Do Not Operate with Suspicious Failures

If you encounter operating failure, do not continue. Please contact with our maintenance staff.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in Explosive Atmospheres.

Ensure Product Surfaces Clean and Dry

一Security Terms

Warning: indicates that death or severe personal injury may result if proper precautions are not taken

Caution: indicates that property damage may result if proper precautions are not taken.

Table of Contents

I. Overview:

The metal oxide arrester tester is used for the measurement and analysis of metal oxide arrester [MOA] leakage. It is mainly used for measuring the resistive current to analyze the degree of zinc oxide aging and damp. The field charged test shall conform to Electric Power Industry Standard of the People's Republic of China DL474.5-92 *Guide for Insulation Test on Site - Lightning Arrester Tests*. The metal oxide arrester tester can be also used for factory and acceptance tests.

II. Structure Diagram for Instrument Panel:

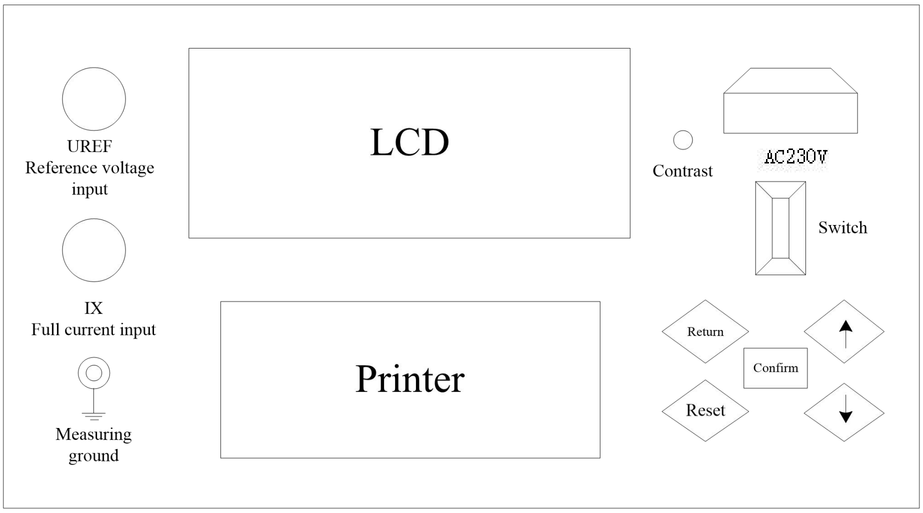


Figure 1

III. Main Technical Indexes:

Range of reference voltage input (peak): 10V-200V

Measurement range of full leakage current (peak): 100uA-20mA

Measurement range of resistive current (peak): 100uA-20mA

Measurement range of capacitive current (peak): 100uA-20mA

Measurement range of angle: 0·-90·

Power consumption:	4W
System measurement accuracy:	± (reading×5% + 5 words) (not more than 2mA for harmonic current)
AC power supply:	AC 220V ±10%，50Hz ±1%

IV. Wiring Diagrams:

1. Laboratory wiring diagram

Precautions: the lower end of the arrester and the ground terminal are marked on the current line. Please wire according to the marks.

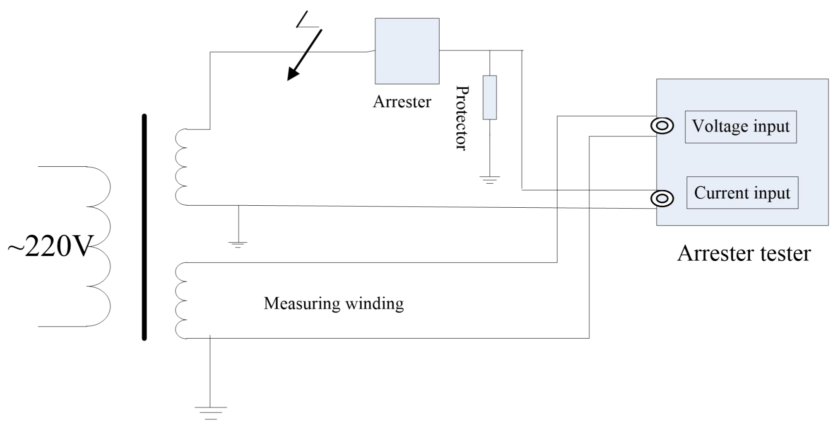


Figure 2

In this method, the adjustable high voltage power supply shall be provided, the voltage signal input is connected to the end of the measuring meter for the testing transformer, one end of the metal oxide arrester is connected to the high voltage, the other end is grounded through the protector to be connected with the ground of the instrument and the ground of the high voltage power supply. The AC signal input is connected to the lower end of the arrester and the ground.

Boosting value: ≤10KV/1.5 ≥35KV/$\sqrt{3}$

2. Online wiring diagram (live test)

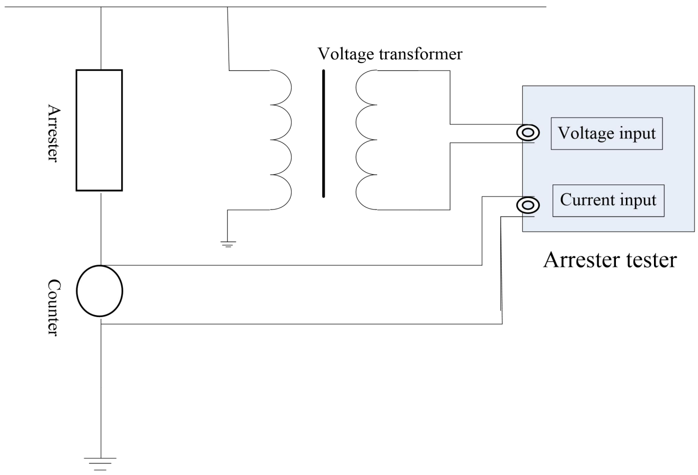


Figure 3

In the online measurement, the voltage signal input is connected to the secondary side of PT located at the same phase as the measured arrester, the current signal input is connected to two ends of the arrester counter, and the ground terminal of the instrument is connected to the lower end of the counter and is connected with the ground.

Refer to the above wiring method for correct wiring according to the field requirements.

V. Instrument Operation:

1. Connect the line and the instrument power supply, and turn on the power supply, then the screen displays as shown in Figure 4.

Arrester characteristics tester
System Settings Data Measurement Data View Instrument Calibration Time Calibration
↑↓ Move Y Enter N Esc

Figure 4 Main Menu

2. Click System Settings to display the menu as shown in Figure 5:

Arrester characteristics tester
Compensation Angle +0.000 Transformation Ratio 01000 Device No 0000-A
↑↓ Move Y Enter N Esc

Figure 5 System Settings Menu

In this menu, you can set the transformation ratio and the compensation angle.

The entry of digits is - 1 2 3 4 5 6 7 8 9 0. Cycle. **The transformation ratio cannot be negative, the first digit of the compensation angle is only -, and other entry is wrong. One decimal point is only used between the data.**

↑: cycle the digit. ↓: move to the right. After the digits are entered, press Return to save.

* Note the correct algorithm of the transformation ratio:

Determination method for transformation ratio of testing transformer: the transformation ratio herein should be turns ratio or voltage ratio of high voltage winding and measuring instrument winding. For example, for the testing transformer with AC output rated voltage of 50KV, the rated voltage of the measuring instrument winding is usually 100V, so the transformation ratio is 50KV/100V=500. Determination method for online transformation ratio: for example, the transformation ratio of 110KV arrester is (110KV/ $\sqrt{3}$)/(100KV/ $\sqrt{3}$)=1100.

*Algorithm of input compensation angle:

When the compensation angle is 0, firstly measure the angle φ{φA and φC} for phase A and phase C, and use {φC-φA}/2=compensation angle, wherein φA is positive, and φC is negative.

3. Click the menu "Data Measurement" to display the menu as shown in Figure 6:

0000-A Arrester Test Interface

Full V	0.000KV	Full I	0.000mA
Fund V	0.000KV	Res I	0.000mA
Cap I	0.000mA	Res Fund I	0.000mA
Freq	50.00Hz	Res I3	0.000mA
A Power	0.000W	Res I5	0.000mA
R Power	0.000W	Res I7	0.000mA
Ratio	0.000	Res IMax	0.000mA
Angle	0.000	Diff Phase	0.00

Wave Save Print Esc

Figure 6 Data Test Main Menu

Compensation angle: for the stored data, the compensation angle can be modified, but the modified value only influences the currently displayed/printed data and cannot be saved.

Transformation ratio: PT or transformation ratio of testing transformation, the displayed test voltage U is the product of input reference voltage Uref and K. As K does not affect the measurement of angle or current magnitude, it can be set to 1, directly displayed as U1. Note that the correct measurements cannot be obtained when there is no U1 input. For the stored data, the voltage transformation ratio can be modified, but the modified value only influences the currently displayed/printed data and cannot be saved.

Test phase difference: the phase difference of the leading fundamental voltage at the fundamental current includes the compensation angle. MOA performance can be evaluated according to the angle, and shall be evaluated by deducting the interference angle in case of interphase interference.

Waveform display Full voltage waveform

Full current waveform

Resistive current waveform

4. Click “Data View” to display the menu as shown in Figure 7:

0000-A January 5, 2015 08:08:08 001-001

Full V	0.000KV	Full I	0.000mA
Fund V	0.000KV	Res I	0.000mA
Cap I	0.000mA	Res fund I	0.000mA
Freq	50.00Hz	Res I3	0.000mA
A Power	0.000W	Res I5	0.000mA
R Power	0.000W	Res I7	0.000mA
Ratio	0.000	Res IMax	0.000mA
Angle	0.000	Diff Phase	0.00

↑ Prev ↓ Next Y Print N Esc

Figure 7 Data View Main Menu

5. Printout

To print, directly operate according to the screen prompt. In order to facilitate the user to analyze and save the test data, the instrument saves 100 sets of test data for the user to print. (After measurement, the user can save the data as required.)

6. Instrument calibration

Enter the password to enter the instrument calibration. Enter the instrument calibration only when the instrument accuracy is wrong. Do not enter at other times.

7. Time calibration

January 5, 2015 08:08:08

↑ Change digits ↓ Move cursor

VI. Measurement Principle and Data Analysis:

The instrument inputs PT secondary voltage as a reference signal and inputs MOA current signal to obtain the fundamental voltage U1, the fundamental current peak and the current and voltage angle Φ (Figure 8) by Fourier transformation. The voltage cophase component is resistive current fundamental value (Ir1p), and the quadrature component is apacitive current fundamental value (Ic1p):

$$Ir1p=Ix1pCOS\Phi \qquad Ic1p=Ix1pSIN\Phi$$

Considering δ=90°, Φ is equivalent to the dielectric loss angle, so it is very simple to evaluate MOA with Φ; Φ is 81° to 86° if there is no interphase interference. According to the requirement that the resistive current cannot exceed 25% of the total current, Φ cannot be less than 75.5°. refer to the following table for the segmented evaluation of MOA performance:

Φ	<75°	75°~77°	78°~80°	81°~83°	84°~88°	>89°
Performance	Very poor	Poor	Average	Good	Excellent	With interference

In fact, consider in case of Φ<80°

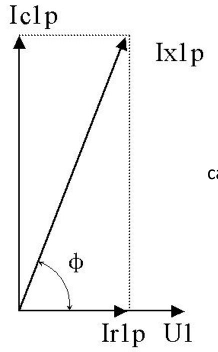


Figure 8 Projection Method

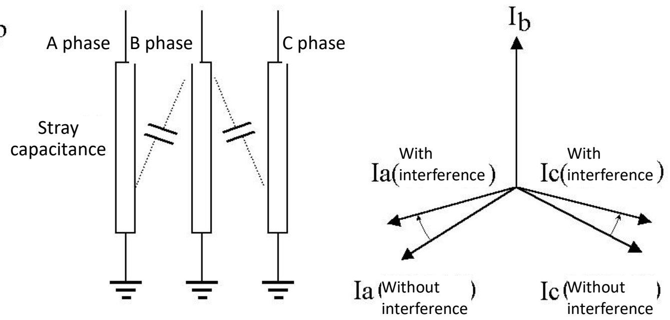


Figure 9 Interphase Interference of In-line Arresters

2.2 Interphase Interference

In the field measurement, the intermediate B phase of the in-line arresters impacts the leakage currents A and C through the stray capacitance: A phase φ is reduced by 2° or so and the resistive current is increased; C phase φ is reduced by 2° or so and the resistive current is reduced to the negative; B phase is not changed. This phenomenon is called interphase interference (Figure 9).

2.3 Performance Evaluation of MOA with Interference

1. It is suggested that the same phase PT secondary voltage should be used to measure the same phase MOA current. The compensation angle is 0, and the interphase interference is not considered in the measurement. For the laboratory measurement, the compensation angle (Φ0=0) should not be used.

The interphase interference can be considered when MOA performance is evaluated. Based on B phase Φ, the reduced value of A phase Φ is basically equal to the increased value of C phase Φ according to the symmetry of interphase interference, so as to evaluate the interphase interference angle. For example, if A phase Φ is 2° less than the normal value, and C phase Φ is

3° more than the normal value, the interphase interference will be approximately 2.5°. When MOA performance is evaluated, A is +2.5°, B phase Φ is not changed, and C phase Φ is 2.5°.

2. If the interphase interference is considered in the measurement, the compensation angle can be set for A/C phase and is added to Φ. Considering the interphase interference of B phase to A/C phase is symmetrical, if the angle Φca for the leading Ia of Ic is measured, A/C phase will be respectively compensated, the same phase PT secondary voltage will be used to measure the same phase MOA current, and the above compensation angle will be added. MOA performance will be evaluated directly according to Φ.

VII. Precautions:

1. When measure the reference voltage from PT or the measuring end of the testing transformer, carefully check wiring to avoid the PT secondary or test voltage short circuit.
2. Be careful not to wrongly connect the current and voltage sampling lines in the connecting process.
3. In the laboratory experiment, the high voltage power supply cannot use the series excitation testing transformer.

VIII. Packing List of Instrument:

1. Host	1
2. Voltage signal sampling line	1
3. Current signal sampling line	1

4. Power line	1
5. Fuse	2
6. Special protector	1
7. Operating manual	1
8. Product certificate	1

Appendix:

I. Main Problems of Metal Oxide Arrester in Operation

1. As the series gap of the the metal oxide arrester is eliminated, the metal oxide arrester withstands the system voltage for a long time, and the current flows through it. The active component valve disc in the current heats to cause the change to volt-ampere characteristics. After long-term action, the valve disc will be aged, even thermally broken down.

2. If the metal oxide arrester is used under the surge voltage, the valve disc will be aged under the action of surge voltage energy.

3. If the inside of the metal oxide arrester is affected with damp or its insulation performance is poor, the power current and the power consumption will be increased, and the internal discharge will be caused in severe case.

4. If the metal oxide arrester is polluted by rain, snow, condensation or dust, the radial discharge will be caused by the large potential difference between the internal valve disc and the external insulator due to the distribution difference of internal and external voltages.

II. Tasks Completed by the Instrument

To judge whether the valve disc of the metal oxide arrester is aged or affected with damp, usually observe the change of resistive leakage current flowing through the zinc oxide valve disc in the normal operation, i.e., observe whether the resistive current is increased as the judgment basis.

III. Main Failures of the Instrument

1. The metal oxide arrester has thermal breakdown

The final reason for the thermal breakdown of the metal oxide arrester is that its heating power is larger than the heat dissipation power. The heating power of the zinc oxide valve disc depends on its current and voltage (the current is the active component of the current flowing through the valve disc).

2. The metal oxide arrester is internally affected with damp

Untight sealing will cause the arrester to be internally affected with damp, or internal water immersion in the installation will also cause the total current of the arrester to be increased under the voltage. If the arrester is affected with damp to a certain degree, the discharge will occur along the surface of the zinc oxide valve disc or the inner wall surface of the insulator to cause the explosion of arrester.

The increase of total current caused by the damp of metal oxide arrester results from the increase of resistive leakage current. Whether the arrester is affected with damp can be judged by detecting the amplitude of angle variation.

To sum up, the above failures can be reflected by the change of resistive leakage current. If you understand the change to the resistive leakage current of the metal oxide arrester, you can predict whether the above failures occur.