

ZXZK-III Vacuum Switch Vacuum degree Tester



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I . Overview

With non-oil development of the medium voltage switch cabinet, the vacuum switch got the extensive expansion and applications with its special advantage. In these years, due to some reasons at using environment or production process, some vacuum switches, when in operation, will have leakage problems from vacuum interrupter, or in severe case, can't operate normally even within its life range, which may cause serious consequences.

Considering that most of the accidents happened because of such reasons, it is essential to test vacuum switch vacuum regularly or irregularly.

The traditional testing method is the withstand voltage method, namely ,let the vacuum switch to be open status, apply a certain voltage on the moving contact, then test the leakage current and predict the quality of vacuum tube. This kind of method has the advantage of simple operation, but it can only judge the quality of vacuum tube, if the vacuum degree at $10^{-4} - 10^{-1}$ Pa, it can't be distinguished accurately, so it can't judge the development trend of the leakiness (that is to know, how about the leakage comparing with the leakage last time)

Huazhong university of science and technology(HUST) has been studying the vacuum degree testing of interrupter of vacuum switch on the spot since 90th. By the effort of the decade, she acquired the patent in 1999 and succeeded in making quantitative test on site without dismantling. By this means, it not only can measure the vacuum degree of vacuum switch whether it is within the scope of normal or not, most important, it can judge the life-span of vacuum switch by comparing the testing result by years and predict the accidents.

This vacuum tester (ZXZK-III) is just the updated generation. The product has many features, such as compact structure, portable type, short testing time, high reliability and stability, high precision, perfect function and so on.

II . Main features

1. Can quantitatively test vacuum degree of interrupter for many types of vacuum switch
2. Don't need to tear down the vacuum switch while testing
3. Accurate and reliable testing results;

4. LCD display, simple operation
5. Testing data can be saved, printed and reviewed
6. RS232 port to connect to PC for computer control on the instrument
7. light weight and easy carrying

Notes: There are two types of magnetic control coils, π coil and flat coil, customer can select according to the structure of switch cabinet.

III. Performances

1. Power supply: AC220V $\pm$ 15%, 50Hz
2. Testing range: $10^{-4} \sim 10^{-1}$ Pa
3. Electric field voltage: 20kV
4. Magnetic field voltage: 1600V
5. Accuracy: 5%
6. Operating condition: $-10^{\circ}\text{C} \sim 40^{\circ}\text{C}$
7. Size: 460 $\times$ 335 $\times$ 330mm
8. Weight: 12kg

IV. Testing principles

This instrument adopts the magnetic control discharge method. Let the two contacts of switch vacuum keep space and put the interrupter in the spiral coil or lay the new-type electromagnetism coil outside the interrupter, and then put on electric field high voltage, thus the large current flow to the coil and generate the synchronous pulse magnetic field outside the interrupter synchronized with the high voltage. Under the action of the pulsed strong magnetic field and the strong electric field, the charged ions in the arc chamber are helical moved and collided with the residual gas molecules, the resulting ion current and residual gas density namely vacuum is proportional. For different structures, the ion current is different when tested at the same condition with the different types of vacuum tube (the tube type). The relevant curve of vacuum degree-ion current can be demarcated by testing. With tested ion current and ion current - vacuum curve under different type of switch, the vacuum degree can be found out.

In order to enhance the sensitivity, the routine magnetic control discharge method need to

tear down the interrupter from the breaker and place inside the spiral tube coil while testing. Thus many machine parameters must be adjusted while installing the interrupter again, the workload is large and the professional personnel are needed. But the new magnetic control coil can surround the interrupter outside, and single chip processor carries on the synchronous control and the datum acquiring and processing, which enhances the sensitivity on the spot.

V. Working principles

Structure of Tester for vacuum degree of vacuum switch is shown in figure 1.

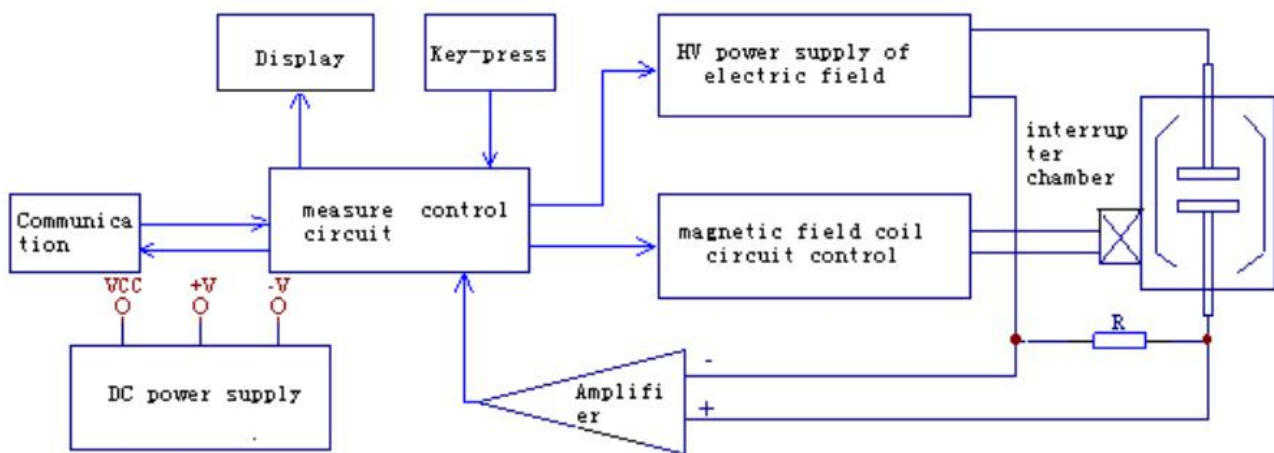


Fig ① magnetic control discharge method testing circuit chart

The tester is made up of control circuit, electric field high voltage generation circuit, magnetic field coil current control circuit, communication, printer and LCD display circuit etc. working process is: the control circuit issues the instruction and the magnetic field capacitance is charged by the switch power supply. the control circuit supervise and control the electric field high voltage output and the magnetic field coil current flow when the voltage of magnetic field capacitance reaches the preset value. And the interrupter will discharge and generate the ion current when being in the strong electric field and magnetic field, as is shown on the curve "I" in figure 2. The current, which is acquired by sampling resistance "R" and is adjusted by some circuits, is processed in single chip processor, after calculation, the vacuum degree is finally displayed on the LCD.

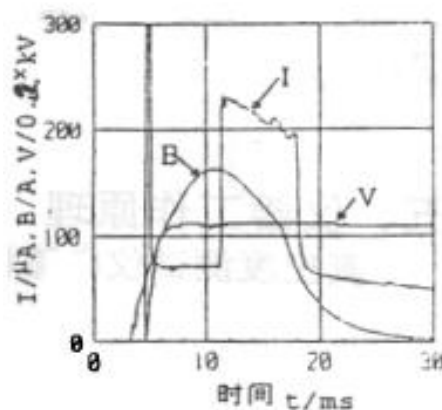


Figure ② Discharge waveform chart

VI. Front- panel elucidations

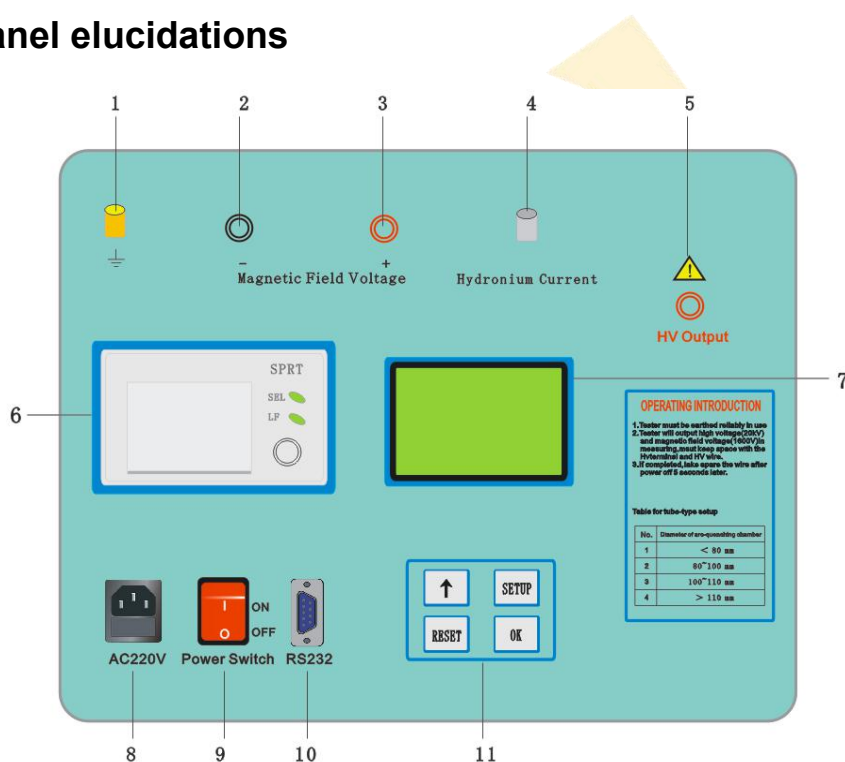


Figure ③ sketch map of front panel

Note:

- | | |
|---------------------------------------|---------------------------------------|
| 1. Grounding port | 2. Ion current port |
| 3. Magnetic field voltage (negative) | 4. Magnetic field voltage (positive) |
| 5. High voltage output port | 6. Printer |
| 7. Liquid crystal display | 8. AC outlet |
| 9. Power switch | 10. Communication port. |
| 11. Keyboard | |

VII. Operating methods

1. please disconnect the vacuum tube with power. The vacuum tube don't need to be teared down from the switch cabinet, but the vacuum breaker should be set to off-state, and the knife of vacuum switch should be open; If the vacuum switch haven't be packed up, the moving contact and static contact should also keep space between each other, and the vacuum switch is placed on the insulate bracket. And at the same time, the magnetic controls coil should be installed in the middle the interrupter but near to the terminal of moving contact a little.
2. Connect the vacuum tube with the tester according to figure④.(note: If using wound magnetic control coil, make the flat cable surround vacuum switch three times, then connected each other) detailed operation:

Firstly, connect the tester to the earth. And then connect the control magnetic coil with the magnetic field voltage positive/negative terminal of tester by the magnetic field current wires. Connect the HV output to the static contact of vacuum tube with HV cable, and connect the ion current input to the moving contact of vacuum tube with ion current wire (shield wire).

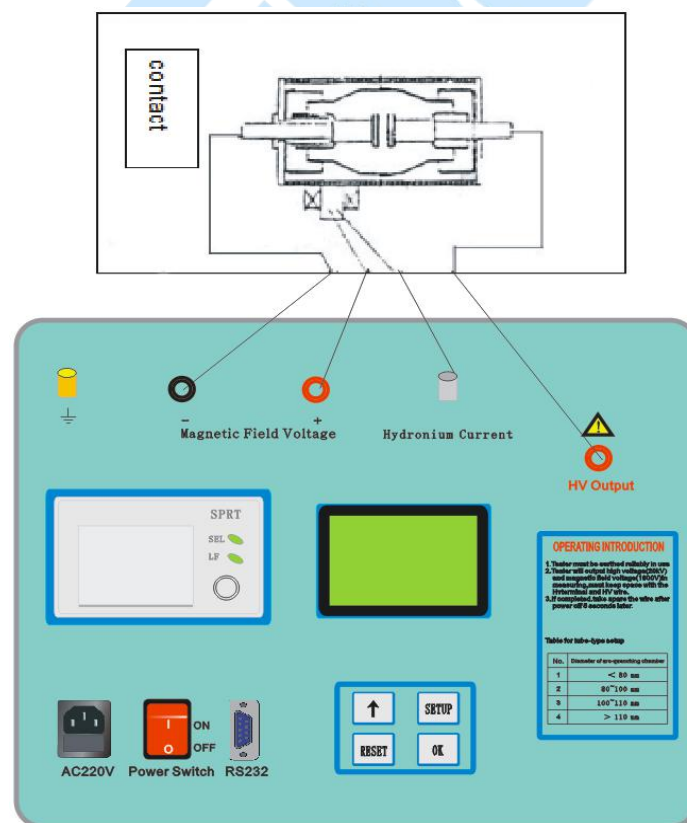
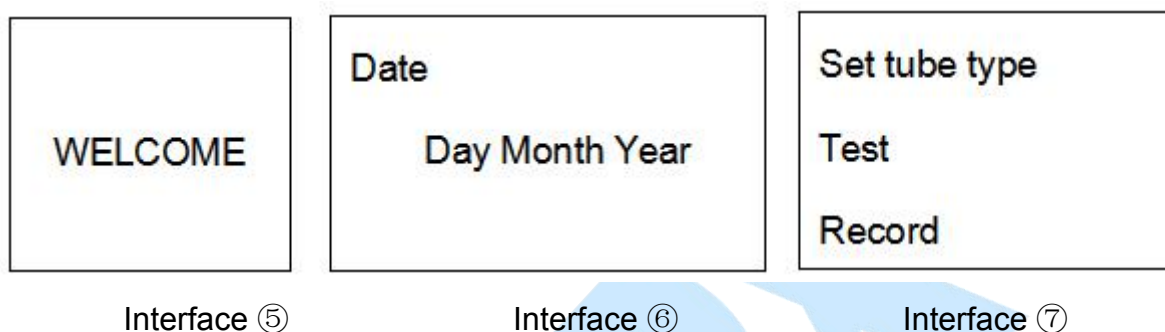


Fig ④ Test connect chart

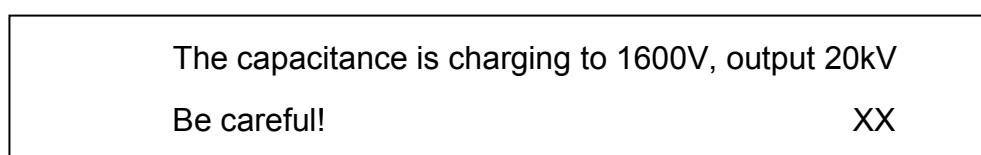
3. Function choice. Open the power supply after completing connection, "Interface ⑤" will be shown on the LCD screen about 3sec, and "Interface ⑥" will be shown later. Move the cursor to choose the year, month and date by pressing the "SETUP" key and proofread the date by pressing "↑" key, and then enter in the interface ⑦ by pressing the "OK" key, at the same time, move the cursor to select the functions by pressing the "↑" key or "SETUP" keys, and the tester will implement the functions according to the instructions of "Set tube type", "Test", "record".



4. Type setup. After choosing "Set tube type", an interface will be displayed on the screen by pressing the "OK" key. At the same time, the type can be setup by pressing "↑" key or "SETUP" keys. The tube parameters as follows:

interrupter diameter ≤ 80mm	NO 1 tube type
80 < interrupter diameter ≤ 100mm	NO 2 tube type
100 < interrupter diameter ≤ 110mm	NO 3 tube type
110 < interrupter diameter ≤ 130mm	NO 4 tube type

5. Vacuum degree measure. measure the vacuum degree after tube type setup (refer to the fourth step). Interface ⑦ will be displayed by pressing "OK" key, choose "Test" by press "OK" key, interface ⑧ will be shown on the screen



Interface ⑧

XX means charge time. When charge time decrease to 0 seconds from 60 seconds, the

tester stops charging, immediately the tester will output pulse high voltage and pulse magnetic field voltage at the same time. Later the value of vacuum degree of vacuum switch will be displayed on the screen, and the interface ⑨ will be displayed after measurement is finished.

Vacuum degree: 2.3E-03Pa		
Save	Print	Return

Interface ⑨

Save the data displayed on the screen at present by pressing " save" key. Print the data displayed by pressing " print" key. If measuring again, press " RESET" key or press " ↑ " or" SETUP" key to move the cursor on the " RETURN", and then press" OK" key, the interface ⑦ will be displayed again.

6. after completing the test, put off the power switch and wait for 5 seconds to tear down the wire. firstly tear down the wire connecting to the tester, and then tear down the wire connecting to vacuum tube and magnetic controls coil.

Please careful reading manual of usage before using it in order to prevent mistake operation.

VIII. Notes

1. The shell of tester should connect to the ground reliably.
2. In order to enhance the accuracy, please clear the appearance of vacuum switch before testing.
3. Please choose the right type of vacuum tube.
4. In the process of testing, the HV output port would output about 20kV high voltage, please keep enough distance with person and the low voltage wire (with people: more than 0.5m), the magnetic field voltage output port can output about 1600V high voltage, be careful!
5. While carrying out the experiment, the wire of magnetic control coil and vacuum tube should be connected firstly, and then connect to the tester. After completing the experiment, tear down the wire connecting to the tester firstly, and then tear down the

other wires. If forget to connect the magnetic control coil while measuring, please put off power supply at once, reconnect, but note that there is still high voltage at the magnetic field voltage output terminal. Do not touch the conductor part of the wire, so as not to be the hurt by the residual voltage

6. After completing the experiment, there still might be 40V or so residual voltage at the output terminal, be careful!
7. In the process of testing, if exception occurs, please put off the power switch firstly and contact the supplier. Never open the case of the tester! Thanks for cooperation.

IX. Accessories

1. Main tester	1 set
2. High voltage test line	1 pcs
3. Ion current line	1 pcs
4. Magnetic control coil	1 pcs
5. Ground wire	1 pcs
6. Hook belt	1 pcs
7. Strap	1 pcs
8. Ruler	1 pcs
9. Magnetic control coil wire	2 pcs
10. Power supply cord	1 pcs
11. Printing paper	2 rolls
12. Manual	1 copy
13. Inspection report	1 copy
14. Qualified certificate and fixing card	1 copy
15. Accessory box	1 pcs