



OPERATION MANUAL

Vacuum Tester-HM6070



WUHAN GOLDHOME HIPOT ELECTRICAL CO.,TLD

Tel.: +86-13720265142

Fax: +86-27-84625205

Email: goldhome03@cablehipot.com

Web.: www.cablehipot.com

Add.: No.A25-1, Huading Mould Industrial Park, Hannan, Wuhan, Hubei, China



Introduction

In JB8738-1998 《vacuum interrupter arc chamber of 3.6-40.5KV AC high voltage switchgear 》 established by high-voltage switchgear National Standardization Technical Committee, it is prescribed that the internal gas pressure measurement and allowable storage time limit inspection must be executed for any user and producer of interruption arc chamber of high-voltage vacuum switchgear. At the same time, it is also noticed that allowable storage time limit of interruption arc chamber should be 20 years, and internal gas pressure of the vacuum interrupter arc chamber should be less than 6.6×10^{-2} Pa.

Inspection methods of Allowable Storage Time of Vacuum Interrupter Arc Chamber: measuring internal gas pressure of vacuum interrupter arc chamber should be with a pulsed magnetic vacuum meter, recode the pressure value P_1 (Pa); after put the vacuum meter aside for period of time- t (d), measure the internal gas pressure of vacuum interrupter arc chamber with this vacuum meter again, and recode the pressure value P_2 (Pa), holding time t should be less than 7d. By the following formula, the allowable storage time of vacuum interrupter arc chamber can be calculated:

$$T = \frac{6.66 \times 10^{-2}}{P_2 - P_1} \times \frac{t}{365} (\text{year})$$

HM6070 vacuum tester for vacuum switchgear is the latest generation of products of my company, it is the upgrade product in the base of ZKD-III vacuum meter on the foundation of notion from the field user. HM6070vacuum tester has some features-higher measurement accuracy, better stability, more capacity.

For vacuum circuit breaker, the method of determining whether or not deterioration of the vacuum tube is inspection with the method of frequency withstand voltage, but this method only distinguish the vacuum interrupter arc chamber of the serious deterioration. When the vacuum of vacuum interrupter arc chamber degrade to 10^{-2} - 10^{-1} Pa, although the breakdown voltage is not reduced, but the interrupter arc



chamber has failed. In the HM6070 vacuum tester for vacuum switch, the new field coils were used, and with the magnetron discharge method the vacuum of the vacuum interrupter arc can be measured without disassembling the interrupter arc chamber. At the same time, HM6070 vacuum tester also used computer for synchronous control, data acquisition and processing, and the sensitivity of HM6070 vacuum tester in the field test of the vacuum interrupter arc chamber is 10^{-5} Pa. The most prominent feature of this instrument (HM6070 vacuum tester) is to use the new excitation coils and data processing methods to achieve the non-demolition measurement of vacuum. The instrument is practical, easy to use, easy to operate, high precision measurement without disassembly, widely used in electric power, steel, petrochemical, textile, coal, railways, and other trades using the vacuum switch.

Specifications

- ✧ Detection objects: various models of vacuum switch
- ✧ Detection method: using new excitation coil and detect vacuum tube without disassembly
- ✧ Application area: This instrument is a all-purpose type, can measure the vacuum of variety models of open magnetic vacuum tube.
- ✧ Detection range: 10^{-5} - 10^{-1} Pa
- ✧ Measurement accuracy: 10^{-5} - 10^{-4} Pa, 15%
 10^{-4} - 10^{-3} Pa, 15%
 10^{-3} - 10^{-2} Pa, 10%
 10^{-2} - 10^{-1} Pa, 10%
- ✧ Magnetic field voltage: 1700V
- ✧ High-voltage of pulsed electric field: 30KV
- ✧ Open distance of switch tube in vacuum test: normal open distance
- ✧ Testing environment: $-20^{\circ}\text{C} \sim 40^{\circ}\text{C}$
- ✧ Weight: 24kg
- ✧ Dimension: $420 \times 320 \times 280$ (mm)
- ✧ Sampler: magnetic coil

Testing principles of instrument

Pull and open two contacts pole of interrupter arc chamber for certain distance, applied high pulse voltage, placed interrupter arc chamber within spiral coil, or placed new electromagnetic coils outside the interrupter arc chamber, it will generate high voltage sync pulse magnetic field in the interrupter arc chamber. Under the influence of this strong electric field and pulsed magnetic field, the electrons in the interrupter arc chamber will move spirally, collide with residual gas and produce ionization, and between the ion current and the density of residual gas(the vacuum value)it is proportional. For different types of vacuum tubes (tube type), because of its different structure the value of ion current is not same under the condition of same contacts open distance, same vacuum, same electric and magnetic fields. By some experiments, the corresponding relationship curve between different type tube's vacuum value and ion electrical source can be calibrated. As the ion current is detected, the vacuum value of this vacuum tube type can be obtained by the curve of ion current and vacuum. The sketch map of test circuit shows in Figure 1.

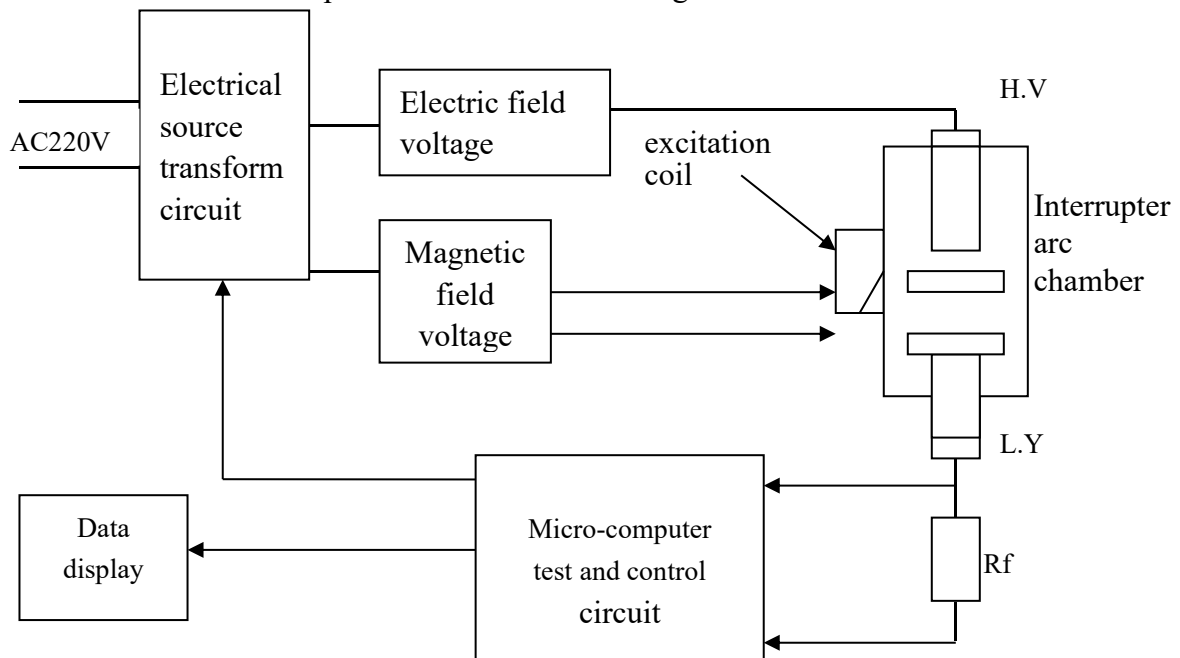


Figure1. Test Circuit of magnetron control discharge for testing vacuum of interrupter arc chamber



In the vacuum testing of the interrupter arc chamber with regular magnetron discharge method, in order to improve measurement sensitivity, the interrupter arc chamber must be removed from the circuit breaker and place inside the helical coil. As a result, the interrupter arc chamber reinstall in the circuit breaker, all parameters of testing device must be readjusted, all workload is numerous and professionals. In the HM6070 Vacuum Tester, new magnetic coil can be surrounded by the interrupter arc chamber from the side, so the interrupter arc chamber must be not disassembly.

At the same time, by using of single-chip computer performing synchronous control, data acquisition and processing, the sensitivity of vacuum field testing for the interrupter arc chamber can be improved enormously.

Operation and Using

■ Instructions of instrument panel and wiring

Figure 2 shows the operation panel of the HM6070 Vacuum Tester, leak detection button is used to determine the preliminary vacuum of vacuum tube, measuring button is used to exert high electric voltage, strong electromagnetic field on the vacuum tube, and measure quantitative the vacuum of vacuum tube. There is a high-voltage output terminal in the left of instrument back, which should connect with the contact of vacuum tube; Ion current input terminal must connect with another contact on the vacuum tube, two output terminal of magnetic field voltage must be connect with two wiring terminal of excitation coils; ground terminal for protective grounding of equipment enclosures; DIP switch is used to enter the tube type of interrupter arc chamber; the tube type of interrupter arc chamber can be ascertained by tube's diameter and type of excitation coils.

■ Operation Steps

(1) Pull and open two contacts pole of interrupter arc chamber for certain distance, and clean the surface; As shown in Figure 2, hanging the excitation coil and wiring all, and enter tube type of interrupter arc chamber through the DIP switch.

- Tube diameter of interrupter arc chamber less than 3" mm is type 00
- Tube diameter of interrupter arc chamber less than 4" mm and greater



than 3" is type 02

➤Tube diameter of interrupter arc chamber less than 5" mm and greater than 4" mm is type 04

➤Tube diameter of interrupter arc chamber greater than 5" mm is type 06

(2) Check the wiring is correct, turn on the power switch. Press the reset button, ensure that the equipment is in the initial state

(3) Press the leak detection button, detecting leak of vacuum tube

Before the test, detecting leak of vacuum tube must be conducted. When detecting leak, Outer of vacuum tube must be wiped clean and dry. If vacuum tube is serious leak, vacuum quantitative testing must be not performed; if qualified, and a vacuum quantitative testing again.

(4) Press the test button and testing the vacuum tube

Press the test button, firstly the tester display electric field voltage and magnetic field voltage, and automatically charging. When the two kinds of field voltage reach a certain value, the tester automatically added the electric field voltage and field voltage on vacuum tubes and excitation coils. At the same time, analysis program automatically will start; the tester will show the test results of vacuum tube and automatically discharge the internal capacitance of the instrument.

The minimum testing value of HM6070Vacuum Tester is $1.06 \times 10^{-5} \text{Pa}$, if the test value of vacuum tube is better than minimum testing value, the tester will still show still $1.06 \times 10^{-5} \text{Pa}$; for vacuum circuit breakers, it show the vacuum bubble is intact, the test recode can be write as $<10^{-5} \text{Pa}$; if vacuum is inferior to $6.6 \times 10^{-2} \text{Pa}$, the vacuum bubbles failed.

In many test of the same vacuum tube, the time interval between two measurements must be not less than 10 minutes. At the same time, power off the tester, and the ion current clamp should connect the output high voltage clamp, eliminate residual high voltage, and perform the next test. Otherwise, the ionized air in the vacuum tube is no time to recover to normal, and it will lead test results to distortion.



- (5) Record test results. (Display results: 3.26E-4Pa is the 3.26×10^{-4} Pa)
- (6) Press the leak detection button, detecting leak of vacuum tube, which will reduce the magnetic field voltage, the ion-voltage line connecting the high-voltage clamp remove the residual high voltage, when the action is complete, press the reset button, and then shut down.
- (7) The out high-voltage clamp connect ground to discharge, dis-charger stick touch the terminal of vacuum connecting high-voltage clamp and remove generation static electricity during the test.

■ Note

- (1) Vacuum test should be carry out in the sunny and dry weather, the surface of the vacuum bubble must be wiped clean. If the vacuum bubble surface is contamination, it will induce vacuum leak, and seriously affect the actual test results of vacuum. In many test of the same vacuum tube, the time interval between two measurements must be not less than 10 minutes. Otherwise, the ionized air in the vacuum tube is no time to recover to normal, and it will lead test results to distortion.
- (2) For vacuum testing of the same vacuum switch, we recommend no more than 3 times a day.
- (3) Before vacuum testing, leak detection should be carried out, if leak detection is qualified, and then pass the quantitative test.
- (4) Red cable connecting red cable clamps is the high voltage cable, black cable connecting black cable clamp is ordinary cables. In the actual wiring process, black cable don't connect the high voltage output terminal in order to avoid test failure and a serious leak or threat to personal and equipment.
- (5) Removal of the magnetic field voltage wires, **with particular attention**: firstly pull out the wires connecting equipment, respectively, followed after removal of all wires on the equipment, then removal of magnetic coils, or **endanger the life, safety and equipment**.
- (6) Installing exciting coil, its orientation line must direct the middle of the joints of the interrupter arc chamber

- (7) In the testing process, any part of body can not touch the high voltage output and magnetic field voltage output, the tester's base should be grounded.
- (8) Test is completed, turn off the power; the high voltage output terminal touch ground and discharge to avoid electric shock by residual voltage of charged capacitor.
- (9) Voltage wires of the magnetic field don't short, or serious damage to equipment!
- (10) Voltage wires and ion current wires must be separated!

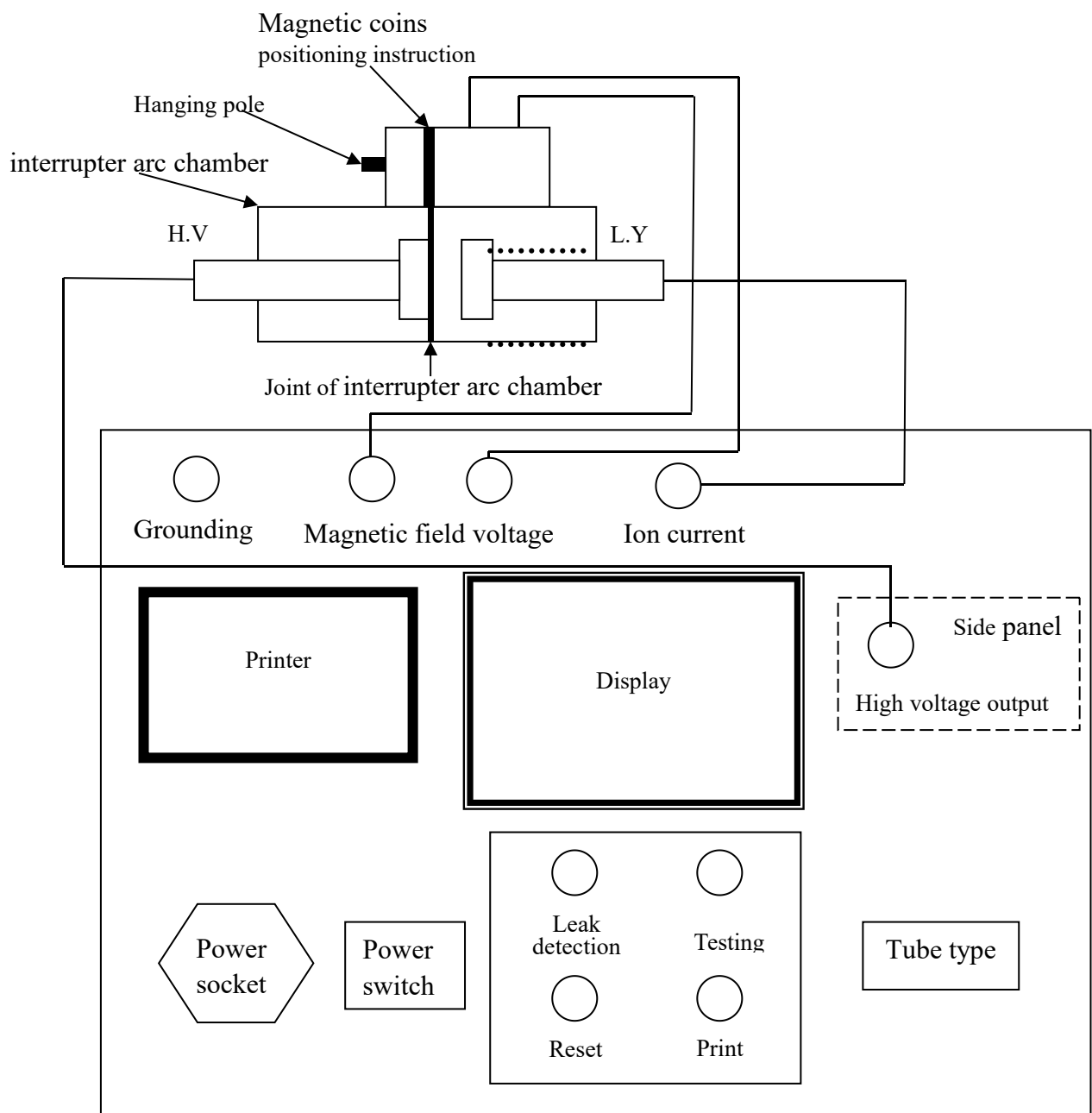


Figure 2. HM6070 Vacuum Tester for vacuum switch



■ Accessories

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|-------------------------|---|
| 1. Magnetic coil: 1 | 5. Instruction manual: 1, Certificate : 1 |
| 2. Special test wire: 5 | 6. Elastic straps: 1 |
| 3. Coil lanyards: 1 | 7. Printing paper: 2 laps |
| 4. Power Line: 1 | |