

# **Service Guide for Xuguang Vacuum Interrupters**

## **1 Main Usage and Service Conditions**

### 1.1 Main Usages

Xuguang ceramic vacuum interrupters, which enable circuit breakers, load break switches and vacuum contactors to break and make currents, are widely servicing in rural and urban power distribution systems and many other fields that need to break circuits frequently such as electricity, machinery, metallurgy, mining, and railways.

### 1.2 Service conditions

#### a) Ambient Air temperature

Indoor highest temperature: +40 °C; outdoor highest temperature: +40 °C;

Indoor lowest temperature: -25 °C; outdoor lowest temperature: -40 °C.

b) Altitude above sea level: Below 1000m; special requirements for altitude is not included.

c) Humidity: Daily average humidity 95%; monthly average humidity 90%; necessary measures should be taken to prevent from condensations outdoors.

d) Occasions: No risk to fire, explosions, violent shake or apparent pollutions by corrosive gas and vapor etc.

e) Earthquake intensity: No more than 8.

f) In the application of switching capacitive or inductive loads such as capacitive banks, HV generators and arc furnace transformers, appropriate protective measures for over voltage should be taken; And it should be noted that resistive capacitor protection should be primarily suggested on switching inductive loads.

g) For more requirements, please take reference to GB/T11022-1999.

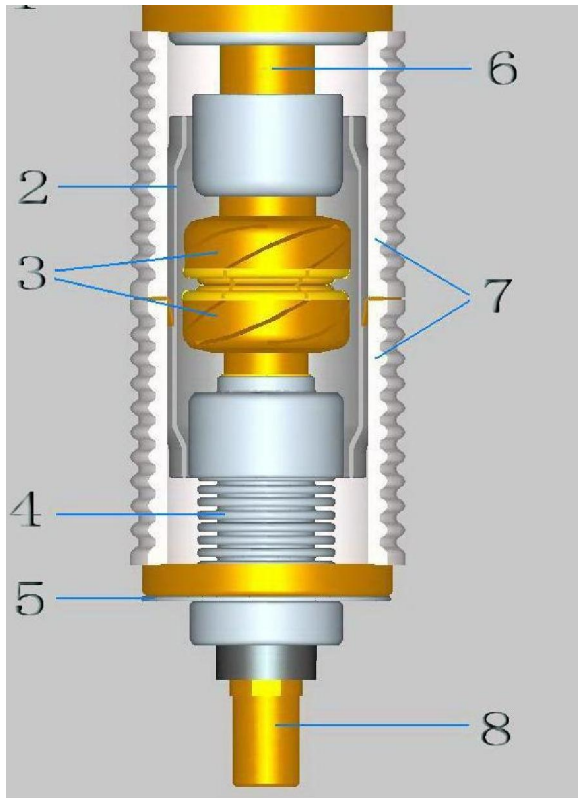
Remarks: When the operating conditions mentioned above can not be met, users should inform and negotiate with the manufacturer.

## **2 Main technical performances**

2.1 Specifications and dimensions of vacuum interrupters should meet up with the requirements of Service guide.

2.2 Specifications and mechanical performance of switchgears should satisfy enterprise standards of interrupters.

### 3 Structure and Principles



**Pic.1-1 Primary Structure of Vacuum interrupter**

1 Fixed Lid; 2 Main Shield; 3 Contacts; 4 Metal Bellows 5 Movable Lid; 6 fix stem; 7 Ceramic Shell; 8 Movable stem

Vacuum interrupters are the core parts of vacuum switchgears. C-O operations of the switchgears are realized by mechanism which simultaneously makes and breaks a pair of opposite contacts inside the vacuum interrupters.

The scheme of vacuum interrupter is simply laid out in Pic.1-1. The cylinder shell, made from inorganic insulating materials such as ceramics, are sealed into a vacuum vessel by metal lids on its both ends. Inside the vacuum interrupter, there is a pair of contacts, one fixed to the stationary rod and the other to the movable rod; still there is a flexible bellow sealed between the movable rod and the metal lid so that the movable rod moves in axial direction. The movable contact is therefore engineered and C-O operations are realized. The

contacts and the bellow are respectively surrounded by two metal shields and the internal environment is high vacuum ( $\leq 1 \times 10^{-3}$  Pa). When the stationary and movable contacts are closed by force of operating mechanism, the load is powered and the current flows through the load. Yet on the other hand, when the live contacts are opened by force of mechanism, vacuum arc occurs between the gaps of the contacts and is always maintained by metal vapors evaporated from the contacts; the vapors become seldom and soon disappeared until the power frequency AC current is close to zero. Simultaneously, when the plasma of the vacuum arc diffuses rapidly, vacuum arc is extinguished and the gap between the contacts becomes insulated again and the current is therefore broken off.

The vacuum arc is maintained by metal vapors evaporated from the contact materials, but not by ions split from gas molecules between the gaps of contacts. When the live contacts are separated in vacuum condition, the contact areas get decreased rapidly until only one or several spots are still in contact. These spots are simply called metal bridges, on which the density of current is highly intensive. Along with the corruption of these metal bridges, the density of

current becomes more intensive while the temperature gets increasingly higher and higher, until the metal bridges are completely melted and at last evaporate a large number of metal vapors. Due to its high temperature and internal strong electric fields, field emissions and vapor ionization are created and metal vapors are further developed into vacuum arc. As long as the structure of the contacts is specially designed, the vacuum arc is well distributed on their surfaces, which thus decreases not only the strength of the arc but the velocity of electric erosion of the contact. The vacuum interrupter is therefore enabled to recover its dielectric strength very quickly when the vacuum arc get disappeared. The metal vapors created during the arcing time get condensed on the surface of the main shield while the little gas released by the contacts is absorbed by condensed metal vapors and getter welded inside the interrupters, which ensure high vacuum condition of the vacuum interrupters.

## **4 Acceptance Inspections**

4.1 When goods are received, the customers should inspect the packages if there is any damage. When the packages are all open, the customers should inspect carefully if the interrupters are mechanically injured or correspond to the certificate of quality. For fine products, ceramic shells of the interrupters should be perfect and without any mechanical injuries; and inside the vacuum interrupters, there should be without any abnormal noise when they are shaken by hands.

### 4.2 Power frequency withstand voltage test

Vacuum interrupters should experience at least one test for power frequency withstand voltage. Before the test, however, the products should be wiped clean with dry cloth or with alcohol. Test is required to be done as followed: at rated full stroke, 70% of rated power frequency withstand voltage is applied to the both ends and held for one minute and then increased to 100% of the voltage for another minute. If interrupters cause no trip and the indicator does not fluctuate inappropriately, the products are qualified. It is permitted if there is any spark or flashover inside the vacuum interrupters.

4.3 If there is any product unqualified, please contact our sales department instantly to solve this problem.

## **5 Installations and Adjustment**

5.1 Before installation, vacuum interrupters should be cleared by cotton or silk with alcohol; meanwhile, the conductive rods and the connections should be cleared so that the vacuum interrupters are in good contact with the switchgears.

5.2 Vacuum interrupters should be installed and adjusted well according to installation requests of circuit breakers; but all mechanical parameters related should meet up with the specifications of vacuum interrupters.

5.3 It is never allowed to strike or hit on vacuum interrupters while installation or adjustment.

5.4 When the plate is connected to the fixed terminal of interrupters with bolts, screw-in depth into the interrupters should be less than the depth of thread marked on the technical drawings of interrupters.

5.5 As showed in Pic.1 and Pic.2, the movable stem should be firstly fixed up with a clumper on the milling flat (if there is any), in order not to move the stem and twist the metal bellows while mounting insulated push rod. If there is no milling flat or interrupters are used for embedded poles, please take reference to the anti-twist torque force given by its specifications. When the tightening force is smaller than the anti-twist torque force, a torque spanner should be used to tighten the insulated push rod. Detailed tightening torque values are given in the form attached. When tightening torque force is higher than the anti-twist torque force, the insulating push rod should be mounted in the manner Pic.2, which will prevent from moving the stem and twisting the metal bellows.

5.6 In service condition, a guide device is strongly requested so that the movable stem moves in axial direction and twists no bellows.

5.7 It should be noticed that the axes of the movable stem is perpendicular to the fixed end plate.

5.8 During installation, the ceramic shells of vacuum interrupters should bear no apparent horizontal stress.

5.9 Vacuum interrupters should not be removed repeatedly, which may cause severe damages to connecting threads; and in order not to twist or damage metal bellows, it is never allowed to twist the movable stem or excessively press the metal bellows.

5.10 Thread locker should not be applied while installing insulated push rod, which will prevent from pulling out threaded loop when the push rod has to be screwed out. If thread locker is used, please try not to pull out the insulated push rod.

5.11 While installing the insulating push rod, screw-in depth should not be less than 1.5 times of nominal diameter of the movable stem.

## **6 Applications and Operation**

6.1 Under service condition, the operating voltage and current should not exceed the rating values of interrupters.

6.2 The vacuum level of interrupters should be inspected periodically through the test of power frequency withstand voltage. It should be done as followed: Rated short time (1 min) power frequency withstand voltage is applied to the gap when vacuum interrupters are open at full stroke (circuit breakers are open). Permanent discharge is not allowed; otherwise, the vacuum interrupters should be replaced.

6.3 While circuit breakers are closed and simultaneously the erosion mark on movable stem gets disappeared (the contact erosion is over 3mm), interrupters go beyond their life cycles and should be replaced immediately.

## **7 Maintenance**

7.1 When packages are removed, vacuum interrupters should be roasted for 48 hours before usage if there is any moisture.

7.2 Regularly, vacuum interrupters should be inspected and cleaned if there is any erosion by moisture or erosive gas because of no use for a long term. If the products are damped, storage conditions should be improved after the process according to 7.1

7.3 Under service condition, routine maintenance should cover:

- a) Power frequency withstand voltage;
- b) Contact erosion;
- c) Surface condition;

## **8 Appendix, packing, transportation and storage**

8.1 Appendix: one copy for Service guide and certificate of quality.

8.2 Packing and transportation

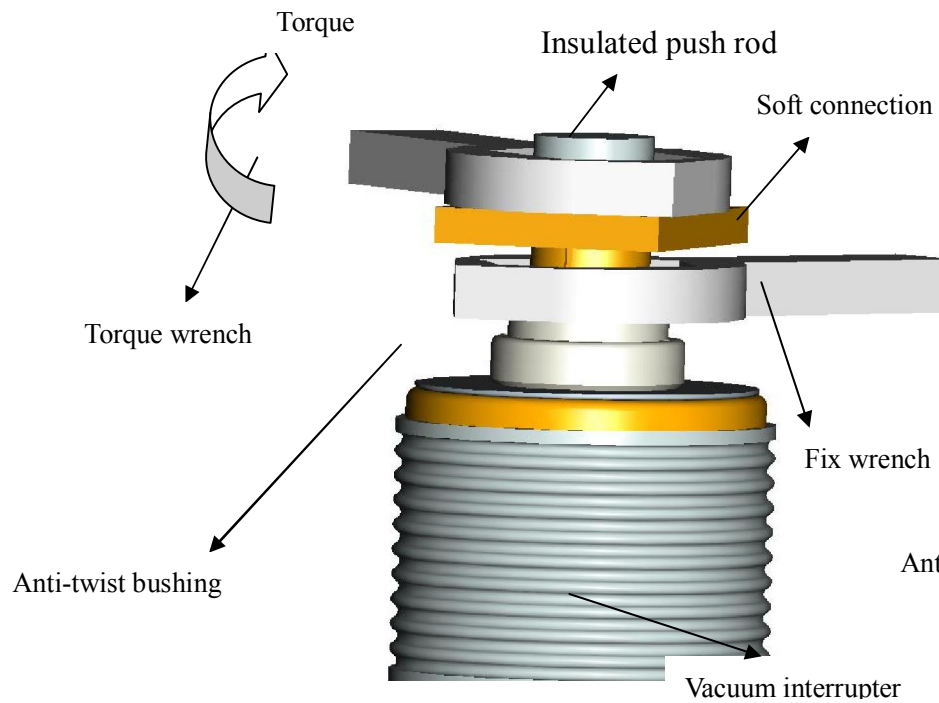
a) Before delivery, vacuum interrupters should be packed in accordance with the standards related to packages. Signs such as “Upwards”, “keep away from moisture”, “Fragile, Handle with care” should be clear and observable.

b) Well-packed vacuum interrupters are suitable for transportation by vehicles, trains, and airplanes. If by air, acceptable turbulence compares to the speed 20KM/H on III Road; packages should be handled with care; No turnover or strike.

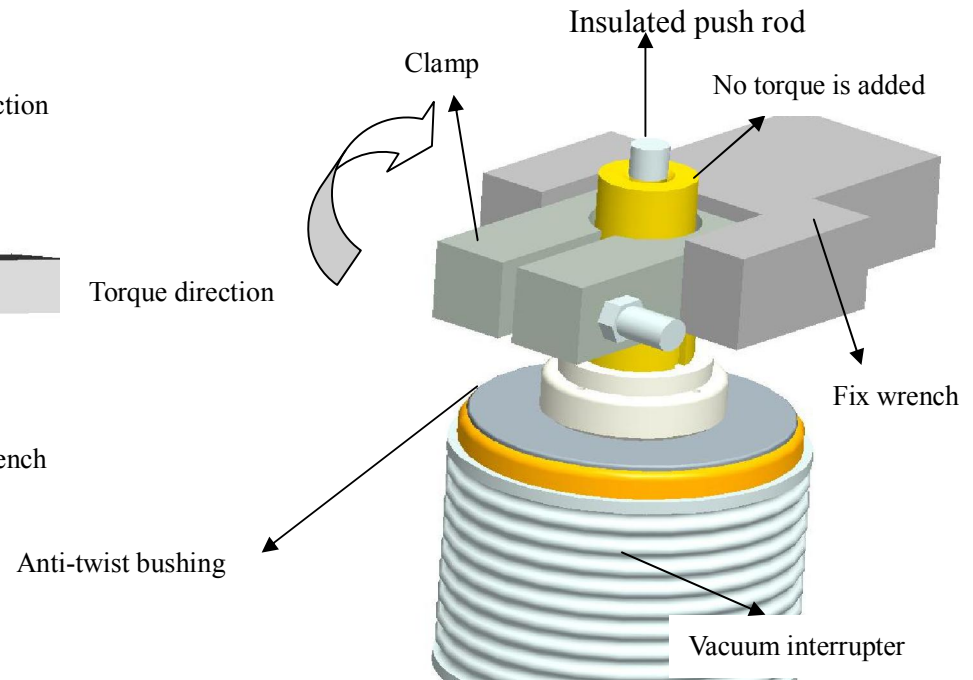
8.3 Storage

Conditions: dry, well-ventilated and corrosion-free warehouses at  $-30^{\circ}\text{C} \sim 40^{\circ}\text{C}$ .

Limit: 20 years uninstalled.



Pic.1



Pic.2

Tightening torque is recommended below:

Thread (Movable stem)	Rated tightening torque (Tolerance $\pm 5\%$ )	<p><b>Note:</b> When the maximum anti-twist torque is smaller than the recommended values, insulated push rod is suggested to be installed according to Pic. 2.</p>
M8	25Nm	
M10	30Nm	
M12	40Nm	
M16	60Nm	