



玻璃钢套管安装使用说明书

Fiberglass Capacitive Transformer Bushing
Installation & Operation Instruction

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1. 产品概况

目前电力变压器事故与故障70%是由套管引起的。传统的充油电容式瓷外套套管，是由于内部存在大量绝缘油等不稳定介质，加之密封不严及密封老化等问题引起；另有极少部分为相对意义上的干式套管（其内部芯体由聚四氟乙烯带、铝箔涂硅油卷制而成）由于其在设计思路、材料使用及工艺装备等方面的局限性，产品本身存在：漏油、污染、机械强度低、密封性能和防污性能差、易爆、危及人身及设备安全等缺陷。上述套管已不能满足电力部门对高压电气产品提出的小型化、无油化、免（少）维护和可靠性能高的使用要求。

电力系统中，用于GIS变电站的出线套管，户外部分为充SF₆气体式瓷套管，由于运行中漏气使内部气体压力下降，导致绝缘失效会造成套管爆炸，近年来使用复合空心绝缘子替代瓷套管逐年增多，虽然避免了爆炸危险，但是仍然存在漏气问题，带来大量监测及维护工作，另外由于GIS出线套管气室SF₆气体性能受压力影响，当环境温度很低时，气体浓缩（低于-40℃会液化），会使绝缘性能降低，所以在环境温度较低时，就不能使用此种套管。现由我公司研发生产的玻璃钢电容式GIS套管，是借鉴国外同类产品的设计理念，采用独创性的新型材料和制造工艺技术而研制出的一种纯干式玻璃钢电容式GIS套管产品，该产品除满足GB/T4109-2008、IEC60137Ed. 6. 0, MOD及有关各项最新标准外，还具有以下显著优点：

- a. 无瓷、无油、无气纯固体，无需维修保养；
- b. 设计绝缘裕度大，半导体材料电容屏，最大限度提高了起晕电压，运行中无局放；
- c. 耐-200℃低温和+135℃高温、阻燃绝缘材料，无分解、电气性能稳定，无燃烧及爆炸危险；
- d. 结构紧凑、体积小、重量轻、便于运输，可任意角度安装；
- e. 测地线缠绕、优化化学铺层设计，抗弯强度高，机械性能优异，尤其适于重震地区；
- f. 硅橡胶复合外套或高强瓷爬伞群满足重污秽地区使用要求。

1. General of Products

Presently, 70% of accidents and faults of electrical transformers are caused by bushings. To the traditional oil capacitive porcelain jacket bushings, it is because there are lots of unstable mediums such as insulation oil inside and there are problems of imprecise seals and aging of seals. There are a few of relative dry bushings, whose internal cores are rolled up by Teflon belts and foils coated with silicon oil, having the defects of leakage of oil, pollution, low mechanical strength, poor sealing performance and poor antifouling performance, explosiveness and danger to human body and equipment safety, as limited by ideas of design, usage of materials and process equipment. Above-mentioned bushings can't meet the power departments' requirements of small size, oil free, free (less) maintenance and reliability on high-voltage electric products. Referring to the ideas of design of similar products, using creative new materials and processes, we have develop a fiberglass capacitive transformer bushing which is a kind of pure dry fiberglass capacitive transformer bushing. This product conforms to

GB/T4109-2008, IEC60137Ed. 6. 0, MOD and various new standards. In addition, it has following advantages:

- a. no porcelain, no oil, no air, pure solid, no need to maintain
- b. large designed insulation margin, capacitive screen of semi-conductive material, improve discharge inception voltage as much as possible, no partial discharge in operation
- c. heat-resisting and flame-retarded insulation materials, no decomposition, stable electric properties, no risk of burning and explosion
- d. compact structure, small size, light weight, easy transportation, available for installation at any angles
- e. winding and optimized mechanical layout design of geodetic lines, high bending strength, excellent mechanical properties
- f. silicon rubber complex jackets or high-strength porcelain climbing umbrella groups to meet operation requirements of different areas

2. 使用条件

- 2.1 适用于10~330kV电力系统；
- 2.2 户内户外均可使用；
- 2.3 环境温度：-50℃~+50℃；
- 2.4 海拔高度：≤2000m，（超过2000m可另行设计）；
- 2.5 安装角度：任意角度安装；
- 2.6 污秽等级：可应用于III级以上重污秽地区。

2. Operation Conditions

- 2.1 Applicable for 10-330kV power systems;
- 2.2 For both indoor and outdoor usage;
- 2.3 Environment temperature: -50℃+50℃;
- 2.4 Altitude: ≤2,000m (available for custom design if above 2,000 m);
- 2.5 Angle of installation: angle-free installation;
- 2.6 Pollution grade: applicable for heavy pollution areas of Grade III and above

3. 主要技术参数

- 3.1 系统标称电压(kV): 10、20、35、45、66、110、132、154、220、330
- 3.2 额定电压(kV): 12、24、40.5、52、72.5、126、145、170、252、363
- 3.3 额定电流(A): 1~3, 150

3. Main Technical Parameters

- 3.1 Nominal voltage of system (kV): 10, 20, 35, 45, 66, 110, 132, 154, 220, 330
- 3.2 Rated voltage (kV): 12, 24, 40.5, 52, 72.5, 126, 145, 170, 252, 363
- 3.3 Rated current (A): 1-3, 150

4. 结构形式

4.1 结构特征

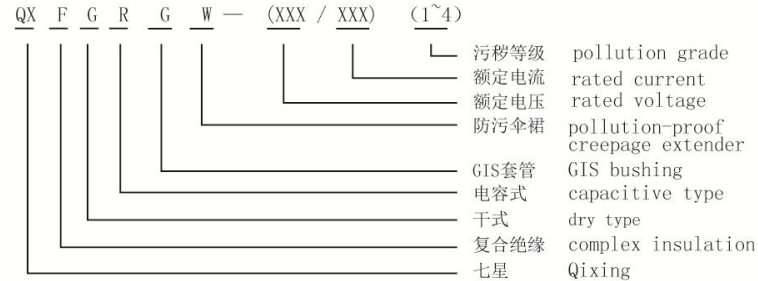
玻璃钢电容式套管的主绝缘是电容芯子，电容芯子是用进口高绝缘性能玻璃纤维浸以超低粘度耐高温环氧树脂，用微机控制缠绕设备按测地线缠绕构成绝缘层，采用半导体适形材料制成电容屏，绝缘层与电容屏交替缠绕间隔设置经高温固化制成纯固体电容芯子；联结法兰由高强度铝合金制成；增爬伞裙采用硅橡胶一次注射成型在电容芯子表面，与电容芯子形成有机整体。

The main insulation of fiberglass capacitive transformer bushing is a capacitive core which is made of imported fiberglass of high insulation properties dipped with heat-resisting epoxy resin with super-low viscosity by winding geodesic lines into insulation layer using computer controlled winding equipment, using semi-conductive conformable material to make capacitive screen. The insulation layer and the capacitive screen are wound and set in turn and they are made into pure solid capacitive core by high temperature solidification. The connection flange is made of high-strength aluminum alloy. The climbing umbrella skirt is formed on the surface of the capacitive core by one-time injection of silicon rubber and becomes an organic body with the capacitive core.

4.2 产品型号说明 Description of Type

Z—智能型 / 自诊断型 Intelligent / self diagnosing

GIS套管产品代号编制如下(注：瓷外套型QXGRGW)：



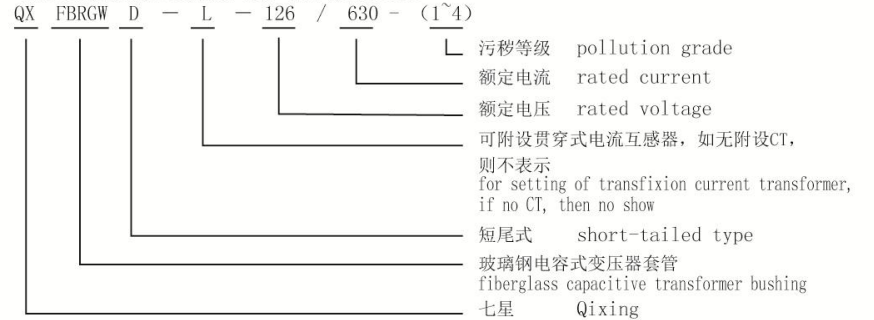
油-SF6变压器套管产品代号编制如下：



油-油变压器套管产品代号编制如下：



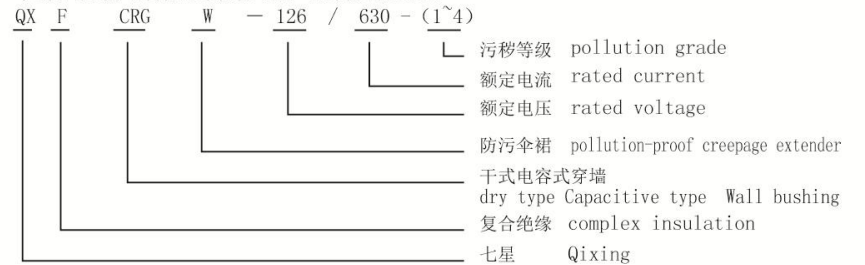
电容式变压器套管型号说明(注：瓷外套型QXBRGW)



非电容式变压器套管型号说明(注：瓷外套型QXBW)



干式电容式穿墙套管型号说明(注：瓷外套型QXCRGW)



5.4 At the time of adjusting the connection terminals, the bolts at the connection terminals should be loosened before adjustment. And tighten the bolts after adjustment to avoid partial warming due to poor contact.

5.5 The installation of cable-through type transformer bushing: Referring to the structural drawing below, loosen the installation bolt, take off the cap and the wire clip, then use special spanner to loosen the lock nut to separate the cap and the lead terminal. Weld the high-voltage leading wire of the transformer into the hold of the lead terminal. Use a lead wire which has a length longer than the bushing and a diameter no less than 2 mm to go down from the terminal to the outside of the tail of the bushing along the inner hole of the bushing. Then hang up the bushing above the installation hole of the transformer. The lower end of the lead wire goes through the hanging ring bolt (or hexagon bolt). Screw it into the screw hold of the upper surface of the lead connector. At this moment, face the bushing directly to the installation hole. Let it down slowly. At the same time, draw up the lead terminal by the lead wire, until the bushing is lowered behind the lifting pedestal of the cover of the transformer. Put the lock nut into the lead wire, insert the cylinder pin and take off the lead wire. Fasten the lead terminal and lock it with the lock nut, take off the cylinder pin. Then install the other parts reverse to the above sequences.

6. 使用与维护

6.1 该套管外绝缘为复合外套,具有良好的憎水性和耐污性,无需清扫;

6.2 该套管由内到外为纯干式实心结构,无需进行密封试验,如用户特殊要求,请与厂方协商;

6.3 套管的预防性试验请参照GB/T4109-2008《高压套管技术条件》和DL/T596-1996《电气设备预防性试验规程》执行;

6.4 套管运行中一般不进行局放试验,必要时如绝缘电阻或介质损耗值出现异常,则应进行局放试验,检验其绝缘性能,其值应满足标准要求;

6.5 运行中每三年测量一次套管的电容量和介质损耗值,测量时通过套管连接法兰上专设的测量端子进行,先将接地帽由测量端子插座上旋下,将测量头插入测量端子中心的测量孔中(电容抽头),即可进行套管的电容量、介质损耗和抽头耐压试验。试验完毕后取出测量头将接地帽装回测量端子上。每次试验时应用万用表测量接地帽的中心插头与其外壳阻值,应确认处于短路状态。测量时,再插拔和旋扭接地帽时,用力应适度,以免造成测量端子插座松动,导致密封隐患,切忌;

6.6 在运输和安装过程中,应避免伞套和金具表面油漆受到磕碰和摩擦,造成损伤;

6.7 套管运行时,末屏可靠接地(测量端子帽拧实);

6.8 测量端子帽除摘下测量时,其余时间务必拧实。

6. Usage and Maintenance

6.1 The external insulation of this bushing is a complex jacket which has

good hydrophobicity and resistance to soiling. It is not needed to clean it.

6.2 The bushing is a pure dry and solid structure from inside to outside. It is not needed to do seal test. If there are special customer's requirements, please contact the manufacturer.

6.3 The preventive tests of the bushing are carried out according to GB/T4109-2008 "High-Voltage Bushing Technical Conditions" and DL/T596-1996 "Procedures for Electric Equipment Preventive Tests".

6.4 Normally, when the bushing is in operation, the partial discharge test will not be carried out. If necessary, such as there is abnormal insulation resistance or dielectric loss value, the partial discharge test should be done to check its insulation properties. The value should meet the requirements of the standards.

6.5 In operation, the capacitance and the dielectric loss value of the bushing should be tested every three years. The test is done through the special testing terminal on the bushing connection flange. Firstly, screw down the grounding cap from the socket of the testing terminal. Put the testing head into the testing hole in the centre of the testing terminal (capacitive tap). Then it is possible to test the capacitance, the dielectric loss and tap withstand voltage. After the tests, take out the testing head and put the grounding cap back to the testing terminal. In every test, a multimeter should be used to measure the resistance values of the center pin of the grounding cap and its shell to confirm that it is in a short-circuit situation. At the time of testing, adequate force should be used to insert, take out and turn the grounding cap to avoid loosening the socket of the testing terminal to avoid hidden risk of sealing.

6.6. In the course of transportation and installation, it should be avoided to bump against and rub the umbrella cover and the painting on the surface of metal parts to avoid damage.

6.7. When the bushing is in operation, the end screen should be grounded reliably. (The cap of testing terminal should be tightened.)

6.8 Except of taking off the cap of testing terminal for test, it should be tightened at any other time.

7. 包装、运输与贮存

7.1 套管在放入包装箱时应将伞群外覆盖塑料薄膜,套管应水平放入包装箱内;

7.2 包装箱内应带有固定架两端有支撑物,使套管不致水平移动和倾斜;

7.3 若长期不使用,应放置在远离火源、热源及无强烈震动、干燥的室内贮存,应用防水毡布或类似的材料将箱体完全覆盖。

7. Package, Transportation and Storage

7.1 When putting the bushing into the package box, the umbrella group should be covered with plastic film. The bushing should be put into the package box horizontally.

7.2 In the package box, there must be a fixing frame with supporters at the two ends to avoid horizontal move and leaning of the bushing.

7.3 If it won't be used for a long time, it should be stored indoors in a dry place far away from fire, heat and without vibration. The box should be covered completely with waterproof felt or similar materials.

8. 订货须知

8.1GIS套管订货时至少需提出下述参数:

电气参数: 额定电压、额定电流、额定频率、外绝缘爬电距离及绝缘净距、SF6端长度;

环境参数: 环境温度、海拔高度、污秽等级;

8.2变压器套管订货时至少需提出下述参数:

电气参数: 额定电压、额定电流、额定频率、外绝缘爬电距离及绝缘净距、油端长度、穿缆长度(很重要)、CT安装位长度(很重要);

环境参数: 环境温度、海拔高度、污秽等级。

8.3油-SF6变压器套管订货时至少需提出下述参数:

电气参数: 额定电压、额定电流、额定频率、油端长度、CT安装位长度(很重要)、SF6端长度;

环境参数: 环境温度。

8.4油-油变压器套管订货时至少需提出下述参数:

电气参数: 额定电压、额定电流、额定频率、两个油端长度、CT安装位长度(很重要)、穿缆长度;

环境参数: 环境温度;

安装方式: 测量端子安装尺寸。

8.5穿墙套管订货时至少需提出下述参数:

电气参数: 额定电压、额定电流、额定频率、户内及户外的外绝缘爬电距离;

环境参数: 环境温度、海拔高度、污秽等级;

安装方式: 安装角度默认为水平安装, 如是其他安装角度请标明; 如需附设贯穿式电流互感器, 须明确电流互感器为分体式还是一体式, 并提出电流互感器的相关参数。

注: 套管法兰和接线端子的设计可以根据变压器制造商的要求进行特殊修改, 也可对用户原有套管提供替代品。

8. Ordering Instruction

8.1 For ordering a wall bushing, the below parameters should be provided at least:

Electric parameters: rated voltage, rated current, rated frequency, indoor

and outdoor external insulation creep distance;

Environmental parameters: environment temperature, altitude, pollution grade

Way of installation: The installation angle is horizontal installation in default. If it is of other installation angle, please indicate it. If it is needed to set transfixion current transformer, it should be clarified that the current transformer is of split type or integral type. The concerned parameters of the current transformer should be provided.

8.2 For ordering a transformer bushing, the below parameters should be provided at least:

Electric parameters: rated voltage, rated current, rated frequency, external insulation creep distance, net distance of insulation, length of oil end, length of transfixion cable (very important), length of CT installation position (very important);

Environmental parameters: environment temperature, altitude, pollution grade

8.3 For ordering an oil-SF6 transformer bushing, the below parameters should be provided at least:

Electric parameters: rated voltage, rated current, rated frequency, length of oil end, length of CT installation position (very important); length of SF6 terminal

Environmental parameters: environment temperature

8.4 For ordering an oil-oil transformer bushing, the below parameters should be provided at least:

Electric parameters: rated voltage, rated current, rated frequency, length of two oil ends, length of CT installation position (very important), length of transfixion cable;

Environmental parameters: environment temperature

Way of installation: installation dimension of testing terminal

8.5 For ordering an wall bushing, the below parameters should be provided at least:

Electric parameters: rated voltage, rated current, rated frequency, The creepage distance of external insulation indoor and outdoor;

Environmental parameters: environment temperature, altitude, pollution grade

Way of installation: Mounting angle default is installed horizontally, as are the other installation angle please mark; as with the through type current transformer, current transformer shall be clearly split or integrated, and puts forward the related parameter of current transformer.

Notes: The design of flange of bushing and connection terminals can be modified subject to the requirements of the manufacturers of transformers. The replacement products are available to replace the original bushings of our customers.

4.3 典型产品主要电器参数 Electric Parameters of Typical Product

额定电压 rated voltage (Ur) kV	系统工作电压 working temperature of system (Un) kV	60s工频耐受kV 60s power-frequency withstand voltage		雷电冲击干耐受电压 lightning shocks dry withstand voltage kV	爬电距离mm creep distance mm	
		干 dry	湿 wet		III级 Grade III	IV级 Grade IV
12	10	28/30	28	75	300	372
24	20	50/55	50	125	600	744
40.5	35	95	80	200	1012.5	1256
52	52	105	95	250	1300	1612
72.5	66	140/155	140	325	1813	2248
126	110	230/255	230	550	3150	3906
145	132	305	275	650	3625	4495
170	154	355	325	750	4250	5270
252	220	460/505	460	1050	6300	7812
363	330	535/625	535	1175	9075	11253

4.4 套管的60s弯曲负荷耐受试验：弯曲耐受负荷按下表进行（单位：N）

60s bending load withstand test of bushing: The bending withstand load is done according to the following table (unit: N)

表二：弯曲耐受负荷 Bending Withstand Load

额定电压, kV Rated Voltage, kV	额定电流 Rated Current, A			
	≤800	1000~1600	2000~2500	≥3150
≤72.5	1000	1250	2000	4000
126	1250	1600	2500	4000
145-363	1250	1600	2500	4000

4.5 玻璃钢电容式GIS套管的出厂试验标准

Standard of Delivery Test of Fiberglass Capacitive Transformer Bushing

按照GB/T 4109-2008《交流电压高于1000V的绝缘套管》及企业标准，出厂试验按下表进行。

According to the GB/T 4109-2008 “Insulation Bushing of AC Voltage above 1,000V” and the enterprise’s standard, the delivery test is done according to the following table.

序号 No.	项目 Item	要求 Requirements				说明 Explanation	
1	外观及尺寸检查 Appearance and Size Check	外观完好，符合图纸要求。 Good appearance. Conform to the requirements of the drawings					
2	介质损耗因数 Dielectric Dissipation Factor	≤0.4%				GB/T 4109中，≤0.5%	
3	电容量 Capacitance	给出实测值 Given actual value					
4	交流耐压 AC withstand Voltage	电压等级kV Voltage Level kV	66	110	220	330	
		耐压值 Withstand Voltage Value	140/155	230/255	460/505	535/625	
5	局部放电量 Partial Discharge	局部放电量在Ur下≤10pC；在1.05Ur / 3 下≤5pC Partial discharge: under Ur≤10pC; under 1.05Ur / 3 ≤5pC				GB/T 4109中，≤20pC	
6	末屏耐压 End Screen withstand Voltage	3kV/1min				GB/T4109中，2kV/1min	
7	密封性 End Screen withstand Voltage	变压器/油-油套管0.15MPa/20min无泄露 GIS/SF6-油套管0.65MPa/20min无泄露 No leakage under 0.15MPa/20min					

5. 安装程序及注意事项

5.1 开箱检查产品外观有无损坏，仔细核对产品的型号规格是否符合订货要求，并按装箱清单察看附件及合格证等文件是否齐全；

5.2 套管安装前应将套管表面擦拭干净；

5.3 套管吊装时，吊绳应固定在连接法兰的吊环上；不得使测量端子受机械力作用，以免损伤；不得使复合外套伞裙受到冲撞或磕碰，以免损伤；

5.4 调节接线端子时应将接线端子处的螺栓松开后调整，调整后将螺栓紧固，以免因接触不良导致局部发热。

5. Installation Procedures & Attentions

5.1 Open the box to check the appearance of product and see whether there are any damages. Check the type and the specifications of product to see whether the product accords with the requirements of the order. Subject to the packing list to check whether there are complete attachments and documents of certificate and so on;

5.2 Clean the surface of the bushing before installation;

5.3 The hanging rope should be fixed on the rings of the flange when hanging up the bushing. The testing terminals should not be applied with any mechanical force to avoid damage. It is not allowed to impact the complex jacket umbrella skirts to avoid damage;