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## 用户手册 User Manual

### SOPVT 运输、安装、维护使用说明书 SOPVT Transportation, Installation and Maintenance Manual M020002535

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## 适用范围 Scope of Application

本使用说明书适用于 72.5-145kV 户外型、站用变压器产品的运输、安装、维护及注意事项等要求。  
The Manual is applicable to transportation, installation, maintenance and other precautions of 72.5-145kV outdoor substation transformer.

## 产品说明 Product Description

### 产品结构简介

#### Introduction to Product Structure

典型的站用变压器结构见图 2.1

Refer to Fig. 2.1 for typical structure of substation transformer

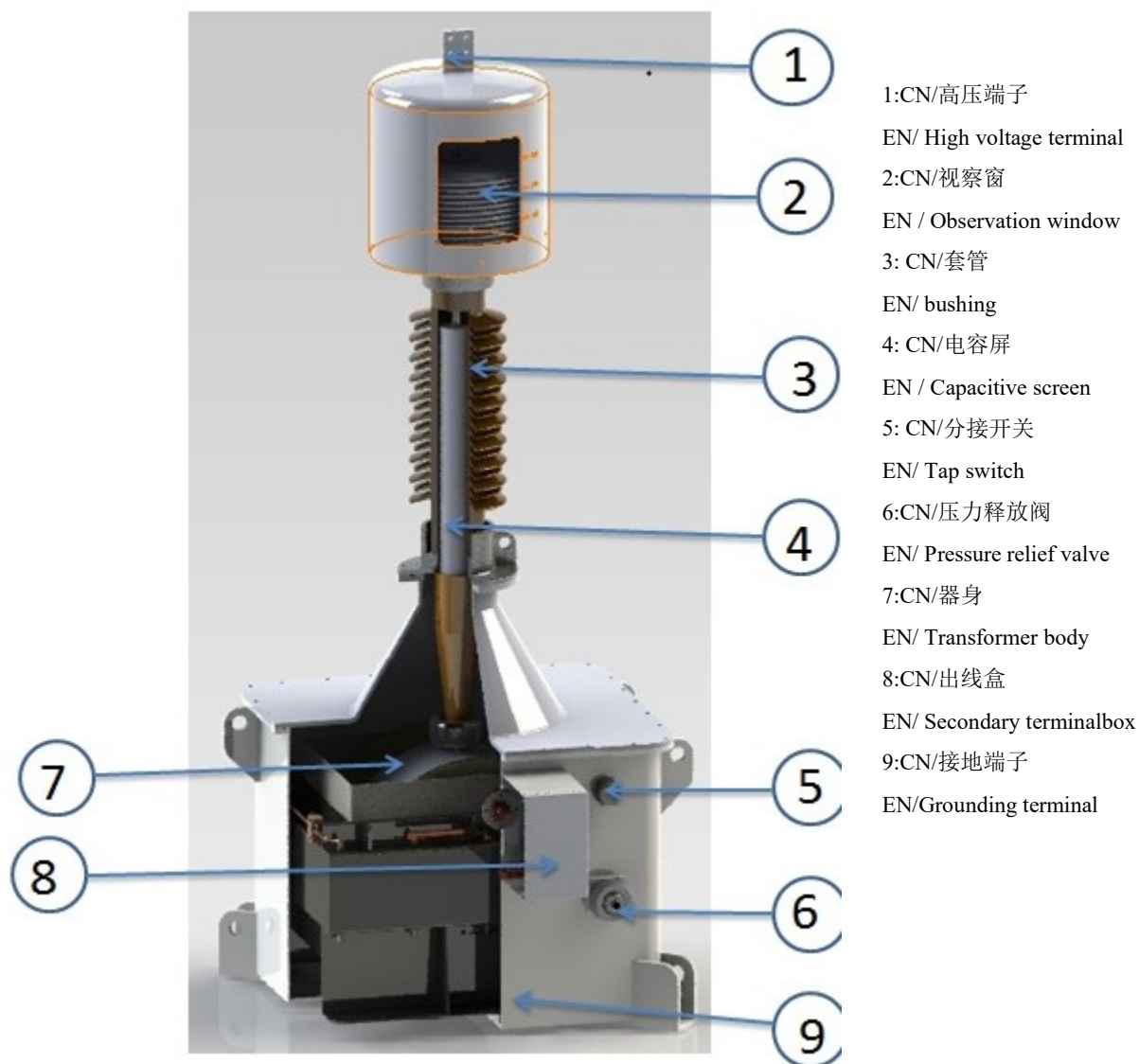


图 2.1 典型的站用变压器结构图

Fig. 2.1 Typical Structure of Substation Substation transformer

**工作条件/Operation conditions****环境条件****Environmental Condition**

最高气温：50 °C

Maximum temperature: 50°C

日平均气温不超过：40 °C

Daily average temperature no more than: 40°C

最低温度：-25 °C

Minimum temperature: -25°C

月平均最大相对湿度：95 % (25°C)

Monthly average maximum relative humidity: 95% (25°C)

以上温度为常规使用温度等级，当该说明书上的使用温度与技术规范不一致时，以签订的技术规范为准。  
The above temperatures are normal service temperature grades, when the service temperature on the Manual is inconsistent with the technical specification, the signed technical specification shall prevail.

**海拔高度****Altitude**

站用变压器实际应用海拔详见产站用变压器上的铭牌。

The actual application altitude of the substation transformer is shown in the nameplate on the substation transformer.

安装处海拔超过 1000m 时，其外绝缘的绝缘水平按 IEC 60071-1:2006 进行修正。

When the altitude of the installation location exceeds 1000m, the insulation level of the external insulation shall be modified according to IEC 60071-1:2006.

未经我公司允许，不得将站用变压器挪用到其他高海拔地区（超过站用变压器铭牌上的海拔）。

Without the permission of our company, it is not allowed to divert the substation transformer to other high-altitude areas (higher than the altitude on the nameplate of the substation transformer).

## 运输 Transportation

产品运输须将产品固定在包装箱内，直立运输；运输时，建议使用站用变压器的原有包装箱，并按原有形式重新装箱包装箱如图 4.1 所示。

The product must be fixed in the packing box and transported vertically; During transportation, it is recommended to use the original packing box of the substation transformer, and repack the packing box according to the original form as shown in Fig. 4.1.



图 4.1 SOPVT 包装箱示意图

Fig. 4.1 Schematic Diagram of SOPVT Packing Box

## 存储 Storage

站用变压器按原有包装形式，储存在干燥通风，无腐蚀的环境中，不允许露天存放，且应做好防潮措施；站用变压器堆放不允许超过包装箱表面堆层标识要求。

The substation transformer shall be packed in the original form and stored in a dry, ventilated and non-corrosive environment. It is not allowed to be stored in the open air and moisture-proof measures shall be adopted. The stacking of substation transformers shall not exceed the stacking marking requirements on the surface of packing box.

## 签收及拆箱检查 Sign for Receipt and Unpacking Inspection

- (1) 站用变压器签收前，核实产品及配件数量是否与订货一致；  
Before receiving the substation transformer, check whether the quantity of products and accessories is consistent with the order;
- (2) 检查包装箱外观是否有损坏、油渍等异常；  
Check the appearance of the packing box to ensure there is no damage, oil stains and other abnormalities;
- (3) 站用变压器开箱吊装前，检查站用变压器外观有无磕碰、损坏或漏油等异常；  
Before unpacking and lifting the substation transformer, check whether the substation transformer is bumped, damaged or leaking oil;
- (4) 站用变压器安装前需检查压力释放阀闭锁装置是否紧固，不松动。  
Before the installation of the substation transformer, check whether the locking device of the pressure relief valve is tight and not loose.

## 吊装 Lifting

- (1) 起吊站用变压器时，应用底座上的四个吊攀，用四根同样长度的吊缆置于起吊钩上，慢慢吊起，注意不要碰伤套管,如图 7.1。  
When lifting the substation transformer, use the four joint hinges on the base and place four cables in same length on the lifting hook to slowly lift the substation transformer. It shall be noted that bushing shall not be damaged. See Fig. 7.1.
- (2) 起吊时，注意绳子的长度，保持站用变压器重心平衡。  
During lifting, the length of cable shall be noted and the center of gravity of the substation transformer shall be kept balanced.
- (3) 起吊时，需避免吊缆损坏产品膨胀器金属罩。  
During lifting, it is necessary to avoid damaging the metal cover of expander by lifting cable.

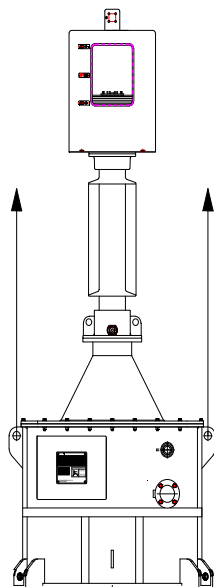


图 7.1 吊装示意图

Fig. 7.1 Schematic Diagram of Lifting

## 安装 Installation

### 站用变压器安装前准备

#### Prepare the substation transformer before installation

站用变压器安装前需将膨胀器外罩拆除，如图 8.1，取出内侧的防护纸板和运输防护垫块，具体操作如下：

将吊带从一次导排孔中穿过并吊起，用内六角扳手拧开膨胀器外罩两侧内六角螺栓，小心拆除膨胀器外罩，取掉内侧的防护纸版和运输防护垫块，最后再将膨胀器外罩复原装配。（吊带由我司随产品提供，需注意此吊带不能用于吊装产品）

Before installing the substation transformer, the outer cover of the expander should be removed(See Fig. 8.1.), and the protective paper plate and transportation protective pad inside should be taken out. The specific operations are as follows:

Pass the sling through the primary guide hole and lift it, unscrew the hexagon bolts on both sides of the expander housing with an inner hexagon wrench, carefully dismantle the expander housing, remove the inner protective paper and transport protective pad, and finally restore the expander housing to assembly.(The sling is provided with the product by our company. Please note that the sling cannot be used for hoisting the product.)



图 8.1 外罩吊装示意图

Fig. 8.1 Schematic Diagram of Lifting the Cover

### 站用变压器安装固定

#### Installation and Fixation of Substation transformer

采用合适长度的吊具，将站用变压器吊到平面支架，站用变压器就位后，用螺栓与安装支架固定牢靠，并用接地排将站用变压器底座与支架等电位连接。产品安装固定后，才可拆除吊具。

Use a lifting tool of appropriate length to lift the substation transformer to the plane bracket. After the substation transformer is in place, fasten it firmly with the mounting bracket with bolts. Connect the base of the substation transformer to the bracket at equal potential with the grounding bar. The lifting tool can be removed only after the product is installed and fixed.

## 压力释放阀 Pressure Relief Valve

在设备运行前必须将闭锁装置拆除，以保证压力释放阀正常工作，如图 8.2  
The locking device shall be removed before the equipment is put into operation to ensure the normal operation of the pressure relief valve, See Fig. 8.2.

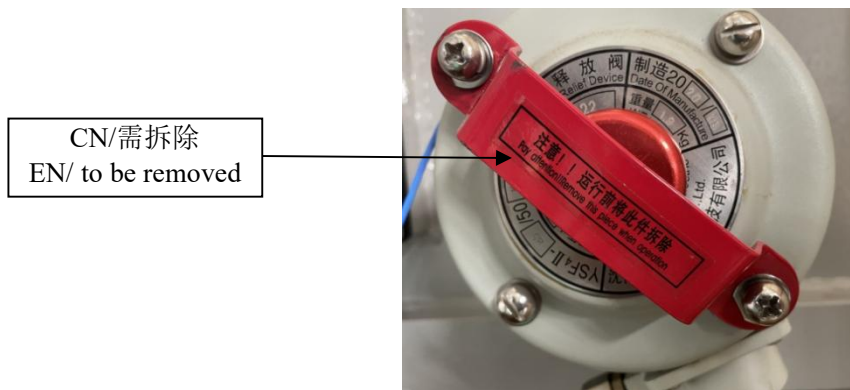


图 8.2 闭锁装置示意图  
Fig. 8.2 Schematic Diagram of The locking device

## 分接开关 Tap Switch

分接开关使用后，需将防雨罩复位拧紧，如图 8.3；  
The rain cover shall be reset and tightened after the tap switch is used, See Fig. 8.3.

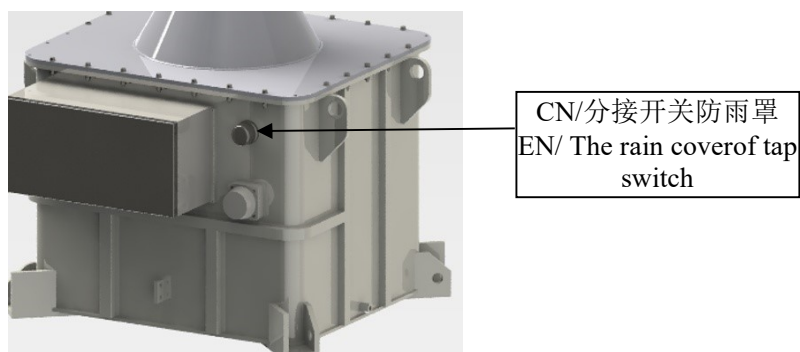


图 8.3 防雨罩示意图  
Fig. 8.3 Schematic Diagram of the rain cover

## 高压端子 High Voltage Terminal

高压端子连接前，对接触面进行清理，保证接触面无锈蚀氧化现象；接触面可涂适量导电膏。连接紧固件，保证长期有效的接触压力。

Clean the contact surface before the connection of the high voltage terminal, so as to ensure that there is no rust and oxidation on the contact surface; the contact surface can be coated with an appropriate amount of conductive paste. The fasteners shall be connected to ensure long-term and effective contact pressure.

## 二次端子连接 Secondary Terminal Connection



在连接二次端子前，应确保系统处于未通电状态，并同时注意由附近运行的设备所引起的游离电磁场。

Make sure that the system is not energized, and pay attention to the free electromagnetic field caused by the nearby operating equipment before connecting the secondary terminal.

(1)按照站用变压器铭牌或说明牌的示意图进行二次端子的连接，检查是否松动，二次端子如图 8.3。  
Connect the secondary terminal according to the schematic diagram of the substation transformer nameplate or instruction plate, and check whether it is loose. The secondary terminal is shown in the Fig. 8.3.

(2)二次绕组不允许短路，正常运行时， $\tan\delta$ 、H0 可靠接地。  
The secondary winding is not allowed to be short circuited, and  $\delta$  and H0 shall be reliably grounded.

(3)实际供货产品二次端子可能与本说明书不同，以实物为准。  
Supplied secondary terminal may be different from the description in the Manual, and the real object shall prevail.

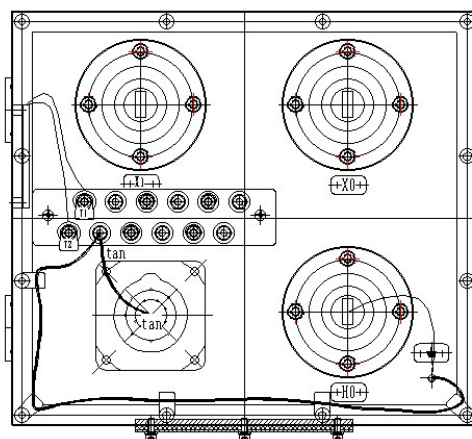


图 8.4 二次端子示意图

Fig. 8.4 Schematic Diagram of Secondary Terminal

### 接地端子连接

#### Grounding Terminal Connection

站用变压器的接地端子位于出线盒下方，该接地点应与电站地网可靠连接。接地线应能承受系统短路电流，如图 8.5。

The grounding terminal of the substation transformer is located under the Secondary terminal box. The grounding point should be reliably connected to the ground grid of the power station. The grounding wire shall be able to withstand the system short-circuit current. See Fig. 8.3.

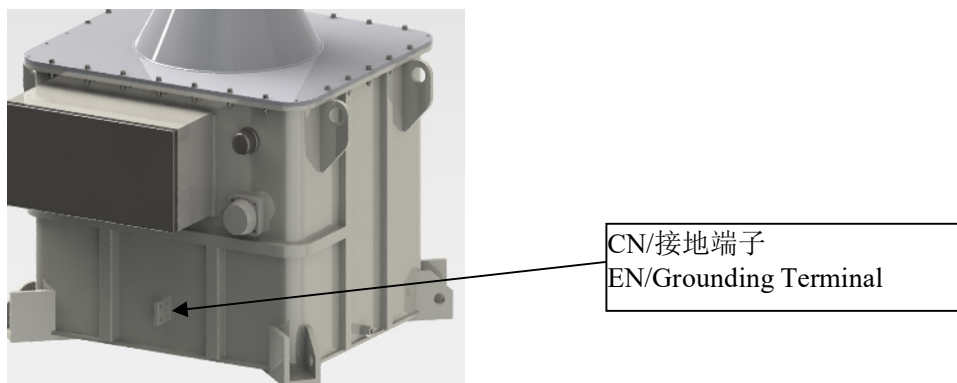


图 8.4 接地端子示意图

Fig. 8.4 Schematic Diagram of Grounding Terminal

## 投运及维护 Operation and Maintenance

### 投运前检查

#### Inspection before Operation

(1) 站用变压器安装固定后，至少静置 24h 后再投运；

After the substation transformer is installed and fixed, it should be kept stand still for at least 24h before being put into operation;

(2) 确认三相站用变压器油位高度一致；

Confirm the oil level of the three-phase substation transformer is consistent;

(3) 检查站用变压器无漏油异常；

Check whether the substation transformer is leaking oil;

(4) 确认  $\tan\delta$  及 H0 端子可靠接地；

Confirm that  $\tan\delta$  and H0 terminals are reliably grounded;

(5) 确认分接开关档位是否与实际需求一致。

Confirm whether the gear if tap switch is consistent with the actual demand.

### 日常巡查项目

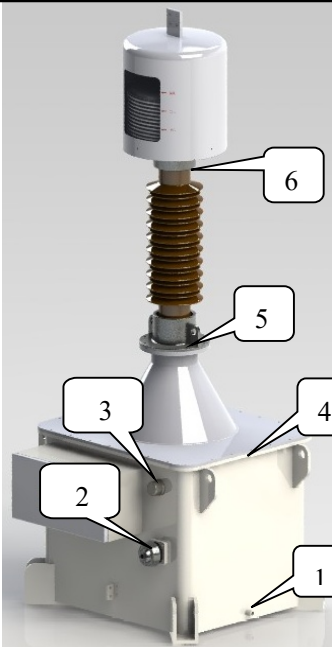
#### Routine Inspection Items

设备投运后，应经常性进行日常检查，检查内容如表 9.1。

After the equipment is put into operation, routine inspection should be carried out regularly according to Table 9.1.

表 9.1 检查项目  
Table 9.1 Inspection Items

序号 S/N	检查项目 Inspection Items		合格要求 Compliance Requirements	巡查时间 Inspection Time
1	运行状态 Operation Status	仪表指示 Instrument Indication	仪表指示正常 Instrument is indicated normally	投运运行期间 During commissioning and operation
2	油位指示器 Oil level indicator	1、检查三相站用变压器膨胀器油位指针高度是否一致； Check whether the oil level indicator height of three-phase substation transformer expander is consistent; 2、油位指示红色标识线位置。 Check the red marker line of the oil level indicator.	1、三相站用变压器的红色油位指示高度基本一致； The indicated height of the red oil level of the three-phase substation transformer shall be basically consistent; 2、油位红色标识线在 MAX 与 MIN 之间，并且清晰可见。 The red mark line of the oil level shall be between MAX and MIN, and be clearly visible.	投运运行期间 During commissioning and operation

3	<p>套管和油箱密封连接部位、膨胀器、分接开关、压力释放阀、油阀位置无油迹</p> <p>No oil contamination on the sealing connecting part of bushing and tank, expander, tap switch, pressure relief valve, and oil valve</p>		<p>六个位置无油迹</p> <p>No oil contamination on the six places</p>	<p>运行期间</p> <p>During operation</p>
4	<p>高压端子</p> <p>High Voltage Terminal</p>	<p>高压端子连接有无扭曲变形，连接处有无变色。</p> <p>Connection of high voltage terminal has no distortion, and the color of connection position shall not be changed.</p>	<p>高压端子连接无扭曲变形，连接处无变色。</p> <p>Connection of high voltage terminal has no distortion, and the color of connection position shall not be black.</p>	<p>验收时</p> <p>During acceptance</p> <p>投运前</p> <p>Before operation</p> <p>运行中</p> <p>During operation</p>
5	<p>套管</p> <p>Bushing</p>	<p>套管伞裙有无破损、裂纹、严重油污、放电痕迹及其它异常情况。</p> <p>Check whether there are damaged, cracks, serious oil contamination, electric discharging trace and other abnormal conditions of bushing skirt.</p>	<p>套管伞裙无破损、裂纹，无严重油污，无放电痕迹及其它异常情况</p> <p>There is no damage, cracks, serious oil stains, electric discharging trace or other abnormal conditions of bushing skirt</p>	<p>运行期间</p> <p>During operation</p>

## 回收处置 Recycle Treatment

此产品主要组成材料成分包含：金属铜、铁、铝，变压器油及陶瓷；在正常工况条件下，站用变压器使用寿命为 30 年。站用变压器到期报废或不再使用后，金属铜、铁、铝，变压器油及陶瓷应集中交给具有资质的单位回收处理，以避免对环境的污染影响。

The main components of the product include copper, iron, aluminum, substation transformer oil and ceramics. Under normal working conditions, the service life of the substation transformer is 30 years. When the substation transformer is scrapped or no longer in use, the copper, iron, aluminum, substation transformer oil and ceramics shall be collectively handed over to the qualified unit for recycling and processing, so as to avoid the pollution and impact on the environment.

## 附录 A Appendix A

## 测介损的试验方法

## Test Method for Measuring Dielectric Loss

整体介损测量说明：

Description on measurement of overall dielectric loss:

将站用变压器高压端子和二次端子从电网上断开，二次端子盒内标记  $\tan\delta$  的端子要从接地端子(≡)断开。测量电压施加在站用变压器顶部的高压 H1 端。 $\tan\delta$  端子接测试仪  $C_x$ ，外接标准电容器（如果有）接测试仪  $C_n$ ，详细见附图 1；测量电压为 10kV，测量时，一次绕组末端 H0 端子、所有二次绕组的末端（X0）及底座必须要接地。

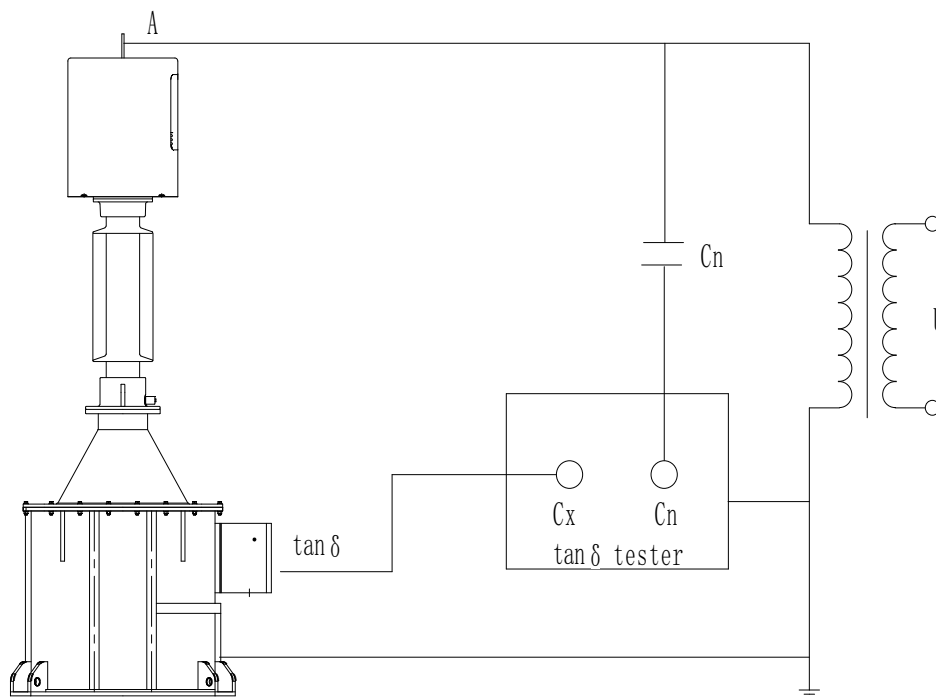
Disconnect the high voltage terminal and secondary terminals of the substation transformer from the power grid, and disconnect the terminal marked with  $\tan\delta$  in the secondary terminal box from the grounding terminal (≡). Apply measured voltage to the high-voltage H1 terminal on the top of the substation transformer. Connect  $\tan\delta$  terminal is to the tester  $C_x$ , and the external standard capacitor (if any) to the tester  $C_n$  as detailed in Fig. 1. The measured voltage is 10kV. During measuring process, the H0 terminal at the end of primary winding, the end of all secondary windings(X0), and the base shall be grounded.

警告：试验时，所有二次绕组只能末端接地，首末端不得短接。

Warning: during testing process, all secondary windings can only be grounded at the end but the first end shall not be short circuited.

试验后，产品在与线路连接前，请确认已将二次端子盒内的端子 N 和  $\tan\delta$  端子可靠接地。

After the test, please confirm that the N terminal and  $\tan\delta$  terminal in the secondary terminal box are reliably grounded before connecting the product to the line.



附图 1 介损测试原理图

Attached Fig.1 Schematic Diagram of Dielectric Loss Testing