## Catalog

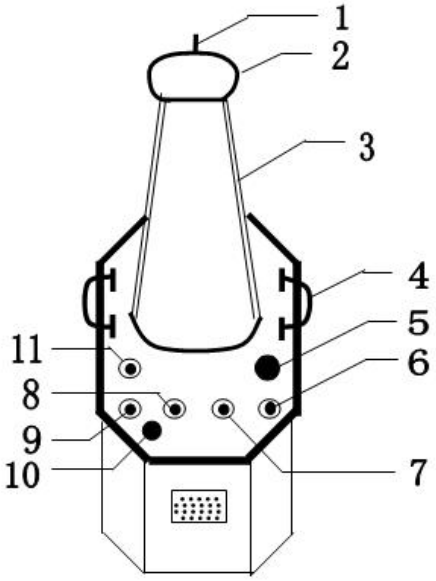
**RDYD-10kVA/100kV Hipot Test Set**

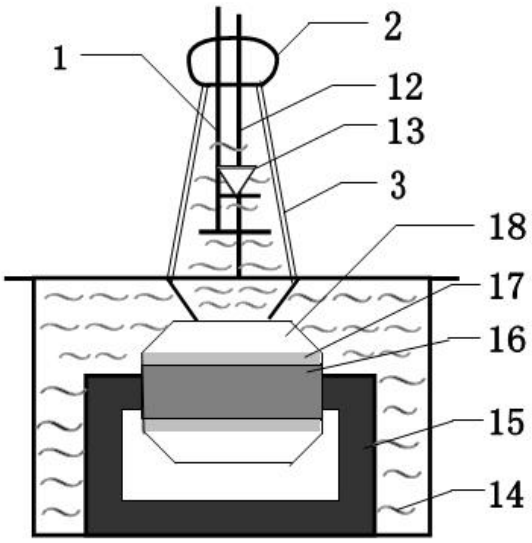
# 1. Brief Introduction

RDYD-10kVA/100kV Hipot Test Set is based on the Electrical and Mechanical Department "Test Transformer" standard, and it is produced through great improvement on the basis of similar products. TE series Oil-Immersed Test Transformer is a new kind of product which is an improved version and made on the basis of TE series test transformer in accordance with national standards "ZBK-41006-89". This series of products have the features of small size, light weight, compact structure, complete functions, versatility and easy to use. Especially applicable to power frequency or DC high voltage dielectric strength tests for high-voltage electrical equipment, electrical components, insulating materials in power systems, industrial and mining enterprises and scientific research departments, etc. It is indispensable and important equipment for high voltage tests.

# 2. Product Structure

RDYD-10kVA/100kV Hipot Test Set adopts single-frame iron-cored structure. Primary winding around the iron-core, the high-voltage winding outside, this kind of coaxial decorate reduced leakage flux, thus increasing the coupling between the winding. Its shell is made into octagonal structure to harmony with the instrument core, thus the general appearance appears beautiful. See the external structure in picture 1, the internal structure in picture 2.




Picture 1: Single test transformer External structure

Picture 2: Single test transformer internal structure

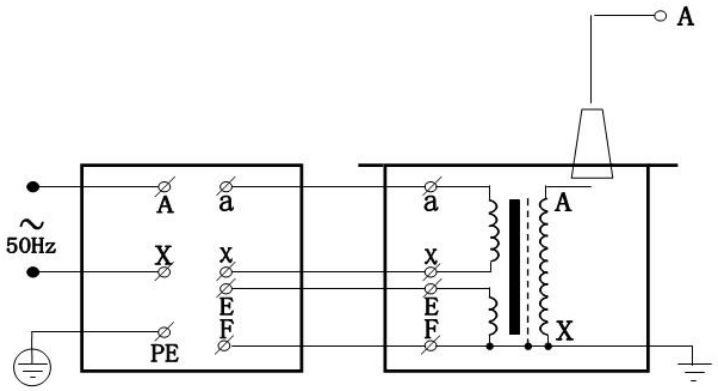
1- Short-circuit rod D
2- Equalizing voltage ball
3-HV bushing
4- Transformer handle
5- Oil valve
6, 7-Secondary voltage input a, x
8, 9-Measuring terminals E, F
10 - Transformer shell earth terminal
11- HV end X
12-HV output A
13-HV silicon assembly
14-Transformer oil
15- Iron core
16-Secondary LV winding
17- measuring winding
18-secondary HV winding

In test transformer, a, x are LV input terminals, E, F are meter measuring terminals, A, X are HV output. There is no HV silicon assembly in TE-OAT series products.

# 3.Working principle

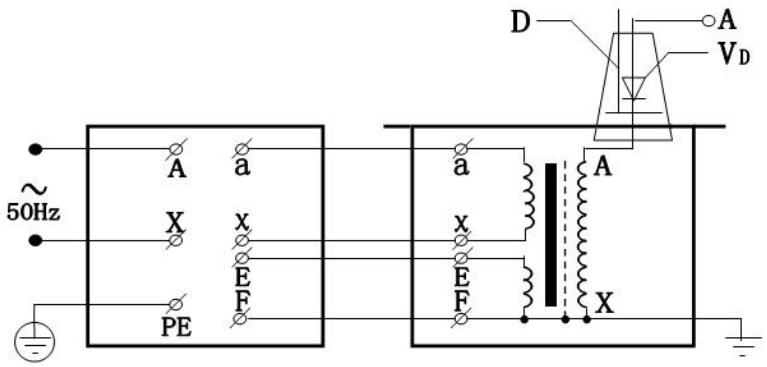
RDYD-10kVA/100kV Hipot Test Set, a single-phase transformer, connects with series control box (which is the equipped special instruments for our test transformer, the details shown in the manual book) under power frequency 220V (above 10kVA is 380V). Use the automatic voltage regulator of control box regulate 0 ~ 200V (or 0 ~ 400V) output to test transformer's primary windings. Test transformer HV winding can obtains test required HV according to electromagnetic induction principle.

1.Single RDYD-10kVA/100kV series test transformer see picture 3




Picture 3: Single RDYD-10kVA/100kV series HV test transformer principle diagram

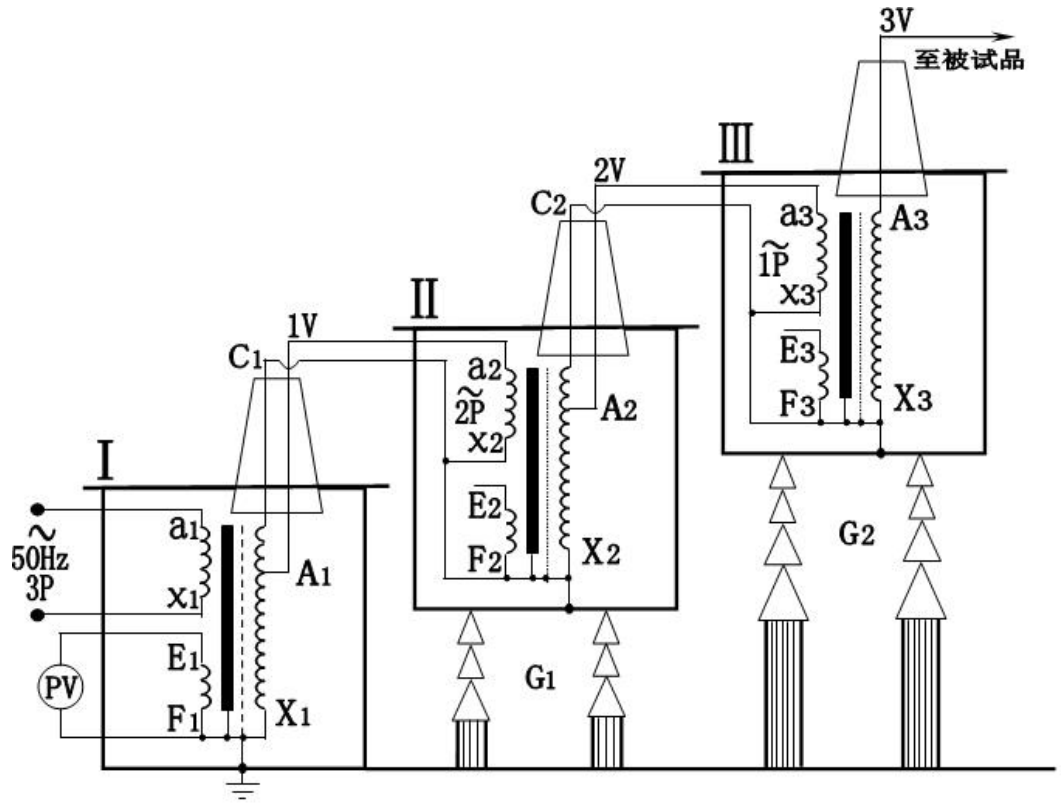
2.Single RDYD-10kVA/100kV series test transformer work principle see picture 4, HV bushing equipped with HV silicon assembly, which is connected with HV circuit as half wave rectifier to gain DC high voltage. When using a short circuit rod short-circuited HV silicon assembly, power frequency high voltage can be obtained; Remove short-circuit rob to get DC output state.




Picture 4: Single AC&DC test transformer principle diagram

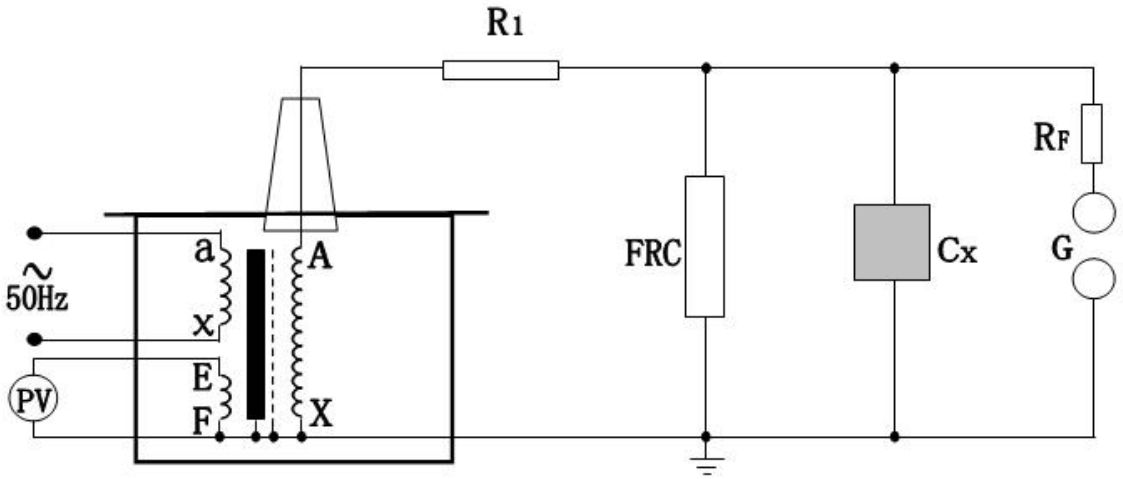
D- Short-circuit rod VD-High voltage silicon assembly

3.The connection principle of three test transformers cascade to obtain higher voltage see picture 5. Cascade high-voltage test transformers have great advantages, because the whole test device consists of several single test transformers, a single test transformer has small apparent power, low voltage, and light weight, easy to transport and install. This device can be used singly and in combination. As it can be cascaded into high output test transformer which has several times higher output than single test transformer, and also can be separated into several sets of test transformer singly. Complete set device with small investment, economical and practical. In picture 5, between grade Ⅰ and Ⅱ, each unit test transformer has an excitation winding A1, C1 and A2, C2. In basic principle of three cascade test transformer, Low-voltage power supply add on primary winding a1x1 of the test transformer I, the output voltage of single test transformer Ⅰ, Ⅱ, Ⅲ are all V. The excitation winding A1, C1 provides power for primary winding of secondary grade test transformer Ⅱ; The excitation winding A2, C2 of the secondary test transformer Ⅱ provides power for the primary winding of thirdly grade test transformer Ⅲ. The cases of secondary grade test transformer Ⅱ and thirdly grade test transformer Ⅲ located at high potential 1V and 2V to earth respectively, so the cases are insulating to the earth, the case of test transformer I is connected to the ground. So the rated output voltage of test transformer Ⅰ, Ⅱ, Ⅲ to the ground is 1V， 2V， 3V respectively. The rated power is 3P, 2P, 1P respectively.




Picture 5: Three test transformers cascade connection principle diagram
P-Apparent power (kVA) V-Voltage(kV) G1、G2-Insulating stents
High voltage silicon assembly in HV bushing of test transformer is not shown.
It is the same as previous picture 4.

4.RDYD-10kVA/100kV series test transformer do power frequency withstand test for test object connection picture see picture 6




Picture 6: Test object power frequency withstand test connection picture
R1-Current-limiting resistor FRC-Resistance-capacitance divider
RF-Sphere gap protective resistance GS-phere gap Cx-Test object

Note: the HV end must be well grounded.

The current-limiting resistor R1 in the frequency voltage withstand test should be chosen based on test transformer rated power. If the rated output current of HV side is between100~300mA, choose 0.5~1Ω/V (test voltage); the rated output current of HV side is above 1A, choose 1Ω/V (test voltage). In general use water resistance as current-limiting resistor, the tube length can be 150kV/m, the thickness of the tube should have sufficient heat capacity. (Preparation method of Water Resistance Liquid: add appropriate amount of copper sulfate into distilled water to make a variety of different resistance)

Sphere Gap & Protection Resistance: when the voltage exceeded the sphere gap value (generally 110%~120% of the test voltage), the sphere gap discharge, which can protect the test object. Sphere Gas Protection Resistance can be selected 1Ω/V (test voltage).

In power frequency withstand test, because test transformer exists leakage reactance, and the test object is capacitive object. So the test transformer measuring voltage of meter terminal is different from the real voltage of test object. (eg. When the capacity of the test object is very big, the real voltage may be much bigger than the indicator voltage of the meter) Therefore, the test object is very dangerous. Generally, use FRC-resistance-capacitance divider to monitor actual output voltage, and use sphere gap for over-voltage protection.

The Notices on power frequency withstand test operation:

（1）The test personnel must be sure what is his/her responsibility during the test and make sure the communication method between each other before operating. And be sure there is special personnel supervises the safety of the test site and observe the state of the test object.

（2）The test object should be cleaned-up first, and keep absolutely dry. Otherwise, the test object will be damaged and cause errors to the test.

（3）Usually the no-load increasing test must be carried out before the large-scaled test. Namely increase the voltage to the test voltage without connect test object, and check all kinds of meters and regulate the sphere gap.

（4）The voltage can not be increased too fast, and prevent increasing voltage suddenly. For example, close the switch suddenly when the voltage regulator is not in the zero position. And the power can't be cut off suddenly. Usually the power can only be cut off when the voltage regulator decrease to “zero” position.

（5）When the voltage increased to test voltage, start timing. After one minute, when the voltage is below 1/3 of the testing voltage, then the power can be cut off.

（6） Decrease the voltage, and cut off the power immediately, at the same time, stop the test and check the causes when the following abnormal phenomenon happen during the voltage increasing or withstand test:

① The needle of the voltmeter swings fiercely big;

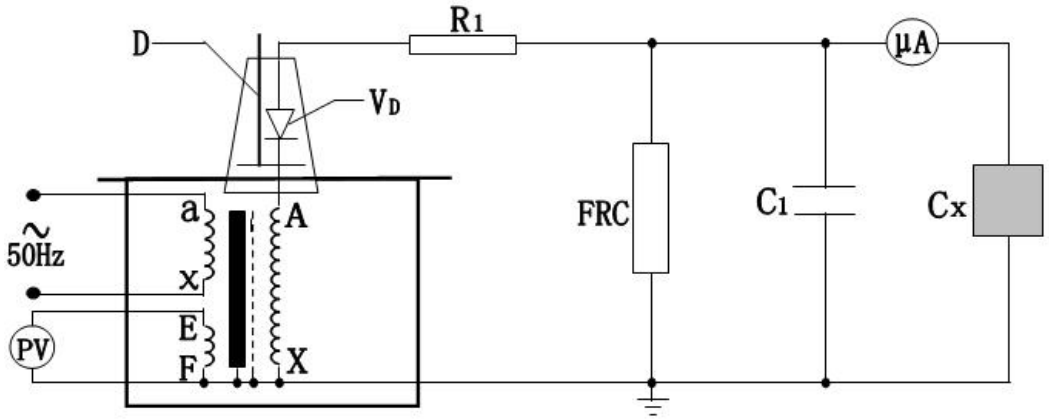
② Burns or smokes;

③ Abnormal sound inside the test object;

（7）The insulation resistance must be measured before or and after the withstand test, and checked the insulation state.

5. RDYD-10kVA/100kV series test transformer do DC withstand test and leakage test for test object connection picture see picture 7

Note: Before doing the test, the short-circuit rod “D” must be drawn out, see picture 7




Picture 7: High voltage DC leakage test connection

VD-High-voltage silicon assembly R1-Current-limiting resistance

C1-High-voltage filter capacitor FRC-Resistance-capacitance divider

CX-Test object μA-Micro-ammeter with protective functions

In leakage test, under rated output voltage, the selected current-limiting resistance must satisfied that short-circuit current in output terminal should not exceed the silicon assembly maximum rectified current. eg. The maximum rectified current of silicon assembly is 100mA used for 60kV test equipment, select current-limiting resistor R1 = 60/0.1 = 600kΩ. Current-limiting resistance should also have sufficient power and the distance along the surface discharge. High-voltage filter capacitor C1 is generally between 0.01 ~ 0.1μF, when the capacity of test object is very large, C1 can be omitted.

Leakage test operation and precautions

（1）Before test, check the power of the test object has been cut off, connect earth for discharge, make sure all the external connect line is clean. Forbid adding the test voltage to the personnel working place.

（2）Increase the voltage only after connecting the lines of test equipment and check without a mistake. Pay special attention to checking the safety distance between the high voltage apparatus, wires and the ground, between the high voltage apparatus, wires and the operators. Make sure the shell of the test object is well earth. All the operations must conform to the safety regulations.

（3）Increase the voltage slowly for the large power apparatus to prevent the micro-ampere-meter from being burned by the charging current of the test object. Increase

the voltage step by step if necessary, and read the steady readings on the micro-ampere-meter under each step.

（4）Observe the test object, test equipment, and microammeter during the test procedure, once the abnormal phenomenon such as breakdown, flash happen, cut off the power supply, check the causes and take down the record.

（5）When the test is over, decrease the voltage. Cut off the power. And then discharge the test equipment completely.

# 4. Safety precautions

(1) Connect the lines according to the coming test. The shells of the test transformer and the operating system must be well grounded. The test transformer high voltage winding X terminal (HV end) and the measuring winding F end must be well grounded.

(2) The second-grade test transformer LV winding X terminal, the measuring winding F end and HV winding X terminal (HV end) must be connected with the shell of the corresponding-grade testing transformer. The same with the third-grade test transformer during the cascade test. The shells of the second and the third grade test transformer must be grounded through the Insulating stents.

(3) After the voltage regulator of the operating system regulated in “zero” position, the power can be connected, the switch can be closed, and start to increase the voltage.

(4) Turn steadily the hand wheel of the regulator to increase the voltage from zero. There are three ways to increase the voltage;

1) Quick increasing method. Increase the voltage step by step in 20 seconds;

2) Slow method. Increase the voltage step by step in 60 seconds;

3) Very-slow way is available.

After the voltage increased from zero in a certain way and at a certain speed to seventy-five percent (75%) of the rated test voltage you need, increase the voltage at the speed of two percent (2%) of the rated test voltage per second to the rated voltage you need, and pay special attention to the measuring meter indicator and the test object. If the abnormal phenomenon of the measuring meter and test object happen during the course of voltage increasing and test. Decrease the voltage immediately, cut off the power supply and check over the reason.

(5) Turn back the voltage regulator steadily to zero in several seconds after test and then cut off the power.

(6) The use of this product should not exceed the rated parameters. Forbid to turning on or turning off the power supply under the condition of full-voltage, except for the necessity in test.

(7) Learn this manual book carefully before use this products to for the high voltage test. And the operator must be professional technician who are familiar with relative regulations.

# 5.The power choose of test transformer

The formula for the apparent power Pn of nominal test transformer:

Pn=kVn 2ωCt×10-9

Pn---The apparent power of the nominal test transformer (kVA)

Vn---The effective value for the rated output high voltage of the test transformer (kV)

K--- Safety factor. When K ≥1 and the nominal voltage Vn≥1MV，K=2, when the nominal voltage is lower, the value of K can be higher.

Ct---the value for the capacitance of test object.

ω---Angular frequency, ω=2πf, f---The frequency of the test power

The capacitance Ct of the test object can be measured by AC bridge. The value of Ct has a great range which can be set according to the type of the instrument. The typical data as following:

| | | |
|---|---|---|
| Simple rod or suspension type insulator: | | dozens of μF |
| Simple grading casing: | | 100～1000 pF |
| Potential transformer: | | 200～500 pF |
| Power transformer: | <1000kVA | ～1000 pF |
| | >1000kVA | 1000～10000 pF |
| High voltage power cable and oil-immersed insulation: | | 250～300 pF /m |
| Gas insulation | | ～60 pF/m |
| Enclosed substation, SF6 gase insulation | | 100～10000 pF |

Choose different (appropriate) safety factor K for different test Voltage Vn. The following different values of K with different Vn for your reference:

| | |
|---|---|
| Vn=50～100kV | k=4 |
| Vn=150～300kV | k=3 |
| Vn>300kV | k=2 |