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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 20833.4-2021

**Rotating electrical machines - The winding insulation - Part 4:
Measurement of insulation resistance and polarization index**

旋转电机 绕组绝缘 第4部分：绝缘电阻和极化指数测量

(English Translation)

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1 Scope

This part of GB/T 20833 specifies the test procedures for the insulation resistance and polarization index of the stator and rotor windings of rotating electrical machines.

This section specifies the minimum recommended values for the insulation resistance and polarization index of the windings of rotating electrical machines with a rated power of 750W and above. This part Suitable for low-voltage, high-voltage AC and DC rotating motors.

2 Normative references

The following documents are indispensable for the application of this document. For dated reference documents, only the dated version applies to this article Pieces. For undated reference documents, the latest version (including all amendments) is applicable to this

document.

IEC 60050-411 International Electrotechnical Vocabulary Chapter 411: Rotating Electric Machine (Internationalelectrotechnicalvocabulary- Chapter411.Rotatingmachinery)

3 Terms and definitions

The following terms and definitions defined by IEC 60050-411 apply to this document.

3.1 Rated voltage

For three-phase AC motors, it refers to the rated line voltage between the two phases; for single-phase motors, it refers to the rated line voltage; for DC motors and excitation motors, Refers to the rated DC voltage.

3.2 Insulation resistance

The electrical insulation capability of the winding against DC current. At a certain time (t) after the voltage is applied, the applied DC voltage is divided by the The quotient of the total DC current of the insulation.

Note 1: The voltage application time is usually 1min (Ri1) and 10min (Ri10), but other values can also be used. The unit of time t is stipulated. the unit of 1 to 10 is Minutes, the unit of 15 and above is seconds.

Note 2: Insulation resistance is sometimes abbreviated as IR.

3.3 Polarization index

The quotient of the insulation resistance measured at two different times. Usually, after applying DC voltage, t2 and t1 are 10min and 1min respectively This is an indicator of the insulation state.

Note: For other times, see Appendix A, A.2.

5 Polarization index

The polarization index is the quotient of the insulation resistance at time t2 divided by the insulation resistance at time t1 after applying a DC voltage, see formula (1), where t2= 10min, t1=1min. Ri10 (1)

In special applications, the quotient calculated from the insulation resistance at other times can also be used as the polarization index.

Ming (see Appendix A). Reading more data within 10 minutes can provide more information.

The polarization index reflects the change in insulation resistance between two specific

time points. Therefore, it is better than a single insulation resistance value.

It shows the contaminants and moisture deposits on the winding surface, and the moisture absorption of the windings. But it may not be able to judge due to unreasonable internal pores caused by impregnation process and thermal damage.

The polarization index can be used to evaluate whether the winding can be subjected to a withstand voltage test and whether it can be put into operation, and it can also provide an evaluation of the state of the insulation structure. Set the required information.

Since the polarization current is negligible within 1 min to 10 min after the voltage is applied, the polarization index test may not be available. It is used in small motors with random winding, field windings of generator rotors, non-insulated excitation, squirrel cage rotor windings and DC motor armatures.

The polarization index depends on the type of insulation structure, especially the nature of the insulation material and the winding production process (for synthetic resins, insects, etc.)

For paint and asphalt, see 7.1). At the same time, it also depends on the type of end anti-corona layer (see Appendix C, C.3) and the size of the test voltage (See 6.4.1). If the winding temperature is kept constant between 1min and 10min, then the temperature has little effect on the polarization index (see 6.1.2).

6.1 Factors affecting insulation resistance test

The polarization index should reach the minimum requirement (see 8.3 for the recommended value) before the withstand voltage test or put into operation.

6.1.1 Overview

Insulation resistance test results depend on environmental factors, mainly winding temperature and air humidity. The influence of winding temperature on insulation resistance can be evaluated with empirical data or test measurements, which can be used to modify the insulation resistance test results at different temperatures (see 6.1.2).

The relative humidity of the air affects the surface leakage current. This effect is usually difficult to evaluate because the relative humidity of the air mainly depends on the air. Slightly disregarded.

6.2 Testing equipment

For the direct measurement method, the preferred device is an ohmmeter. When the reading of R_{i1} is less than 5000M ohm, the digital high resistance meter should meet the following condition.

---Display. three digits;

---Accuracy. Reading accuracy $\pm 5\%$, range accuracy ± 5 .

If there is no insulation resistance meter, the insulation resistance can be obtained by measuring voltage and current (indirect method). This method may use regulated DC Power supply, voltmeter, microammeter. In fact, the voltage output by the DC voltage source will fluctuate, causing the current to also change. $i_c(t) = C_0 dU_0 / dt$. Since the capacitance C_0 of most high-voltage motors is very large, the DC power supply should have minimal stability and noise to ignore this effect.

According to the voltage and current readings, the insulation resistance is calculated according to formula (4). Where. R_{it} ---Insulation resistance value at time t , in megaohms (M ohm);

U ---The measured voltage of the DC voltage source (Voltmeter reading), in volts (V);

I_t --- the measured current (ammeter reading) at time t , in microamperes (μA).

When measuring large insulation resistance values, in order to avoid the influence of the leakage current and capacitance of the test cable, it is advisable to use a protective instrument.

The whole set of equipment should raise the voltage to the test value within 5s.

6.3.1 Overview

According to the test target and its design, different test circuits are used. In order to check the minimum recommended value of insulation resistance, the entire winding should be checked Test; In order to check the insulation problems between the windings of each phase and the windings, if the windings of each phase can be easily disconnected, it should be carried out phase by phase measuring. In order to achieve the test purpose, the same connection method should be used.

If possible, all external devices such as cables, switches, capacitors and current transformers should be disconnected from the windings. To record with Winding connection equipment.

For the insulation resistance test of the direct water-cooled winding, it is advisable to completely drain the water to make the internal circuit completely dry. Maybe some water-cooled windings are manufactured The supplier has provided a method for measuring insulation resistance without draining the cooling water. Generally, if the water is not excluded, the conductivity of the water should be less than the production plant Recommended value of home. In this case, the conductivity of water will greatly affect the insulation resistance value, so it can be estimated that $PI=1$, $R_{i10}= 1M \text{ ohm}$.

In any case, untested winding components should be grounded to avoid adverse effects, such as compensation current or induced AC in the test loop Current.