AUTOMATIC INSULATION TESTING SET
DAC-MAT-5

Summary

The automatic insulation testing set DAC-MAT-5 is a testing set that can automatically measure insulation of wired coil for appliances such as low voltage generators. With this one set, measurement of insulator resistance, direct current absorption (PI), and capacitance tangent (tanδ) can be done continuously without changing wiring after each test. Therefore, testing time can be greatly reduced, and this set is the best choice for on-site insulation testing. The measured data is automatically saved in internal memory, and can be exported to personal computers using the attached exportation software. Thus, printing reports of measurement results can be easily done.

Feature

- ◇ Measurement of Mega ohm resistance, PI, tanδ using one device
- ◇ Small, lightweight (6 kg), compact and portable
- ◇ Measured data are stored in internal memory (can be exported to PC)

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Specifications

■ Test Items

- Insulation Characteristic Test (1 minute value)
  - Direct current (DC)
    - Insulation Resistance Test (1minute): DC250V/500V/1000V
    - DC Absorption Test (PI): DC500V/1000V
  - Alternating Current (AC)
    - Tan delta (tanδ) Test: AC100V - 500V

■ Insulation Resistance Test

● Test Range	: DC250V	100KΩ - 2.00GΩ	
	DC500V	1MΩ - 9.99GΩ	
	DC1000V	1MΩ - 9.99GΩ	
● Resolution	: DC250V	1kΩ	
	DC500V	0.01MΩ	
	DC1000V	0.01MΩ	
● Accuracy	: ± (10% of rdg+1digit)		<1MΩ
	± (5% of rdg+1digit)		1MΩ - 1GΩ
	± (10% of rdg+1digit)		>1GΩ

■ DC Absorption Test (PI)

- ● Test voltage : DC500V/1000V
- ● Test Range : 1μA - 9.99mA
- ● Resolution : 1nA
- ● Accuracy : ±(5% of rdg+1digit)
- ● Test duration : 1 - 10 minutes
  (Settable on a minute-by minute basis)

■ Tan Delta Test (tanδ)

● Test Voltage	: AC100V - 500V 50/60Hz		
● Test Range	: Capacitance	1nF - 100nF	AC100V - 500V
		1nF - 200nF	AC100V - 250V
	tanδ	0 - 60%	
● Resolution	: tanδ	0.01%	
● Accuracy	: Capacitance	±(2% of rdg+1digit)	
	tanδ	±(0.1%+3%rdg+1digit)	
● Interface	: RS232C		
● Power Supply	: AC100V - 250V±10% 50/60Hz		
● Size and Weight	: W323 x H195 x D288 (mm), about 9kg		
● Accessories	: 1) Measuring Cable x 1		
	2) Power Cable x 1		
	3) Grounding Cable x 1		
	4) Rotating light x 1		
	5) Storage Bag x 1		
● Option	: 1) Thermal Printer		
	2) Aluminum Hard Case		

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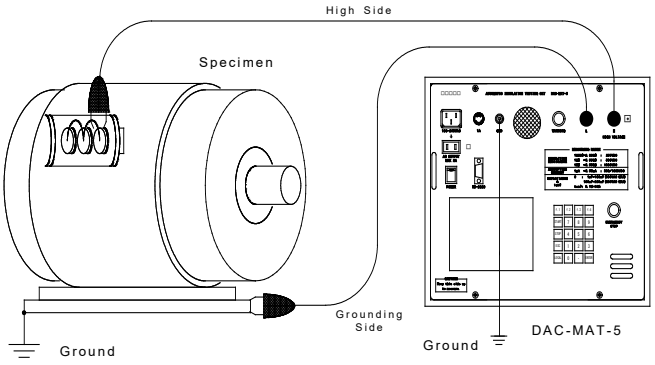
Measurement Method

- Always record temperature and humidity when measuring. Measurements are easily influenced by temperature and humidity, so recording is necessary.
- Compare measured value directly after stopping and measured value after a while. If there is a difference, internal absorption of humidity as well as surface dirt can be considered as a cause.
- Compare with past data, and do not determine using only the measured value. There is difference on data based on sample structure, size and voltage, so comparison with last measured data is recommended.

Connecting Diagram



Insulation Resistance Test

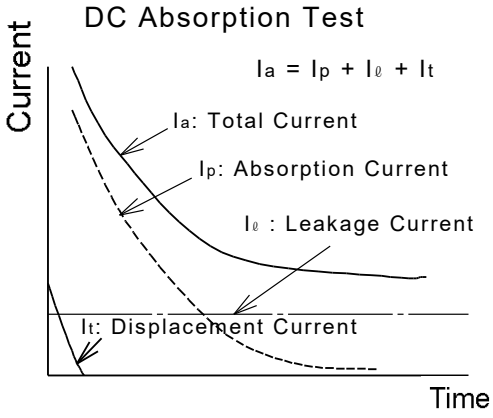
For the insulation resistance test, one minute value for one of DC250V, 500V, 1000V is measured. The resistance depends of size, structure and voltage of the rotating machine, so analysis should be done based on change after time, not by the size of absolute value.

[Allowed minimum limit]
R(MΩ)=Rated voltage(v)/Rated power(KW) + 1000

DC Absorption Test

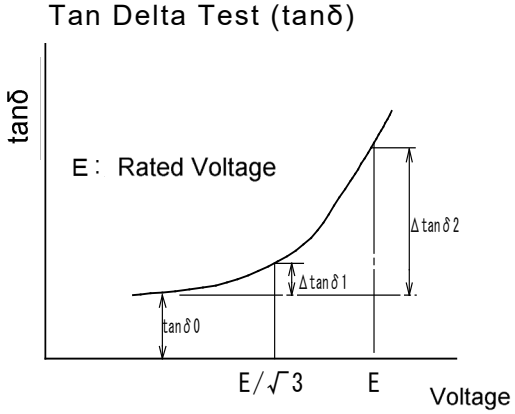
In Direct Current Absorption Test, Polarization Index (PI) is obtained by conducting with either DC500V or DC1000V, and measuring the current in after one minute and ten minutes.
If the insulating layer is humid, or there is dirt on the surface, the leakage current will be larger, and the polarization index becomes smaller.

Polarization Index (PI)
= Current after 1 minute/Current after 10 minutes



Tan Delta Test (tanδ)

The capacitance tangent (tanδ) test is conducted by changing the voltage between AC100V to 500V. tan δ0 is a specific value depending on the material, but may change due to dirt on surface or insulator degradation. Therefore, by observing change in tan δ0, the humidity inside the insulating layer can be implied. △tan δ increases with start of partial discharge, but tanδ may increase with voltage increase for other reasons, so watch out for this.
tanδ₀: < 10% : Δtanδ < 1



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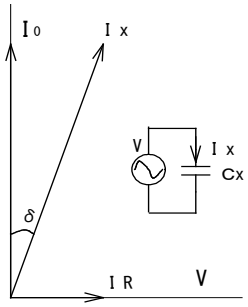
Dissipation Power Factor tanδ Test

Fig. 1 Vector Diagram



When alternating current is applied to an insulator pinched by electrodes, if there is no loss in the insulator, the phase of the current is advanced by 90 degrees compared to the applied voltage. However, in insulators, there are dissipation by leakage current (WI), induced polarization (Wp), and partial discharge (Wi), therefore the current flowing through the insulator (Ix) is delayed by δ compared to 90 degrees. δ is proportional to the loss, and this delay angle δ is called dielectric loss angle. Fig. 1 is a vector diagram of voltage applied to the insulator and current. The current flowing through the insulator (Ix) can be separated to the charge current (I0) and dissipation current (IR). The ratio of charge current and dissipation current (IR / I0) is tan δ, or the polarization tangent. tan δ is a material specific value regardless of shape and dimensions of the insulator, and can be used to describe the property of the insulator. The ratio of current (Ix) and (IR) is cosθ or dielectric power factor, and this value is sometimes used in evaluation of insulators.

■ Equivalent circuits in appliances

In general, breakdown of insulators for rotating machines and transformers are believed to be caused by degradation of enamel coating for coil wiring and protective insulating materials. In this case, the equivalent circuit will include capacitance and will look like the one shown in Fig. 2. C and tanδ will be measured between the powered part and ground. Fig. 2 shows the case for a rotating machine.

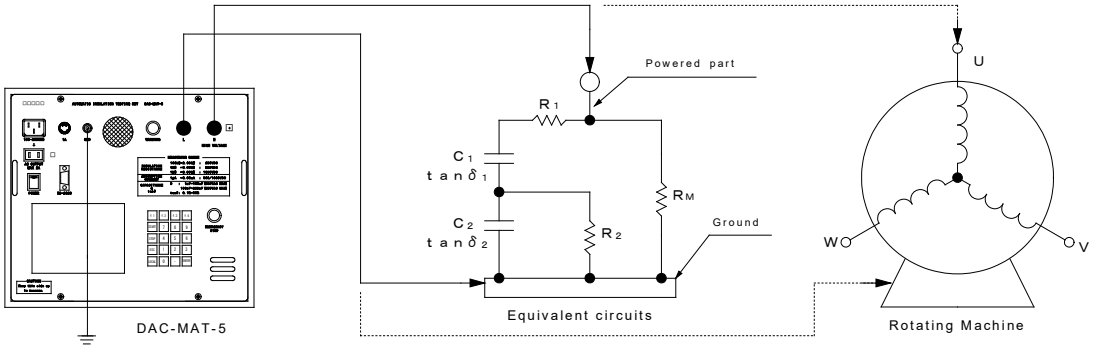


Fig. 2

The symbols for the equivalent circuit are as follows. (Measured value is synthesized value.)

R1 : Equivalent resistance of wiring (can be almost ignored for tan δ)
C1 : Capacitance for enamel coating
$\tan\delta_1$: Capacitance loss of enamel coating (specific value)
C2 : Total capacitance of the material for improving insulation
$\tan\delta_2$: Total specific capacitance loss of the material for improving insulation
R2 : Total DC leakage current of the material for improving insulation
(cannot be measured in meg ohm resistance test)
RM : DC leakage current of the outside (measured value of meg ohm resistance test)

Specifications are subject to be changed without prior notice.

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