

GENERATOR TESTING

APPLICATION GUIDE





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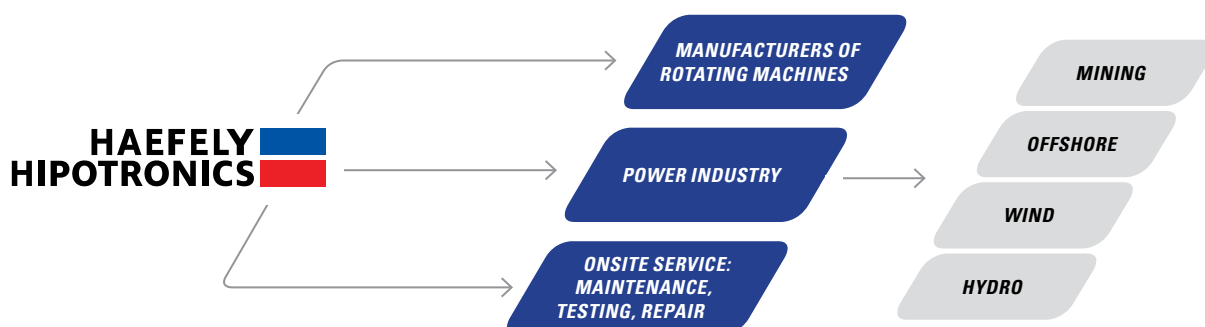
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GENERATOR TESTING

A generator is tested several times throughout its lifetime - after being manufactured, once installed onsite, during periodic maintenance checks, etc. Generator manufacturers, service / maintenance companies and those in the hydro power / wind power / mining / offshore industries use HAEFELY HIPOTRONICS products to perform such tests.

Our test equipment is what makes performance monitoring, quality inspections and insulation evaluations of generators quick and easy.

MARKET SEGMENTS



PRODUCT LINE OVERVIEW

HAEFELY HIPOTRONICS offers the widest range of test equipment on the market for generators in both marine and industrial applications. Below are the most in-demand products for such testing.

TYPE OF TEST	PRODUCT						
	TSR SERIES	700 SERIES	DDX9121b	800 SERIES	5478	MIDAS + 528X	2820A + NK
	•	•					
			•				
				•			
					•		
						•	•

RELIABLE AND USER-FRIENDLY



AC HIPOT TESTING

TANK RESONANT SYSTEMS

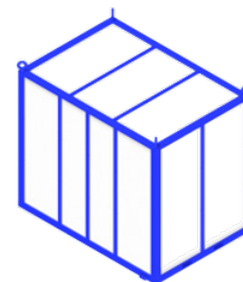
AC resonant test systems with low Q values are needed for testing high capacitive loads with high loss - i.e. generator stator and rotor windings. Our **Tank Series Resonant (TSR)** systems, as part of a series resonant circuit, provide undistorted high voltage at system frequency. They are designed to ensure your generators are tested in accordance with the latest standards.

The systems below can be configured for either **series** or **parallel operation**. All major high voltage components in the TSR system listed are in one, single enclosure (pictured below).

	Power Rating (kVA)	Tap Voltage	Approximate Cabinet Size (m) W x H x D	Cabinet Weight (kg)	Max. Load (nF) ** Tap 1, Tap 2	
					50 Hz	60 Hz
TSR30-300	300	30 / 15	1.6 x 2 x 2.7	4000	1061, 4244	884, 3536
TSR60-600	600	60 / 30	2 x 2 x 2.7	4500	530, 2122	442, 1768
TSR60-750	750	60 / 30	2 x 2 x 2.7	5000	663, 2652	552, 2210
TSR60-1M2	1200	60 / 30	2 x 2.3 x 2.7	5500	1061, 4244	884, 3536
TSR75-750	750	75 / 50	2 x 2 x 2.7	5000	424, 954	353, 795

*This is a list of standard models used for generator testing. Please consult factory for other voltage and current ratings. **Max. loads do not include the preload provided with generator test systems. The true maximum load capability is outlined in detailed quote specifications.

TSR SERIES



AC DIELECTRIC SYSTEMS

The most common test for manufacturers and service groups is a high voltage AC dielectric withstand test. The test involves applying AC voltage to a winding to verify if it can withstand an applied voltage. This confirms the quality of a new generator, as well as validates the insulation condition after it's been installed. The **700 Series** AC dielectric test systems are designed to perform such tests in accordance with IEC60, IEEE 4, IEC270 and other test standards.

700 SERIES



MODEL

	Voltage (kV)		Current (mA)	Controller
710-1	10	100		Manual
710-2	10	200		Manual
710-10	10	1000		Auto / Manual PLC
730-60	30	2000		Auto / Manual PLC
750-100	50	2000		Auto / Manual PLC
775-200	75	2667		Auto / Manual PLC

*This is a list of standard models used for generator testing. Please consult factory for other voltage and current ratings. Also note that standard input frequency is 50 or 60 Hz.

PARTIAL DISCHARGE

DDX9121b

The **DDX9121b partial discharge measuring system** is the latest in the DDX family of PD detection equipment. It is modular and fits a wide range of applications, including generator testing.

This unit covers traditional PD measurement according to IEC60270, Radio Interference Voltage (RIV) measurement and DC partial discharge measurement. The DDX9121b is also capable of simple Pass / Fail testing to advanced phase resolution time analysis.

DDX9121b & MIDAS can easily perform combined partial discharge and C & Tan δ tests without any reconnections. The **MIDAS** (pg. 7) has a reduced inherent PD level of < 500 pC and can therefore be used for PD testing on rotating machines such as generators.



DDX9121b

FEATURES

- ✓ Simultaneous RIV and PD reading
- ✓ User-defined measuring band
- ✓ Modular design (stack up to 9 units)
- ✓ Data acquisition
- ✓ AC and DC measuring modes
- ✓ Embedded switch with 4 PD inputs per detector

BENEFITS

- Set up, control, test, monitor and generate test reports from a single computer
- Windows-based software makes for easy operation with little to no training
- Compact design, standard BNC measuring cables and remote control capabilities make it easy to integrate into test systems



DC HIPOT TESTING

800 SERIES

HAEFELY HIPOTRONICS' **800 Series** of portable DC Hipot testers are made for testing generators and other electrical apparatus in the field. The series consists of a single-unit design that ranges from 15 kV to 80 kV as well as a two-unit design that ranges from 120 kV to 170 kV.

Accurate voltage and current measurements are assured via voltage readings that are taken directly at the output of the high voltage transformer as well as current measurements that are taken in the return leg. The product also uses a natural, ester-based fluid (FR3) for added benefit to the customer.

	TEST VOLTAGE						
	0-15 kV	≤ 30 kV	≤ 60 kV	≤ 80 kV	≤ 100 kV	≤ 120 kV	≤ 170 kV
MODEL							
815	•						
880	•	•	•	•			
8120	•	•	•	•	•	•	
8170	•	•	•	•	•	•	•



FEATURES

- ✓ Full-wave voltage doubling rectifier
- ✓ Zero start interlock and guard circuit
- ✓ Internal discharge solenoid

BENEFITS

- Ideal for field testing applications
- Simple control panel
- Minimal set-up time

INSULATION RESISTANCE

5478

The **5478 portable teraohmmeter** is a multi-purpose digital tester intended for analyzing, inspecting and maintaining high voltage insulation. Insulation in generators can fail due to excessive heat, moisture, dirt, vibration and / or aging. To detect such deterioration, it is necessary to perform regular insulation resistance tests.

MEASUREMENTS

- ✓ Insulation resistance up to 5 TOhm
- ✓ Step-up voltage measurement
- ✓ Withstand voltage measurement
- ✓ Diagnostic measurements
- ✓ AC / DC voltage and frequency measurements



POWER FACTOR / C TAN δ

MIDAS

Electrical insulation of generators undergo aging processes due to thermal overload, mechanical stress, electrical impurity (voids, foreign particles) and environmental factors (temperature, humidity). High voltage insulation will ultimately fail, unless checked and handled with proper action.

Taking Capacitance and Tan δ measurements with the portable **Mobile Insulation Diagnosis & Analyzing System (MIDAS)** is one of the best parameters for keeping track of insulation health. Test methods for determining power / dissipation factor are stated in standard specifications (e.g. VDE 0530 Part I, IEC 34-1, CENELEC document 345, IEC 216, IEEE 286-1975).

The MIDAS 2880G is specifically designed for rotating machines. With its unique 15 kV output voltage, it has more power to test large capacitances up to 47 nF at 60 Hz (or up to 2 μ F with the **5289** option).



APPLICATION NOTE

TYPICAL VALUES / LIMITS FOR C & TAN δ MEASUREMENT

New machines may have measured values exceeding this specification. Construction of the machine, corona shields, etc. have a significant effect. Therefore a comparison of measurements (phase-to-phase, two identical machines or against previously obtained results) is recommended.

*E.g. Single-phase values for a 500 MVA generator.
Values at $1.0 U_N$ (21 kV); $C = 0.27 \mu\text{F}$; $\tan \delta = 0.014$.*

$\tan \delta$ at $0.2 U_N$	max. 0.04 Typical value ≤ 0.02
$\Delta \tan \delta$ (tip-up) from $0.2 U_N - 0.6 U_N$	max. $0.006 / 0.2 U_N$
$\Delta \tan \delta$ (tip-up) from $0.6 U_N - 1.0 U_N$	max. $0.008 / 0.2 U_N$
Or $\Delta \tan \delta / \text{kV}$	max. 0.0025

According to IEC 34-1 and VDE 0530 standards

insulation quality can be considered as stable	$\Delta < 10\%$
insulation is slowly / quickly degrading / deteriorating	$\Delta > 10\%$

MIDAS

	OUTPUT VOLTAGE	CONTROLLER
	$\leq 15 \text{ kV}$	Laptop Touchscreen
MIDAS 2880G	•	•
MIDAS 2881G	•	•



Tan $\delta 1 \times 10^{-4} / 10 \text{ kV}^* / 33 \text{ kVA}$
*maximum 12 kV



Tan $\delta 1 \times 10^{-4} / 15 \text{ kV} / 100 \text{ kVA}$



Tan $\delta 1 \times 10^{-4} / \text{e.g. } 33 \text{ kV} / \text{e.g. } 700 \text{ kVA}$

2820A



The **2820A** measuring bridge is designed for measurement of low dielectric losses and impedances.

NK SERIES



The **NK Series** of SF_6 gas-insulated standard capacitors is used as a comparison standard when measuring C & Tan δ .

528X



The **5288A** & **5289** are automatic resonating inductors used to increase the power range for testing higher capacitive loads.



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