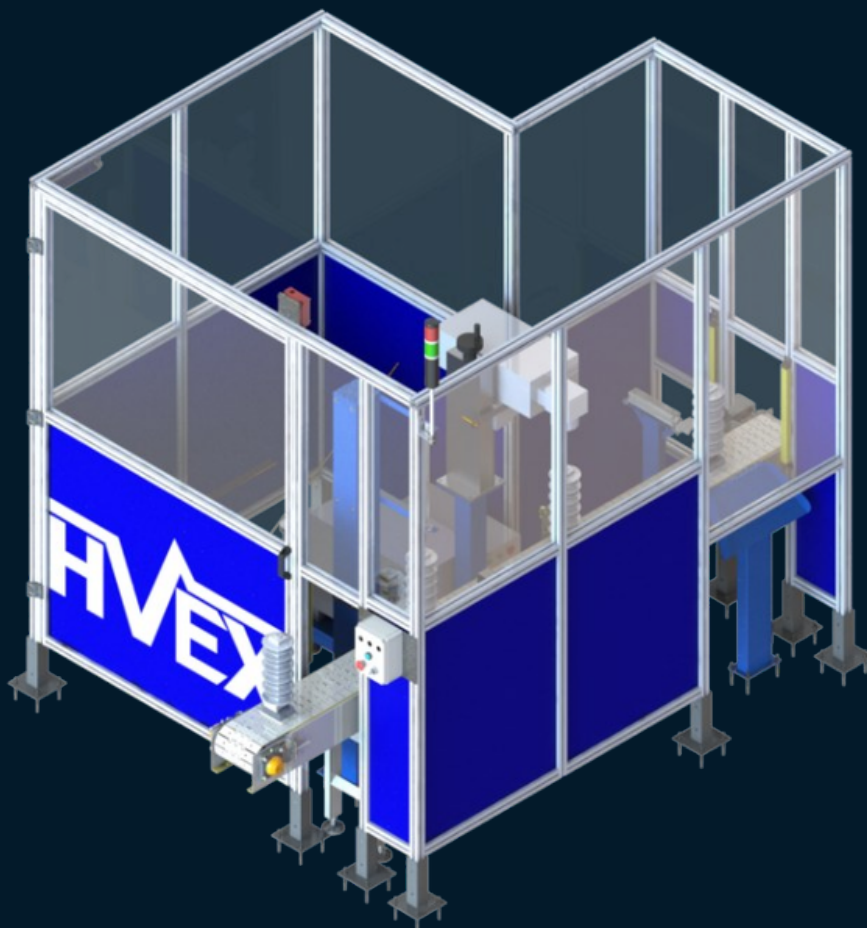


Routine Testing Laboratory

For Metal Oxide Distribution Surge Arresters up to 36.2 kV



Standards

ABNT NBR 16050:2012 . IEC 60099-4

ABNT NBR IEC 60270 (Partial Discharges)

Description and Operation

Description

The Routine Testing Laboratory is an automated line developed by HVEX for performing routine tests on non-linear metal oxide resistor distribution surge arresters, without spark gaps, with a nominal voltage (U_r) of up to 36.2 kV, in accordance with ABNT NBR 16050 and IEC 60099-4. It integrates, in a single system: power panel, control panel, industrial frequency test source free of partial discharges, partial discharge measurement circuit according to ABNT NBR IEC 60270, shielded test cell, laser recording station and proprietary software for operation, analysis and traceability.

The flow and unitary: each lightning rod and the component is individually tested and receives its own verdict. The approved part — a resistive component with a leakage current of less than 1 mA and partial discharges of less than 10 pC — is released for laser engraving and proceeds to the packaging preparation conveyor. The rejected part has its engraving blocked by software interlock and is diverted to the segregation area, with the test record preserved.

An integrated security system — magnetic locks, emergency buttons, area scanner and light curtains — It oversees all access, guiding the flow from batch registration to the issuance of a standardized report in a single interface.

Operation

Preparation and registration

The operator selects the registered model (U_r , U_c , declared reference current and acceptance limits) and enters the serial number; the part is then positioned in the single test station.

Automated connection

High-voltage clamps and grounding wires connect the lightning rod;

The pneumatic pistons close the test circuit and the partial discharge measurement circuit.

Execution of the tests

Measurement of the reference voltage (U_{ref}) at the reference current, measurement of the total leakage current and the resistive component at the continuous operating voltage (U_c), and measurement of partial discharges at $1.05 \times U_c$, in automatic sequence, with real-time graphs.

Individual verdict

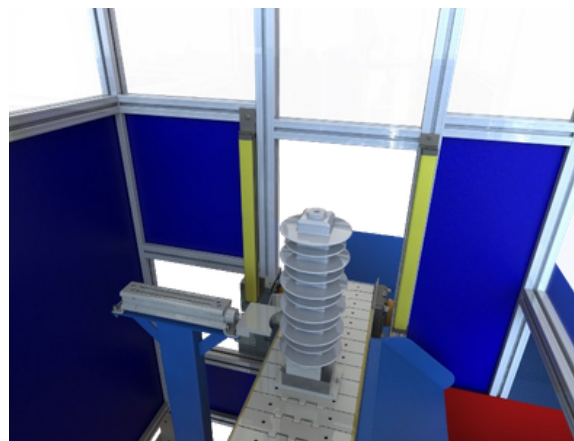
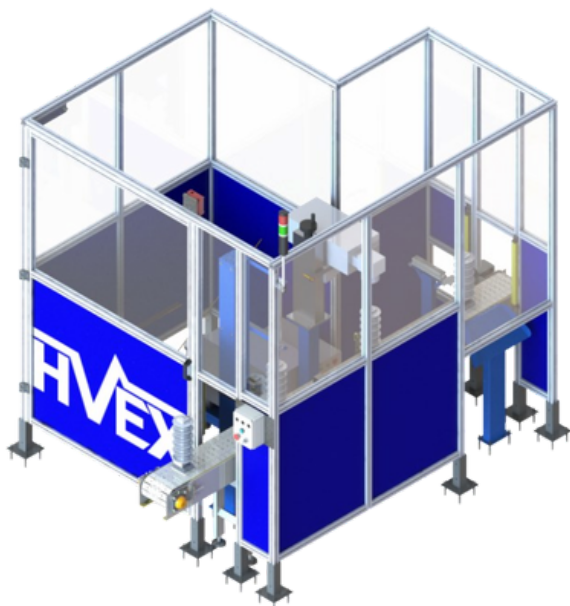
Approval is conditional upon resistive leakage current < 1 mA and partial discharges < 10 pC. The result is linked to the serial number before any movement of the part.

Recording and destination

Approved: Laser marker release (serial number, U_r/U_c , batch, date and DataMatrix), confirmation reading and transfer to the packaging preparation conveyor. Rejected: Engraving blocked and diversion to the segregation area.

Analysis and reports

Consolidated results by part and by batch, with standardized reports exportable in Excel, Word, PDF, and CSV formats.



Technical Specifications

Standards Followed	
Lightning rod	ABNT NBR 16050:2012 — Non-linear metal oxide resistor surge arresters without spark gaps for alternating current power circuits · IEC 60099-4
Partial discharges	ABNT NBR IEC 60270 — High-voltage electrical test techniques: partial discharge measurement (ABNT NBR 6940)
High voltage tests	ABNT NBR IEC 60060-1 (definitions and general requirements) · ABNT NBR IEC 60060-2 (measurement systems)
Complementary	IEC 60099-5 (selection and application) · IEEE C62.11 (external market, upon request)
Security	NR-10 · NR-12 · ABNT NBR ISO 13849-1 (safety functions)

Object of Test	
Product	Non-linear metal oxide resistor distribution surge arresters, without spark gaps — polymer or porcelain housing.
Voltage range	Nominal voltage (U_r) from 3 kV to 36.2 kV, with the continuous operating voltage (U_c) corresponding to the model.
Class	Rated discharge current 5 kA and 10 kA · line discharge class 1
Production flow	Unique format — one piece per cycle, with individual connection, rehearsal, verdict, and destination.
Reference cadence	60 to 90 seconds per unit (~40 to 60 pieces/hour), depending on the stabilization time and the parameterized partial discharge routine.

Routine Tests Performed	
Reference voltage (U_{ref})	Measured at the reference current (I_{ref}) declared by the manufacturer — peak value of the resistive component of the current at industrial frequency. Record of the value corrected to 20 °C by the thermal coefficient of the ZnO block.
Leakage current at U_c	Measurement of total leakage current and separation of the resistive component at the DC operating voltage.
Partial discharges	Measurement at $1.05 \times U_c$ using the electrical method, according to ABNT NBR IEC 60270, with coupling capacitor, measurement impedance, and traceable load calibration.
Complementary tests	Residual voltage under atmospheric impulse (8/20 μ s) and leak tightness — other routine tests foreseen in ABNT NBR 16050 / IEC 60099-4 — available in dedicated modules, upon request.

Technical Specifications (continuation)

Approval and Allocation Criteria	
Resistive leakage current,	Approved with a value of less than 1 mA in the continuous operating voltage (U_c)
partial discharges	Approved with a value lower than 10 pC at $1.05 \times U_c$ — the normative limit of ABNT NBR 16050 / IEC 60099-4 is 10 pC.
Part approved	Automatic laser marker release · recording and confirmation reading · transfer to the packaging preparation conveyor
Item rejected.	Recording blocked by software interlock · diversion to segregation area · non-conformity label and test record
Parameterization	Configurable limits per model and per client, with change control restricted to the Administrator profile.

High Voltage Test Circuit	
CA test source	Partial discharge-free test transformer · 5 kVA · 220 V – 50 kV · self-leveling potential difference less than 5 pC at maximum test voltage
Voltage regulation	Motorized variac with programmable ramp — prevents the injection of switching noise into the partial discharge measurement circuit.
Blocking filter	High-voltage low-pass filter for attenuating mains noise.
Voltage measurement	Capacitive divider class 0.5 · HVEX kilovoltmeter with peak and RMS readings
DP Circuit	Coupling capacitor 1 nF / 100 kV · Quadripole (measuring impedance) · Load calibrator from 2 pC to 100 pC
Shielding and grounding	Shielded test cell, single-point grounding, and background noise kept at 2 pC or less.

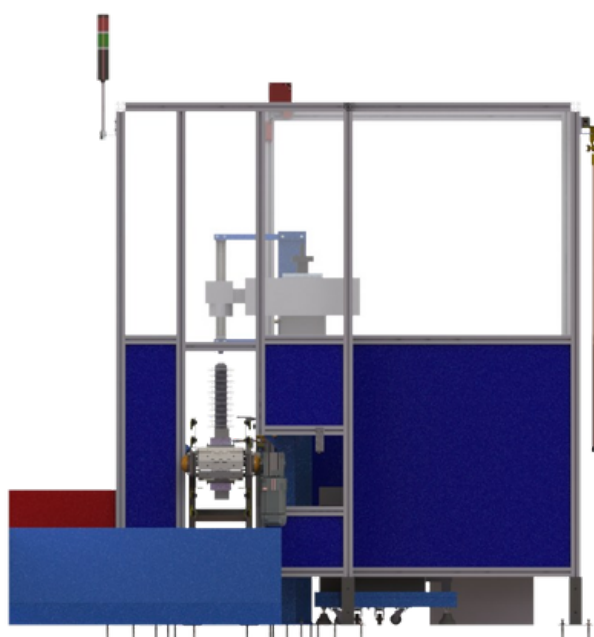
Measurement	
Partial discharges	Detector compliant with ABNT NBR IEC 60270 · range from 40 kHz to 400 kHz (broadband) · resolution of 0.1 pC · calibration at the beginning of each shift
Leakage current	Precision shunt with dedicated conditioning · 0 to 5 mA range · 1 μ A resolution
Resistive component	Voltage reference separation, with capacitive component compensation and harmonic analysis.
Reference voltage	Determined by a controlled ramp up to the reference current, with synchronized acquisition of voltage and current.
Thermal compensation	Uref correction to 20 °C · monitoring of the cell's ambient temperature

Technical Specifications (continuation)

Power Panel	
Power supply	220 V three-phase · 60 Hz
Main circuit breaker	Siemens · 63 A · 36 kA (Class S) · 690 V
Surge protection.	Embrastec SPD · 15 kA · Uc 275 V
Power quality	Segregated and filtered power supply for the test circuit, dedicated to partial discharge measurement.

Control, Automation and Marking	
Controller (PLC)	Altus Nexto NX3004
Data acquisition	HVEX Acquisition Module
Instrumentation	HVEX Kilovoltmeter · HVEX Multimeter (MULT-X) · Precision shunt
Actuators	Self-lubricating pneumatic pistons for high voltage connection and grounding
Laser marking	20 W fiber laser marker · Serial number, Ur/Uc, batch, date and DataMatrix recording · Recording confirmation reader
Movement	Input conveyor, test station and packaging preparation conveyor, with automatic diversion of rejected parts

Communication	
Protocols	Modbus (via PLC / HVEX Acquisition)
Integration	Remote control and acquisition via software · Configurable IP
Corporate Systems	Integration with MES/ERP for batch release and production reporting (optional)



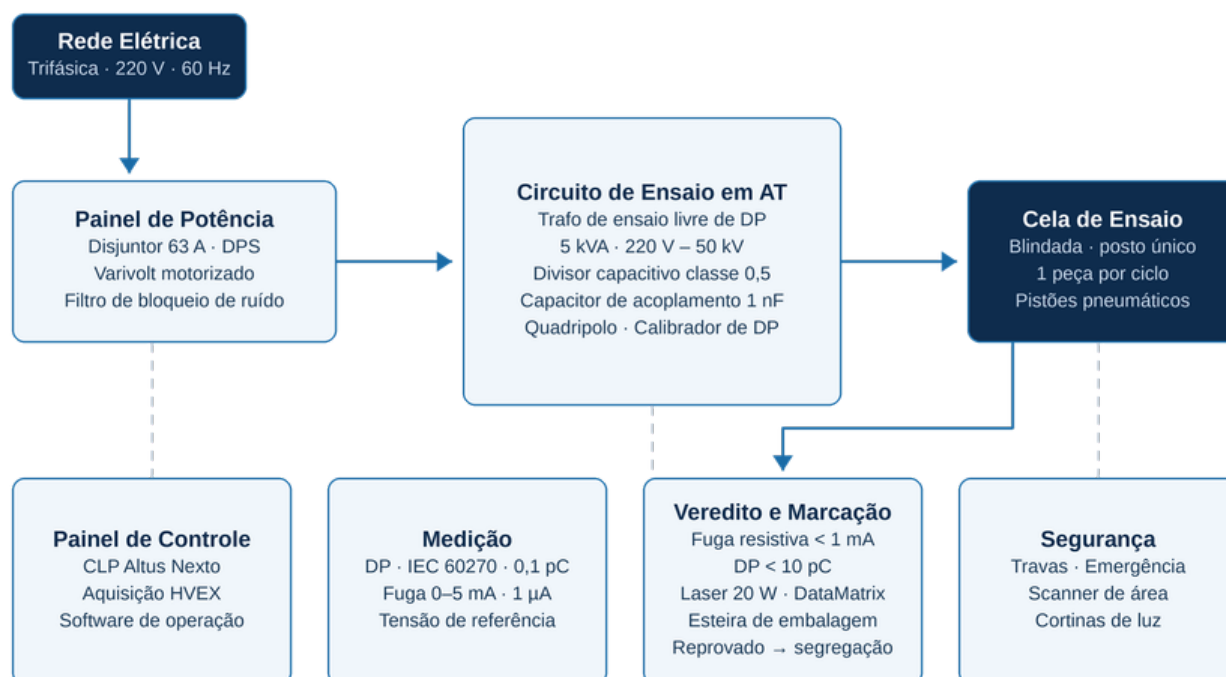
Technical Specifications (continuation)

Security	
Interlock Area	Magnetic locks and sensors on doors and Keyence windows;
Emergency	Emergency buttons . Schneider safety relay (Category 4 / PL e);
Monitoring	Area scanner; Light curtains; Light signaling and siren;
Automatic grounding	Discharge and grounding of the test specimen and coupling capacitor at the end of each cycle, before cell release;
Compliance	Design and operation aligned with NR-10 and NR-12.

Software and Traceability	
User Levels	Administrator · Operator · Viewer
Registration	Lightning arrester models (Ur, Uc, Iref and acceptance limits), measuring instruments and sensors.
Test control	Real-time measurement and graphing · piston and sensor calibration · event logging
Traceability	Result linked to the recorded serial number · batch history · recording blocked in case of rejection
Reports	Test certificate per piece and summary per batch · export in Excel, Word, PDF and CSV

Testing and Disposal Flow	
1. Registration	Selection of the model and reading/recording of the part's serial number. Transfer
2. Positioning	from the incoming conveyor to the single station and closing of the cell. Actuation of
3 · Connection	the pneumatic pistons and confirmation of continuity and grounding. Ramp to Uc and
4 · Essay	$1.05 \times U_c$ · measurement of Uref, total and resistive leakage current, and partial
5 · Verdict	discharges. Approved if the resistive leakage current is less than 1 mA and the partial
6a · Approved	discharges are less than 10 pC; otherwise, rejected. Laser engraving, confirmation
6b · Failed	reading, and sending to the packaging preparation conveyor. Engraving block,
7. Registration	diversion to the segregation area, and non-conformity label. Recording of raw data
	and test certificate, with traceability by serial number and batch.

System Diagram



Functional architecture of the distribution surge arrester test line: power supply, partial discharge-free test source, shielded cell with single station, measurement and disposal of the part after the verdict.



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