



Power Testing & Technology Institute



HISTORY

- 2013 | Seeking to be accredited as a testing agency by ASTA(UK)
Accredited as a testing agency by ANCE(Mexico)
Completed the construction of a DC short-circuit facility
- 2012 | Accredited as a testing agency by FIRI(China)
Signed a memorandum of understanding with KEPCO PTC(Korea)
Expanded the EMC shielded enclosure
Completed the construction of DC load facilities
- 2010 | Completed the construction of a extra high voltage composite test facility
- 2009 | Accredited as a testing agency by KERI(Korea)
- 2007 | Completed the construction of hybrid environments and vibration facilities
- 2005 | Completed the construction of a EMC shielded enclosure
- 2003 | Expanded the load facility
- 2002 | Accredited as a calibration agency by KOLAS
- 2001 | Certified as a testing agency by the KEMA(Netherlands)
Accredited as a testing agency by the UL(U.S.)
- 2000 | Accredited as a testing agency by KOLAS
Recognized as a Corporate R&D center
- 1999 | Established the Power Testing & Technology Institute(PT&T)

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Trust leads to more trust!

Established by Korea's best industrial electricity, electronic, materials and energy company LSIS, PT&T became the first private business entity in Korea to be equipped with 2000 MVA short-circuit testing facilities, high voltage testing apparatus and reliability testing equipment. Its objectives include technological development to improve product performance and reliability, technological expertise in test evaluation and fair operation. In particular, as an internationally certified testing and calibration agency accredited by KOLAS, PT&T has been contributing to the development of technologies and enhancement of competitiveness of the electric power equipment industry through its international level of test, evaluation and calibration services.

PT&T's thorough, rigorous and accurate tests will result in trust, and the electric power equipment and systems built on such trust will deliver the most reliable performance in respective fields.



View of PT&T

High Power Lab

High Power Lab performs tests on the mechanical and electrical performance of electrical power equipments by using short-circuit power generators so as to simulate the short-circuit failures(single line-to-ground fault, double line-to-ground fault and 3-phase fault) and the load switching performance of power devices.



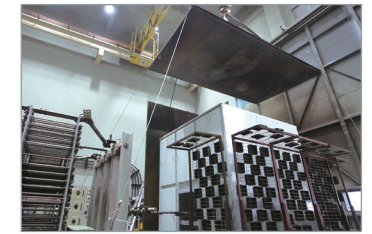
Short-circuit power generator



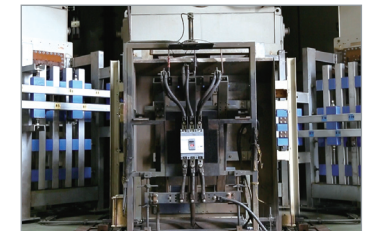
Medium voltage short-circuit transformer

Types and description of tests

1. Short-circuit making and breaking test : It is a test to determine whether the circuit breaker can make and break when the circuit is short-circuited, and consists of "O" and "CO" operations.
2. Short-time and peak withstand current test : It is a test to determine the mechanical stability and the thermal current carrying capability of power devices with respect to short-circuit current applied for a short time. Usually, short-time current tests are conducted for three seconds or less duration.
3. Load current switching test : It is to test the switching performance of a circuit breaker with regard to a variety of resistive, inductive and capacitive loads.
4. Internal arc fault test : It is a simulation test to evaluate the safety of a switchgear and controlgear assembly to ensure that the operator of the switchgear and controlgear assembly is unharmed when an internal or an arbitrary object causes a short circuit between lines in the switchgear and controlgear assembly. The internal arc fault test is usually conducted for three seconds or less duration.



Medium voltage test



Low voltage test



Internal arc fault test

Specification of major equipments

1. Short-circuit power generator
 - Rated voltage : 18 kV • Rated capacity : 3-phase 85 MVA
 - Short-circuit capacity : 2000 MVA
2. Protection circuit breaker
 - Rated voltage : 18 kV • Rated current : 3000 A • Rated short-circuit breaking current : 100 kA
3. Making switch
 - Rated voltage : 24 kV • Making current : 47 kA, 0.45 s • Closing time precision : ± 0.1 ms
4. Medium voltage short-circuit transformer
 - Rated voltage : 18 kV / 25.8 kV • Rated capacity : 3-phase 180 MVA • Impedance : 1.35 %
5. Low voltage short-circuit transformer
 - Rated voltage : 18 kV / 1000 V • Rated capacity : 3-phase 30 MVA • Impedance : 2.5 %
6. Medium voltage test capacity
 - Short-circuit making and breaking test
 - 3-phase 7.2 kV 63 kA, 3-phase 25.8 kV 25 kA, 3-phase 36 kV 16 kA
 - Load current switching test
 - Inductive load : 3-phase 25.8 kV 1250 A
 - Capacitive load : 3-phase 25.8 kV 500 A, 1-phase 25.8 kV 420 A
7. Low voltage test capacity
 - Short-circuit making and breaking test : 3-phase 250 V 170 kA, 3-phase 500 V 240 kA, DC 1500 V 100 kA
 - Short-time and peak withstand current test : 3-phase 200 kA 1 s, 3-phase 100 kA 3 s
8. Low voltage test capacity by network facility
 - Short-circuit making and breaking test : 3-phase 220 V 50 kA, 3-phase 480 V 50 kA, 3-phase 600 V 50 kA

High Voltage Lab

High Voltage Lab conducts dielectric test, temperature-rise test and general characteristic test for high and low voltage switchgears.



Dielectric tests area



Lightning impulse withstand voltage test

Types and description of tests

1. Lightning impulse withstand voltage test : It is a test to determine whether a product can withstand impulse wave of abnormal voltages generated by a lightning strike.
2. Power frequency withstand voltage test : It is a test to determine whether a product can withstand excessive over voltage generated at power frequency.
3. Partial discharge test : It is a test to confirm the electrical breakdown phenomenon that may occur within an insulator with application of power frequency voltage.
4. Temperature rise test : It is a test to determine whether the temperature of any part of product exceeds temperature-rise limits specified in the standard.



Power frequency withstand voltage test



Partial discharge test



Temperature rise test

Specification of major equipments

1. Lightning impulse withstand voltage test
 - Test voltage : ± 340 kV
 - Wave shape : $1.2 \mu s \times 50 \mu s$
 - Charging voltage : 400 kV
2. Power frequency withstand voltage test
 - Test voltage : AC 100 kV
 - Capacity : 15 kVA 220 V
3. Partial discharge test
 - Test voltage : AC 50 kV
 - Measuring range : 1 pC ~ 100 nC
 - Background noise level : Less than 1 pC
4. Temperature rise test
 - Test current : 3-phase AC 10 kA, DC 2 kA
 - Transformer : 1-phase 120 kVA 440 / 20 V
 - Current transformer : 15 VA 10 kA / 5 A

Synthetic Lab

A synthetic testing is a test method which all of the current is obtained from capacitor bank or short-circuit generator (current circuit) and in which the applied voltage and/or the recovery voltages (transient and power frequency) are obtained from separate capacitor bank (voltage circuit).



View of the simplified composite test lab



LMS operation

Types and description of tests

1. Low voltage short-circuit breaking test : It is a test to verify the short-circuit performance of test object by using a capacitor, reactor and short-circuit transformer as a voltage and current source.
2. High voltage synthetic short-circuit breaking test : We have 2 kinds of synthetic short-circuit test facilities. One is the synthetic test method by using capacitor banks both of current source and voltage source, the other is by using a short-circuit generator as a current source and capacitor banks as a voltage source. The test is conducted by simulating current and voltage required by the standard.
 - Short-circuit breaking test : 1-phase 245 kV 50 kA
 - Short-circuit making test : 1-phase 245 kV 50 kA
 - SLF breaking test : 1-phase 245 kV 50 kA
 - Capacitive current breaking test : 1-phase 245 kV 400 A



Short-circuit making test



SLF test



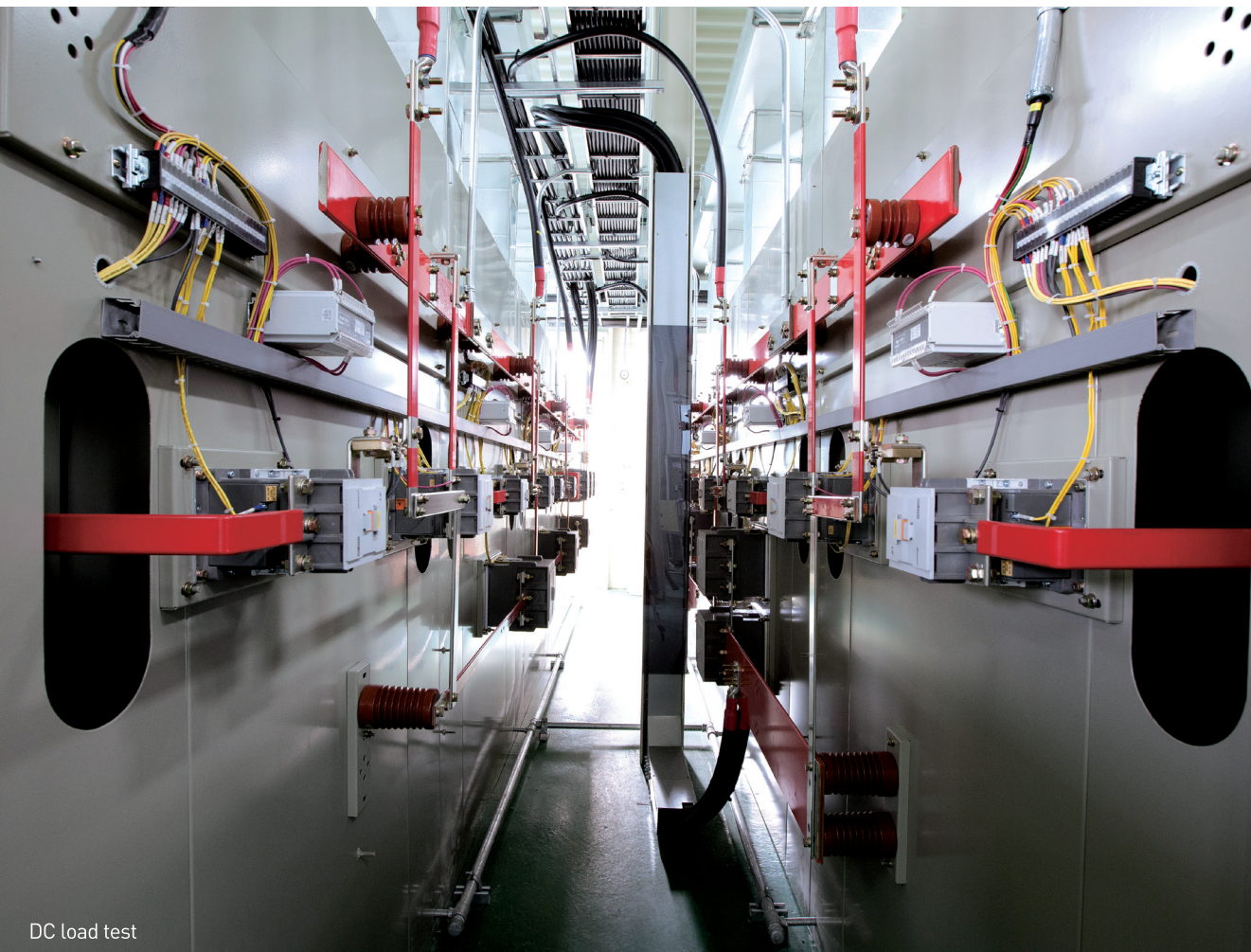
Capacitive current switching test

Specification of major equipments

1. Current source circuit
 - Capacitor bank(Cg) : 11 kV, 30000 μ F(150 μ F, 200 EA)
 - Reactor : 0.1 mH ~ 2.0 mH
2. Voltage source circuit
 - Capacitor bank(Cs) : 60 kV, 36 μ F(4 μ F x 9 EA, 8 steps)
 - Reactor : 0.1 mH ~ 302 mH
 - Capacitor bank(Ce) : 0.001 μ F ~ 16 μ F(12 steps)
 - Resistor : 0.1 Ω ~ 784 Ω

Load Lab

The Load Lab evaluates the load current switching, mechanical operation, temperature-rise, dielectric and short-circuit making and breaking performance of low-voltage power equipment such as circuit breakers and contactors.



DC load test



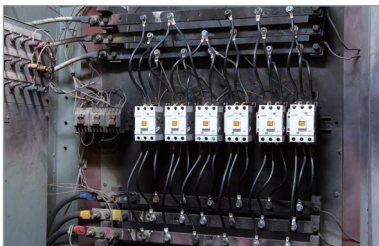
Measurement by a power meter

Types and description of tests

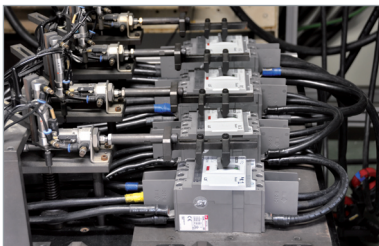
1. Load current switching test : It is a test the switching performance of a circuit breaker and contactor with regard to a variety of resistive, inductive and capacitive loads.
2. Mechanical operation test : It is a test the mechanical durability of a circuit breaker and contactor by switching the product on and off while neither power source or load is connected to the main circuit.
3. Short-circuit making and breaking test : It is a test to determine whether the circuit breaker can make and break when the circuit is short-circuit, and consists of "O" and "CO" sequence.
4. Tripping limits and characteristics : It is a test to evaluate whether the breaker works well within a certain amount of time when a current exceeding the rated current occurs.
5. Temperature-rise test : it is a test to determine whether the temperature of any part of product exceeds temperature-rise limits specified in standard.
6. Dielectric properties : It is a test to determine whether a product can withstand over-voltage that may occur at commercial currency as well as to evaluate the electrical insulation performance of the product.



Short-circuit and load transformer



MC load current switching test



MCCB load current switching test



Manipulation of short-circuit desk

Specification of major equipments

1. Load current switching test :
3-phase AC 690 V 10000 A, DC 1000 V 4000 A
2. Short-circuit making and breaking test :
3-phase AC 690 V 25 kA
3. Temperature-rise test :
AC 3000 A, DC 4000 A

EMC Lab

The EMC Lab examines the quality of products by simulating various electromagnetic wave noises in the environment where the product is installed. It evaluates the product's durability by generating a variety of excessive noises such as the radiation noise of walkie-talkies and mobile phones, electrostatic discharge and surges.



View of the electromagnetic anechoic chamber



Electromagnetic wave radiated immunity test

Types and description of tests

1. Electrostatic discharge immunity test : It tests the immunity of a product against the electrostatic discharge of a human body. [IEC 61000-4-2]
2. Radiated, radio-frequency, electromagnetic field immunity test : It is a test on varying radiation noises that exist in the air such as those of wireless communications. [IEC 61000-4-3]
3. Electrical fast transient / burst immunity test : It is a test regarding high-frequency transient voltages generated in a power system. [IEC 61000-4-4]
4. Surge immunity test : It tests the immunity of a product against lightening surge induced in a power system. [IEC 61000-4-5]
5. Conducted disturbances immunity test : It tests the immunity against high-frequency conductive noise generated in the power line / signal line. [IEC 61000-4-6]
6. Power frequency magnetic field immunity test : It tests the immunity against the magnetic field generated by high current. [IEC 61000-4-8]
7. Voltage dips, short interruptions and voltage variations immunity test : It tests the immunity against power failures and interruptions that may occur in a power system. [IEC 61000-4-11]
8. Damped oscillatory wave immunity test : It is to test the immunity against the switching noises of a power system. [IEC 61000-4-12, IEC 61000-4-18]
9. Harmonics test : It measures the harmonics released from a product or tests the immunity against harmonics. [IEC 61000-3-2]
10. Measurement of conducted and radiated disturbance : It measures the electromagnetic waves released from the electrical line of a product or those propagating in the air. [CISPR 16-2-1, CISPR 16-2-3]

Specification of major equipments

1. Electrostatic generator : Max ± 30 kV
2. Electromagnetic wave radiated immunity test apparatus : Max 200 V/m, 0.08 ~ 6 GHz
3. Electrical fast transient generator : Max ± 4.4 kV, Max 1 MHz
4. Surge generator : Max ± 15 kV
5. Electromagnetic wave conducted immunity test facility : Max 30 V, 150 kHz ~ 80 MHz
6. Voltage dips, short interruptions and voltage variations immunity test equipment : 12 kVA
7. Harmonic analyzer : Max 50th, Max 1 kV, Max 5 kA
8. Equipment to measure the release of electromagnetic wave : 9 kHz ~ 3 GHz



Surge immunity test



Electrostatic discharge immunity test



Transient immunity test



Damped oscillatory wave immunity test

Environmental Lab

The lab conducts simulation tests of weather conditions, vibration and impact, etc. that might occur in the process of transportation, storage, installation and use of a product so as to evaluate the reliability of the product.



Data concentration unit characteristics test



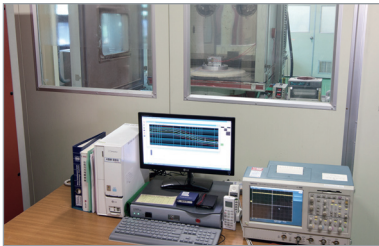
View of the environmental lab

Types and description of tests

1. Climatic test : It evaluates whether a product performs properly by simulating the temperature and humidity of the place where the product is stored, maintained and used.
2. Combined environmental test : It verifies the performance of a product by simulating an environment similar to the actual environment where temperature, humidity and vibration are present at the same time.
3. Vibration and impact test : It simulates the vibration and impact that might occur in the process of transporting, installing and using a product.
4. Thermal shock test and rapid change of temperature test : These are to confirm the effects of repetitive exposures to rapid temperature changes on a product.
5. Dust test : It is to determine whether the product performs properly in a dusty environment.



Combined environmental test



Vibration test



Dust test



Thermal shock test

Specification of major equipments

1. Constant temperature and humidity chamber and a rapid temperature change chamber
 - Temperature and humidity : -70 ~ 150 °C, 20 ~ 98 % R.H.
 - Temperature gradient : 1 ~ 10 °C/min
2. Heat impact tester
 - Temperature : -70 ~ 200 °C
 - Temperature change : Within 3 minutes
3. Vibration and impact tester
 - Frequency : 5 ~ 2000 Hz
 - Amplitude : Max 50.8 mm
 - Exciting force : 20 kN
4. Combined environment test :
 - Temperature + humidity + vibration
5. Dust tester : IP5X ~ 6X La2 Category2

Smart Device Lab

The Smart Device Lab measures the renewable solar generation energy and evaluates the performance of electric car chargers, intelligent meters, and protective relay that protects a power system as well as any measuring instruments.



View of the smart device lab



Test on the characteristics of smart devices

Types and description of tests

1. Error test for watt-hour meter : It is a test to determine whether the electricity meter (used to measure electricity consumption) performs accurately and within tolerance range.
2. Solar power generation performance monitoring test : It is a test to measure the quantity of electricity generated by photovoltaic cells and the quantity of electricity transferred after such electricity generation.
3. Performance test of electrical vehicle chargers : It is a test to determine whether the charging quantity is measured accurately during electric vehicle charging.
4. Smart meter test : It is a test to determine whether a meter can (i) measure the quantity of electricity consumed by a household accurately and (ii) sends such information to the electricity business so that the business can control and read such information remotely.
5. Test on the measurement / behavior characteristics of protective relays : It is a test to determine whether the relay can close the breaker in the power system within a specified time upon occurrence of any error in voltage, current and phase of the system so as to prevent accidents.
6. Measuring test : It is a test to determine whether a device can measure and indicate the voltage, current, power factor and frequency, etc. of the power system accurately.

Specification of major equipments

1. Electricity meter error test apparatus
 - Voltage / current capacity : Max 300 V 120 A
 - Accuracy : ± 0.05 % or less
2. Precision power source unit
 - Voltage / current capacity : Max 300 V 120 A
 - Accuracy : ± 0.02 % or less
3. Commercial frequency withstand voltage : Max 5 kV, 50 / 60 Hz
4. Lightning impulse withstand voltage : Max 19.5 kV
5. Programmable AC source
 - Rated capacity : 2 kVA
 - Output voltage : Max AC 300 V, Max DC 424 V
 - Harmonic wave : Max 40th



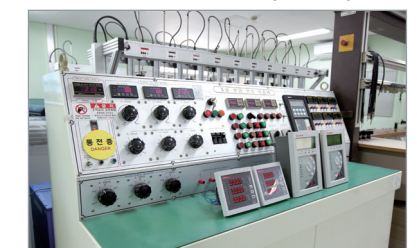
Static meter function test



Smart meter error test



Voltage change test



Test on the measurement / behavior characteristics of protective relays

EV Lab

It is a vehicle electrical equipment testing lab, which conducts tests related to the characteristics, environment and loads of products mounted on an electric vehicle.



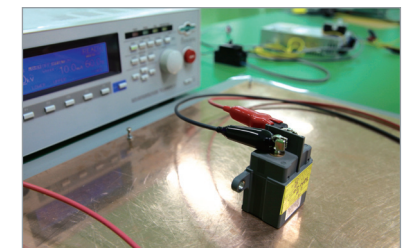
Jump-start test



Operating simulation test

Types and description of tests

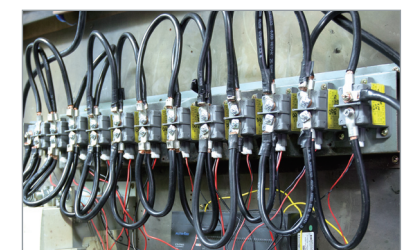
1. Jump-start test : It is a characteristics test to verify the EV-Relay operation at the peak voltages that may be applied initially when jump-starting a car.
2. Operating simulation test : It is a simulation test for various situations that might occur with the product when the EV-Relay is in operation.
3. Withstand voltage test : It confirms whether the product can withstand high voltages applied between the main circuit and the coil which are not contacting each other electrically.
4. Heat cycle test : It is a environment test performed by installing the EV-Relay in a constant temperature and humidity chamber and then changing the ambient temperature from low to high temperatures.
5. Mechanical life test : It is a reliability test on the abrasiveness of the coil and the limits of the product, performed by consistently turning on and off the contact points of the EV-Relay.



Withstand voltage test



Heat cycle test



Mechanical life test

Specification of major equipments

1. Constant temperature and humidity chamber
 - Temperature and humidity : $-70 \sim 150^{\circ}\text{C}$, 20 ~ 98 % R.H.
 - Temperature gradient : $1 \sim 10^{\circ}\text{C}/\text{min}$
2. Test simulator
 - Power source : DC 450 V 30 A, DC 10 V 260 A
 - Channel : 8 Channel
3. Withstand voltage tester : 25 V ~ 1000 V, 0.01 M Ω ~ 9.99 G Ω
4. DC load equipment : DC 600 V 600 A

BESS Lab

The BESS(Battery Energy Storage System) Lab evaluates the performance of a battery energy storage systems, which charges renewable energies in a storage battery and discharges them when necessary.



External event test on PCS for BESS

Types and description of tests

1. BESS performance test : It is a test to determine whether power is generated depending on the energy consumption of the load with the use of energy stored in a storage battery.
2. Electrical insulation test : As with the lightning impulse and commercial frequency withstand voltage tests, it is a test to evaluate whether a product can maintain insulation where neither short circuit nor line-to-ground fault occurs even if abnormal voltages appear in the power system due to lightning or the like. It also tests whether the product can protect human body from electric shock.
3. Anti-islanding test : It is a test to evaluate the function that, upon detecting abnormality in the power system, separates the BESS device from the system for protection.
4. Abnormal test : It is a test to evaluate whether the power system is safely protected from accidents including short-circuits on the output side of BESS, interruptions in the system voltage, voltage dip, load interruptions and the like.

Specification of major equipments

1. PV simulator : DC 50 kW 1000 V 80 A
2. Load simulation apparatus
 - R(62.5 kW) Active power • L(62.5 kVAR) / C(62.5 kVAR) Reactive power
3. AC power supply interconnected with the electric power systems
 - Power source : 1-phase and 3-phase 16 ~ 819 Hz / 0.01 Hz
 - Capacity : 30 kVA • Voltage : Max 520 V
 - Current : Max 1-phase 67 A, Max 3-phase 33 A



Energy storage device characteristics test



PCS characteristics test



PCS insulation test

Plural interconnection test



Calibration Lab

We are accredited as an internationally-certified calibration agency in regard of high voltage and current devices, length, mass and temperature. We support suppliers, not to mention in-house equipment.



Calibrator

Items and description of calibration

We have certificates in 10 sub-categories and 59 items, the details of which are as follows :

- 102. Linear dimension : Gauge blocks, filler gauges and 9 other items
- 104. Form : Precision surface plates, optical flats and optical parallels
- 105. Complex geometry : Contact coordinate measuring machines, measuring microscopes and thread plug gauges
- 106. Various dimensional : Inside / outside micrometers, dial / digital gauges and other 5 items
- 201. Mass : Electric balances, platform scale balances and weights
- 401. DC voltage & current : DC power supplies, DC current shunts and 4 other items
- 402. Resistance, capacitance and inductance : Resistance meters, insulation testers and 3 other items
- 403. AC voltage, current & power : AC power meters, puncture / safety testers and 8 other items
- 404. Other DC & LF measurements : Analogue / digital multimeters, oscilloscopes and 5 other items
- 501. Contact thermometry : Thermomecoules of base metal and other 3 items

Specification of major equipments

1. Gauge block comparator
 - Resolution : 0.01 μm • Measurement uncertainty : 0.04 μm
2. Electronic balance : 0 ~ 200 kg
 - Resolution : 0.01 mg • Measurement uncertainty : 0.11 mg
3. Multifunction calibrator : 1000 V 100 A
4. Oscilloscope calibration
 - Bandwidth : 3 GHz
5. Electrical power standard : 3-phase 38.5 kW 700 V 80 A
6. Standard platinum resistance thermometer : 0 ~ 400 $^{\circ}\text{C}$
 - Resolution : 1 mK • Measurement uncertainty : 2 mK



Gauge block comparator



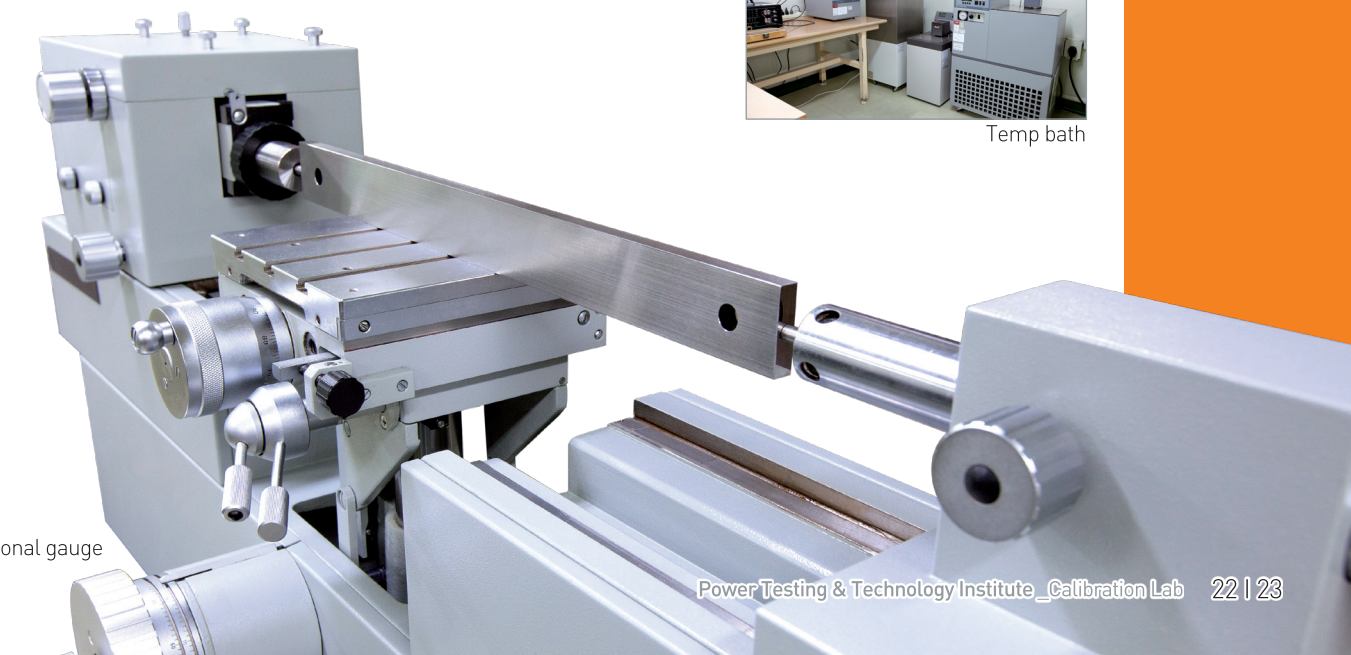
Height calibrator



Electronic balance



Temp bath



Two-dimensional gauge

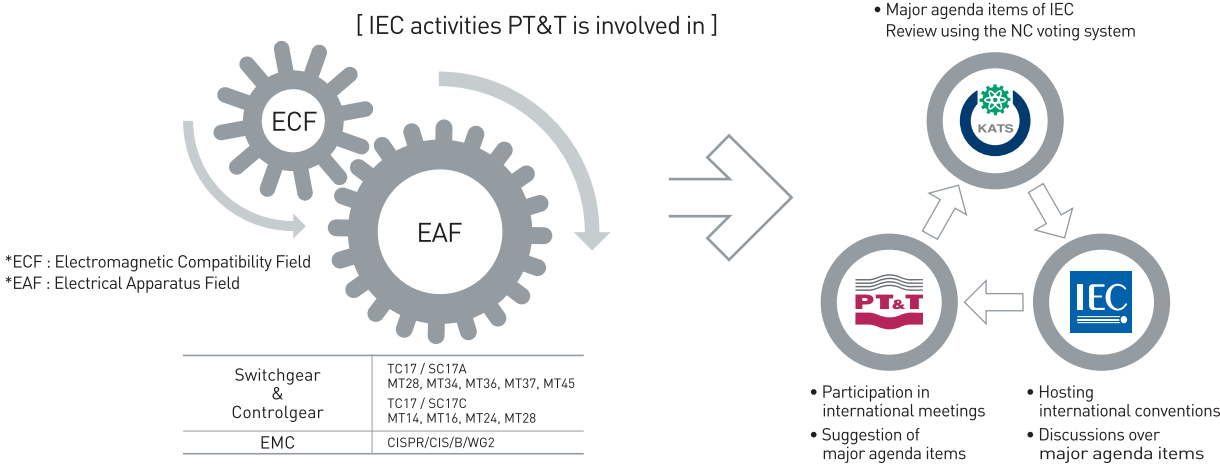
International Standard Activities

The International Electrotechnical Commission(IEC) is a worldwide cooperative body working on the standardization of electric, electronic and relevant technologies. It was established in Geneva, Switzerland in June 1906 so as to respond to the demand of the global market efficiently. It consists of technical committees(TC), subcommittees(SC) and working groups(WG). Around 60 full member countries establish and amend international standards by submitting agenda items and voting on them.



IEC standardization activities of PT&T

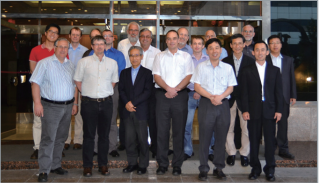
In an effort to enhance competitiveness of our products in the globalization era, the testing departments of PT&T conduct research activities on IEC international standards.

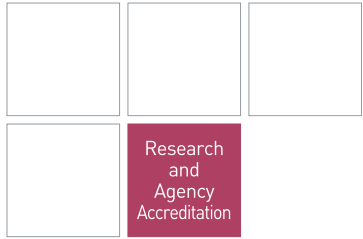


IEC standards research activities of PT&T

PT&T is actively involved in the establishment and amendment of standards through its in-house IEC community activities and participation in international meetings of IEC technical committees. We also analyze trends to prepare testing method and facilities in advance and are engaged in reflect, the design of relevant products.

No	IEC technical committee activities we are involved in	
1	TC 13	Electrical energy measurement and control
2	TC 14	Power transformers
3	TC 28	Insulation co-ordination
4	TC 42	High-voltage and high-current test techniques
5	TC 56	Dependability
6	TC 70	Degrees of protection provided by enclosures
7	TC 77	Electromagnetic compatibility
8	TC 82	Solar photovoltaic energy systems
9	TC 95	Measuring relays and protection equipment
10	TC 104	Environmental conditions, classification and methods of test
11	TC 109	Insulation co-ordination for low-voltage equipment
12	TC 17 / SC 17A	High-voltage switchgear and controlgear assemblies
13	TC 17 / SC 17B	Low-voltage switchgear and controlgear assemblies
14	TC 17 / SC 17C	High-voltage switchgear and controlgear assemblies
15	TC 17 / SC 17D	Low-voltage switchgear and controlgear assemblies
16	TC 23 / SC 23E	Circuit-breakers and similar equipment for household use
17	TC 32 / SC 32A	High-voltage fuses
18	SC 77A	Low frequency phenomena
19	SC 77B	High frequency phenomena
20	SC 77C	High power transient phenomena
21	CISPR	International special committee on radio interference
22	CISPR / SC A	Radio-interference measurements and statistical methods
23	CISPR / SC B	Interference relating to industrial, scientific and medical devices
24	CISPR / SC D	Interference relating to vehicles and components
25	CISPR / SC F	Interference relating to household appliances tools
26	CISPR / SC I	Electromagnetic compatibility of multimedia equipment and receivers





Research Activities / Agency Accreditation

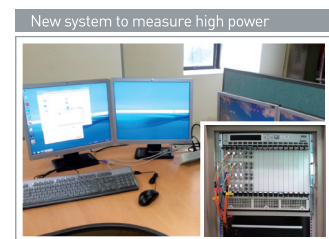
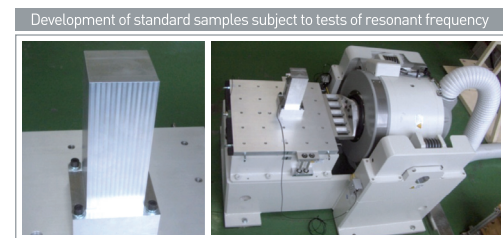
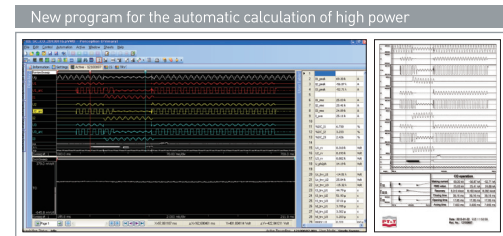
As an internationally certified testing agency accredited by KOLAS, PT&T classifies into four categories as follows and issues certifications about them :

- Type test : With respect to a test subject specifically examined in accordance with applicable procedures, it tests all rated characteristics and performance specified by the manufacturer according to relevant requirements for development tests as prescribed by applicable national or international standards.
- Performance test : It is a test of certain rated properties and performances out of various development test items, performed in accordance with development procedures and requirements.
- Item test : It is performed when a product fails on a certain test item at a test undertaken in accordance with development test procedures, publicly recognized standards or technological standards.
- Reference test : It is a test performed according to the requirements of the client.

In addition, as a internationally certified calibration agency, PT&T issues certifications of analysis in regard of length, temperature, mass and electricity.



Research Activities



Agency Accreditation



CESI



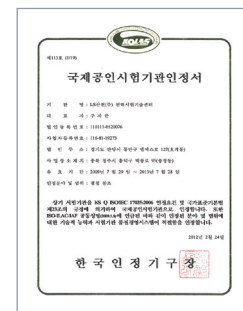
KEMA



KERI



UL



KOLAS Testing



KOLAS Calibration

We choose the most strict way!

PT&T is not tolerant.

We do not compromise nor settle for less than what the relevant standards call for.

We find the most rigorous and strict methods in the world and apply them as test standards. As a result, the products we tested and certified are trusted and used in the global market.

The rigorous tests conducted by PT&T, which technologies and systems must pass in order to be applied and used in practice and to make the world better, are establishing new criteria anyone can agree and trust.



PT&T is recognized to be the best in the world!

Through the most rigorous and strict tests in the world, we not only vouch for the reliable performance and quality of products and systems that consumers use but we also motivate manufacturers to develop better products. Accordingly, we have the stature well recognized by many agencies and experts. We will not settle for the status quo, but strive further to be the best of best in the world.



LSIS | Power Testing & Technology Institute

