

# KONČAR

ELECTRICAL ENGINEERING  
INSTITUTE



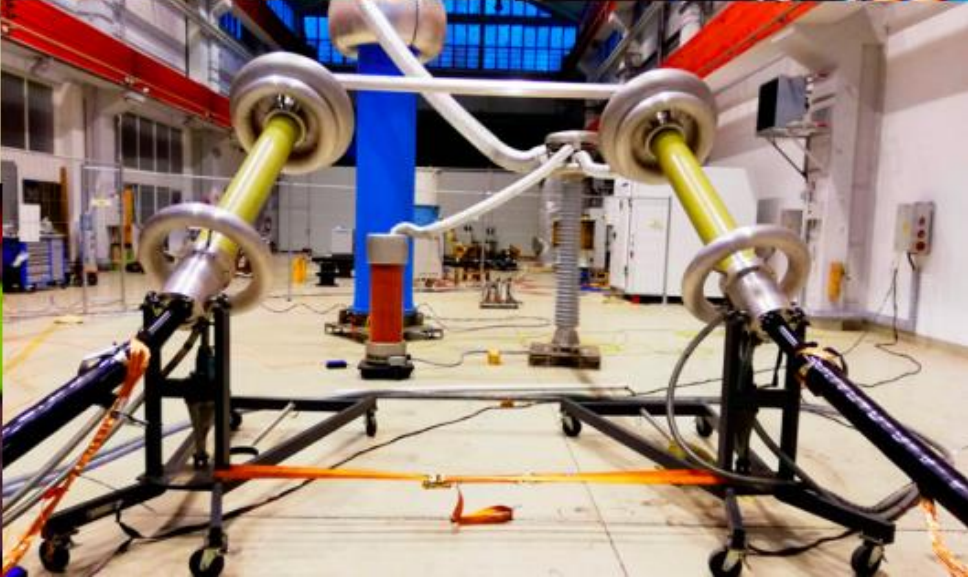
LABORATORY  
CENTER

A photograph of a high-voltage testing setup. A central black vertical rod is surrounded by a series of blue, glowing, spiral-shaped components. A bright blue, glowing arc of electricity is visible, extending from the top left towards the center of the spiral. The background is dark and industrial.

# Laboratory Center

ACCREDITED TESTING SERVICES



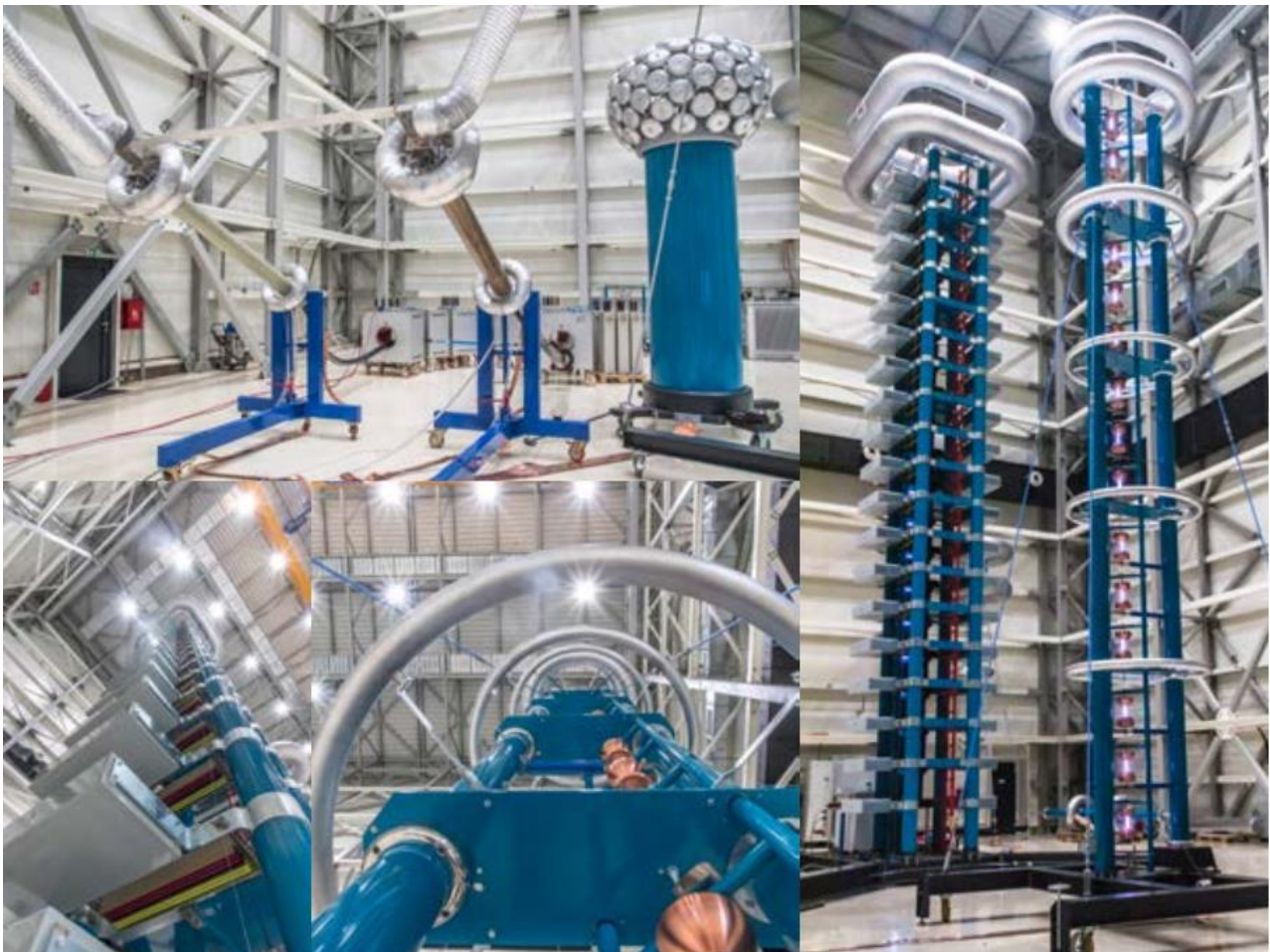




## Laboratory Center performs type tests for the following equipment:

- » Bushings
- » Power Cables and Accessories
- » Shunt Capacitors
- » Distribution Transformers
- » Instrument Transformers
- » Switchgear
- » Insulators
- » Fittings for Overhead Lines
- » Conductors
- » Optical Ground Wires (OPGW)
- » Compression and Mechanical Connectors
- » LV Electrical Equipment

The Laboratory Center is approved to perform testing by DEWA and TRANSCO.



# ACCREDITED TESTING AND CALIBRATION SERVICES

Qualified and accredited laboratories of the KONČAR – Institute's Laboratory Center offer testing services of electrical equipment and mechanical components, calibration of measuring and test equipment, as well as diagnostic tests on site.

The Laboratory Center services are based on the competencies of experts, quality, speed, and the "one-stop testing" approach. The customer obtains complete support for the testing required to place the product on the market.

## Accreditation

Laboratory Center of KONČAR – Electrical Engineering Institute is accredited by the Croatian Accreditation Agency (HAA) in accordance with HRN EN ISO/IEC 17025 for the scope of tests specified in the Accreditation Certificate No. 1035 and the scope of calibration specified in the Accreditation Certificate No. 2057. HAA is a signatory of EA-MLA and ILAC-MRA.

Accreditation confirms independence and competence in providing testing and calibration services. Using modern testing and measuring equipment, Laboratory Center meets the requirements of international standards and customers' needs.



Accreditation Certificate No. 1035



Accreditation Certificate No. 2057



## TESTING FACILITIES

Laboratory Center is accredited for almost 700 testing and calibration methods, according to the requirements of international standards and technical specifications.



# BUSHINGS

Bushings have always been one of the most critical components of the electric transportation grid. They are the most common cause of catastrophic transformer failure. According to some international standards, the tests on bushings are more severe than tests on components on which they are implemented. Over many years of experience, our laboratory has provided type test services for top bushing manufacturers of oil-air, oil-oil, oil-SF6, and air-air bushings.

Our laboratory can perform tests on mineral oil and ester oils, which are increasingly requested by customers. The laboratory has its purification machines for both oil types, allowing time savings if oil regeneration is necessary.

## Tests on bushings

### Standards:

- » IEC 60137
- » IEEE Std C57.19.00
- » HRN EN IEC/IEEE 65700-19-03

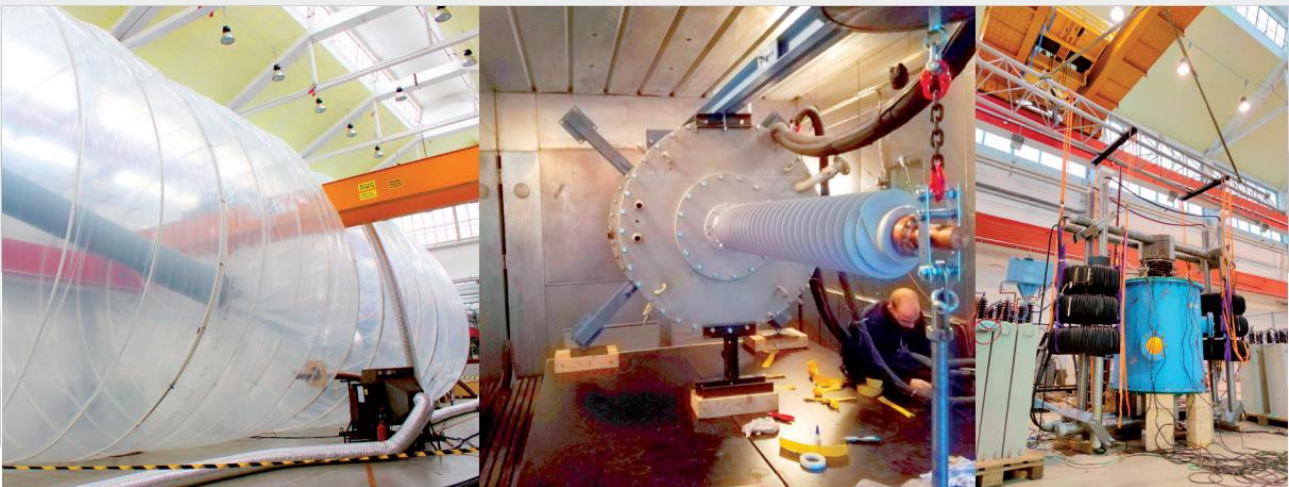
### Standard tests:

- » Routine tests
- » Verification of dimensions
- » Dry lightning impulse voltage withstand test
- » Dry or Wet switching impulse voltage withstand test
- » Wet switching impulse voltage withstand test
- » Wet power-frequency voltage withstand test
- » Long duration power-frequency voltage withstand test

- » Electromagnetic compatibility tests (EMC)
- » Cantilever load withstand test
- » Tightness tests
- » Temperature rise test
- » Verification of calculation of the thermal short-time current withstand
- » Thermal stability test (IEC 60137 clause 8.6)

### Special tests:

- » Temperature rise test at elevated ambient temperature
- » Thermal stability test at elevated ambient temperature
- » Climatic tests
- » Climatic cantilever tests





## CABLES AND ACCESSORIES

As a transmission path of electric energy, cables have been attracting a lot of attention because of the public resistance towards overhead lines in urban areas and the increase in renewable power generation (especially off-shore). Since the cable is laid underground (or on the sea bed), reparation in the case of failure could be time-consuming, resulting in financial losses. Testing is the most important tool to ensure safety, and reliability and to minimize the risk of failure.

With growing demands for DC transmission due to long distances and low losses, Laboratory Center performs full type testing of HVDC cables.

### Tests on cables and accessories

#### Standards:

- » IEC 60840, IEC 62067, IEC 62895
- » IEC 60502-2, HD 620 S2
- » IEC 60502-1, HD 604 S1, HD 603 S1
- » IEC 63026
- » IEC 61442, HD 629.1 S3, IEC 61914
- » HD 605 S2/S3

#### Tests:

- » Routine tests
- » Bending test on the cable
- » Heating cycle voltage test
- » Power-frequency voltage tests
- » Partial discharge measurement
- » Lightning and switching impulse voltage tests
- » Superimposed lightning and switching impulse voltage test
- » DC tests
- » Long term tests at 50 Hz and 500 Hz
- » Check of cable construction
- » Mechanical properties of insulation before and after ageing
- » Mechanical properties of over-sheaths before and after ageing
- » Ageing tests on pieces of complete cable to check compatibility of materials
- » Pressure test at high temperatures
- » Hot set test
- » Carbon black contents of black PE overheats
- » Flame propagation
- » Water penetration
- » Examination of the cable and cable system
- » Prequalification tests and tests after installation



# SHUNT CAPACITORS

Shunt capacitors are used in electric power systems to improve the power factor of the distribution network. As the load in a distribution network is mostly inductive, the power factor is lowered, and the power consumption is increased. Higher current means more line losses. Usually, shunt capacitors are assembled in banks, so the failure of one unit in a bank increases the stress on other units in the same bank.

Our laboratory can perform complete type and routine tests on shunt capacitors as well as special tests according to customer requests. The only possibility to detect the oversight in design is during the type and design tests.

The laboratory is fully capable of performing an overvoltage test, one of the most challenging tests for capacitors.

## Tests on shunt capacitors

### Standards:

- » IEC 60871-1
- » IEC 60871-2
- » IEC 60871-4

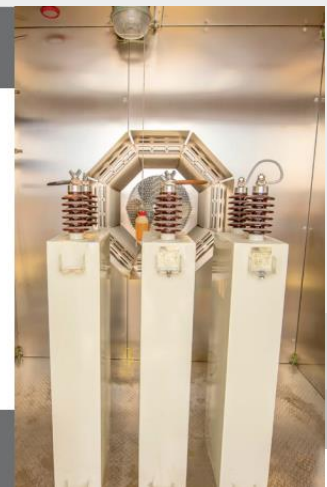
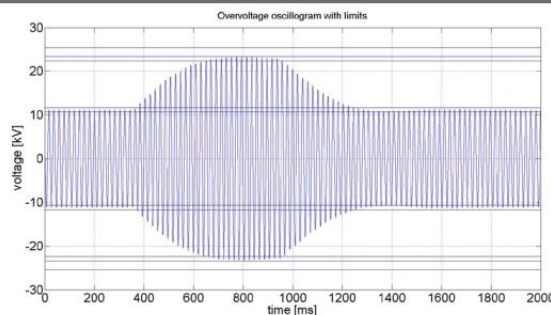
### Standard tests:

- » Routine tests
- » Thermal stability test
- » Measurement of the tangent of the loss angle ( $\tan \delta$ ) of the capacitor at elevated temperature

- » AC voltage tests
- » Lightning impulse voltage test between terminals and container
- » Short-circuit discharge test
- » Disconnecting test on fuses
- » Overvoltage test

### Special tests:

- » Ageing test





# DISTRIBUTION TRANSFORMERS

Distribution transformers are an essential part of the energy system. Their normal operation is essential for the distribution of energy to customers. International standards specify a series of tests covering all requirements on the transformer. Since the Ecodesign Directive took effect in 2021 (Tier 2), which imposes more strict requirements, most transformers must be redesigned and retested to comply with this directive.

In our anechoic chamber, we can perform sound level measurements with low ambient noise.

## Tests on distribution transformers

### Standards:

- » IEC 60076-1,
- » IEC 60076-2
- » IEC 60076-3
- » IEC 60076-5
- » IEC 60076-10
- » IEC 60076-11

### Standard tests:

- » Routine tests
- » Temperature rise test
- » Full wave lightning impulse test
- » Chopped wave lightning impulse test
- » Measurement of partial discharge
- » Measurement of sound level

### Special tests:

- » Mechanical test of DETC
- » Short-circuit withstand test
- » Measurement of harmonics in excitation current
- » Radio interference voltage test
- » Linearly rising front-chopped lightning impulse test
- » Capacitance measurement
- » Insulation resistance tests
- » Climatic tests
- » Environmental test
- » Fire behavior test - in cooperation with subcontracted accredited laboratory
- » Vacuum and pressure tests



# INSTRUMENT TRANSFORMERS

Whenever there is an energy transfer between the supplier and user, there is a need for metering and protection.

One-stop test solutions for instrument transformers have been achieved by including all the types and special tests on instrument transformers within the scope of accreditation of the laboratory.

## Tests on instrument transformers

### Standards:

- » IEC 61869-1
- » IEC 61869-2
- » IEC 61869-3
- » IEC 61869-4
- » IEC 61869-5
- » GOST 7746
- » GOST 1983

### Standard tests:

- » Routine tests
- » Tests for accuracy
- » Short-time current tests on current transformer
- » Short - circuit withstand tests on voltage transformer
- » Lightning and switching impulse voltage withstand test
- » Wet test for outdoor type transformers

- » Electromagnetic compatibility test
- » Temperature rise test
- » Verification of degree of protection by enclosures
- » IP and IK
- » Enclosure tightness test
- » Ferro-resonance tests
- » Transient response tests
- » Type tests for carrier frequency accessories

### Special tests:

- » Chopped impulse voltage withstand test on primary terminals
- » Mechanical tests
- » Multiple chopped test
- » Transmitted over voltage tests
- » Internal arc fault test
- » Ferro-resonance tests on inductive voltage transformers





# LOW VOLTAGE ELECTRICAL EQUIPMENT

Low voltage electric power equipment is a crucial part of the energy system, especially for safety reasons. Electrical installations can be affected by overloads, short circuits, insulation degradation so it is important to have reliable low voltage protective equipment.

The only way to ensure product quality, safety, and reliable operation are to perform type test proscribed by relevant international standards. By type testing, the manufacturer can confidently place their products on the market knowing that they are safe to use.

## Test on low voltage equipment

### Standards:

- » IEC 61439-1
  - » IEC 61439-2
  - » IEC 61439-3
  - » IEC 61439-4
  - » IEC 61439-5
  - » IEC 61439-6
  
  - » IEC 60898-1
  - » IEC 61008-1
  - » IEC 61009-1
  - » IEC 60669-1
  - » IEC 61058-1
  - » IEC 62208
- » IEC 60947-1
  - » IEC 60947-2
  - » IEC 60947-3
  - » IEC 60947-4-1
  - » IEC 60947-5-1
  - » IEC 60947-6-1
  - » IEC 60947-7-1
  
  - » IEC 60269-1
  - » IEC 60269-2
  - » IEC 60269-3
  - » IEC 60269-4

### Test:

- » temperature-rise test
  - » short time withstand current test
  - » short circuit making and breaking capacity
  - » dielectric tests
  - » EMC test
  - » mechanical tests (axial, static and shock load, torsional stress, mechanical strength...)
  - » IP and IK test
- » environmental tests (dry heat, salt mist, damp heat, resistance to corrosion...)
  - » tripping limits and characteristics
  - » operational and overload performance test
  - » cut-off current characteristics
  - » I<sup>2</sup>t and over-current discrimination
  - » verification of non-deterioration of contact and insulating parts
  - » electrical and mechanical durability test

# MEDIUM AND HIGH VOLTAGE SWITCHGEAR

Medium and high voltage switchgear and controlgear are important parts of power systems in terms of distribution, protection, and metering and it is crucial that they work reliably.

Our laboratory can provide a complete set of test required by the international standards covering medium and high voltage equipment, as well as development, field and special tests according to national standards or specific customer request.

## Test on medium and high voltage switchgear

### Standards:

- » IEC 62271-1
- » IEC 62271-100
- » IEC 62271-102
- » IEC 62271-103
- » IEC 62271-105
- » IEC 62271-200
- » IEC 62271-202
- » IEC 62271-203

### Tests:

- » temperature-rise tests
- » measurement of the resistance
- » short-time withstand, and peak withstand current tests
- » dielectric tests (power-frequency, lightning and switching impulse, partial discharge, radio interference)
- » bus transfer current tests
- » induced current switching tests
- » tightness tests
- » EMC tests
- » mechanical operation and endurance tests
- » IP and IK tests
- » environmental tests (dry heat test, cold test, humidity test ...)





# INSULATORS FOR OVERHEAD LINES AND FITTINGS

Increasing interconnections between countries and introduction of renewables on a larger scale results in a growing demand for enhanced capacity in overhead transmission systems. Our laboratory offers full testing service of glass, porcelain and composite insulators according to relevant standards and customer specifications

## Tests on insulators for overhead lines and fittings

### Standards:

- » IEC TR 62730
- » IEC 60383-1
- » IEC 60383-2
- » IEC 60437
- » IEC 61109
- » IEC 61952
- » IEC 61211
- » IEC 62217
- » IEC 61284

### Standard tests:

- » Routine tests
- » Design test
- » Lightning and switching impulse (dry or wet) voltage tests
- » Power frequency voltage test (dry or wet)
- » RIV and corona tests
- » Mechanical tests

### Special tests:

- » 5000 h multistress test
- » Impulse puncture test



# OVERHEAD LINE CONDUCTORS

Since the beginning of power distribution, overhead line conductors were the means of energy transportation. The conductor is selected corresponding to the requirements of the energy system. Deficiency in the construction of overhead line cables could lead to additional line losses or mechanical failures. Therefore, the tests prove that the production of the overhead line conductor follows the requirements for electrical and mechanical characteristics.

## Tests on overhead line conductors

### Standards:

- » IEC 61089
- » IEC 61953
- » IEC 60794
- » IEC 62004
- » IEC 60889
- » EN 50540
- » EN 50182
- » EN 50183
- » EN 50189
- » EN 61395

### Tests:

- » Stress-Strain test
- » Creep test

- » High Temperature Sag-Tension Test
- » Ultimate tensile Strength Test
- » Short Circuit test
- » DC resistance test
- » AC resistance test
- » Conductivity test on aluminum wires
- » Impact test
- » Verification of conductor construction
- » Breaking strength of wires
- » Torsion test
- » Wrapping test
- » Zinc deposition, adhesion and uniformity test
- » Aeolian vibration test
- » Galloping test





## OPTICAL GROUND WIRES (OPGW)

OPGW is primarily used by the electric utility industry, placed in the secure topmost position of the transmission line where it shields the all-important conductors from lightning while providing a telecommunications path for internal as well as third party communications.

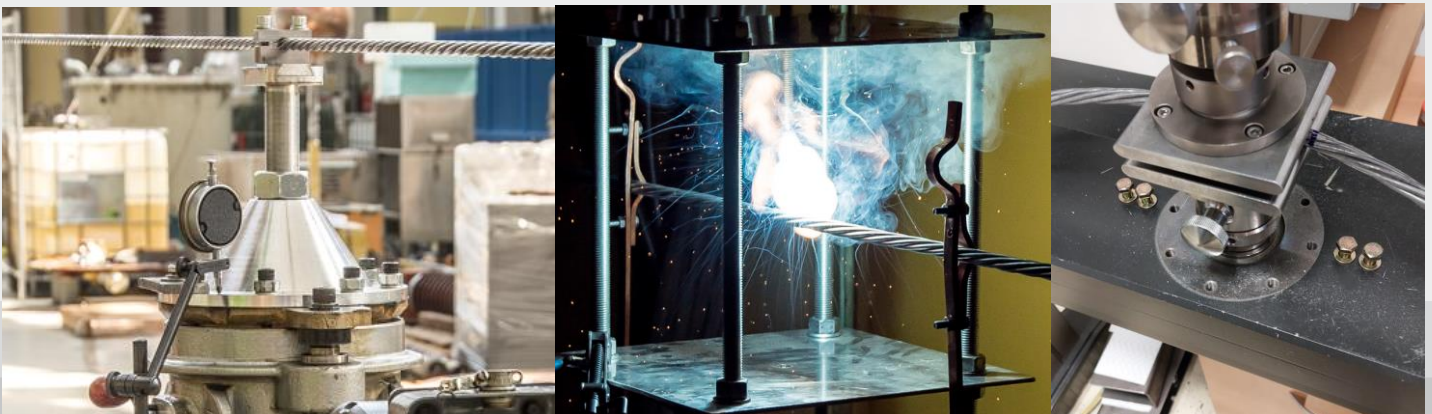
### Tests on OPGW

#### Standards:

- » IEEE Std 1138
- » IEC 60794-4-10

#### Tests:

- » Aeolian Vibration Test
- » Bend Test
- » Creep Test
- » Crush Test
- » Galloping Test
- » Impact Test
- » Lightning Arc Test
- » Seepage of Flooding Compound
- » Sheave Test
- » Short Circuit Test
- » Strain Margin Test
- » Stress-Strain Test
- » Temperature Cycle Test
- » Tensile
- » Twist Test
- » Water Ingress Test



# COMPRESSION AND MECHANICAL CONNECTORS

Cable connectors are an integral part of electric power systems as they allow different electrical systems to connect. They will have to withstand severe stresses in many applications, so it is essential that the mechanical and electrical properties of cable connectors are verified by type testing according to relevant international standards.

Our laboratory can perform complete type tests according to IEC 61238 and EN 50393 standards on various cable connectors like lugs, sleeves, pin-type terminals, T and X joints, reduction connectors, bolted or compression connector types.

## Tests on cable connectors

### Standards:

- » IEC 61238-1-1
- » IEC 61238-1-3
- » EN 50393

### Tests:

- » Electrical resistance measurement
  - » Heat cycling test
  - » Short-circuit test
  - » Mechanical test
  - » Impulse voltage withstand test
  - » AC voltage withstand test
- » Insulation resistance test
  - » Impact test
  - » Heating cycle test
  - » Immersion test
  - » Metallic screen short-circuit current withstand test



## KEY LABORATORY CAPACITIES

Number of employees 99

### Dielectric tests:

- » Main test hall (LxWxH) 35x30x28 m, AC 1,2 MV, DC 1,2 MV, Impulse 3,6 MV
- » Secondary test hall 23x19x15 m, AC 1,0 MV, DC 640 kV, Impulse 2,4 MV
- » AC/DC/Impulse withstand/flashover tests dry/wet, PD measurement, C-tan $\delta$ , RIV, Thermal stability, Heat-cycle voltage tests, Ferroresonance...

### High power tests:

- » Main test area: 7x6 x7,5 m + outdoor area 20 x 10 m
- » Power source for the HP Laboratory: 30 kV, 50 Hz from the distribution network
- » Short circuit tests: three phases up to 40 kA duration 3s; up to 67 kA duration 1s one phase: up to 40 kA duration 3s, up to 120 kA duration 0.1 s power
- » transformers up to 2 MVA, 6 %, up to 20 kV rated voltage
- » Low voltage make break tests: 75 kA@240 420 550 V, 50 Hz; 30 kA@725 1000 V, 50 Hz. Fuse testing: I1 up to 120 kA@550V
- » Power tests of converters, test area 500 m<sup>2</sup>, 2x400 kW 440 V DC; 1x220 kW 230 V DC; 0-500 V AC 0-60 Hz, 500 kVA (with various step-up transformers up to 36 kV); 120 kVA, 30-200 Hz





**Temperature rise:**

- » Main test hall 180x22x12 m (flexible test area also used for long duration ageing tests, pollution tests, mechanical tests on large objects, developmental tests,...)
- » Heat Run Tests Busbars up to 12 kA, 3ph; MV/LV cabinets up to 10 kA 3ph, transformers up to 60 MVA, DC current up to 12 kA

**Environmental tests:**

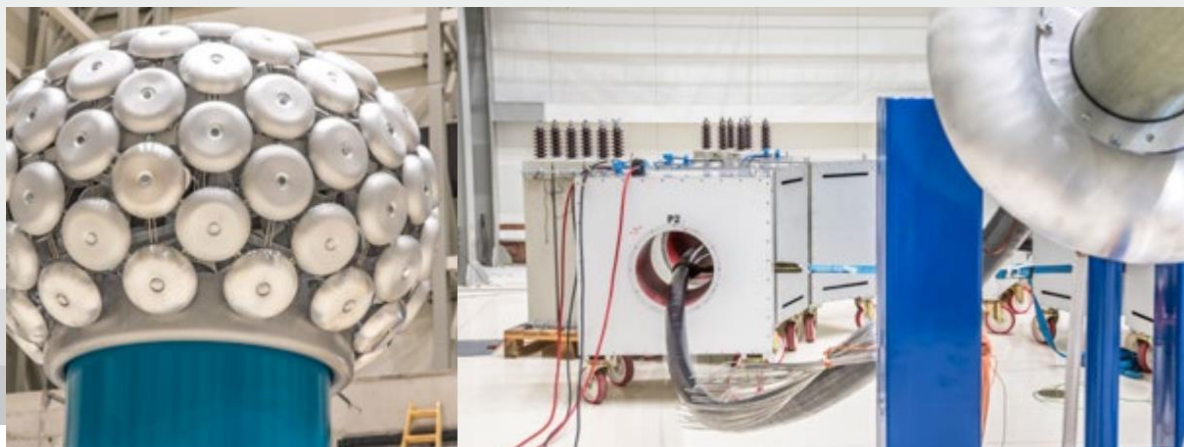
- » Walk-in climatic chamber 50 m<sup>3</sup>, 4,9x3,3x3,25 m, -60 °C to +105 °C
- » Smaller chambers up to 1,5 m<sup>3</sup> -60 °C to +180 °C
- » IP protection up to IP68 and protection provided by enclosures IK 0-10
- » Salt mist corrosion resistance, UV resistance tests
- » Anechoic room for sound level (noise) measurements 8,0x7,4x5,5 m
- » Resistance to vibrations
- » Multistress tests (simultaneous testing with voltage applied, UV, heat, rain, salt-fog, humidity)

**Material testing:**

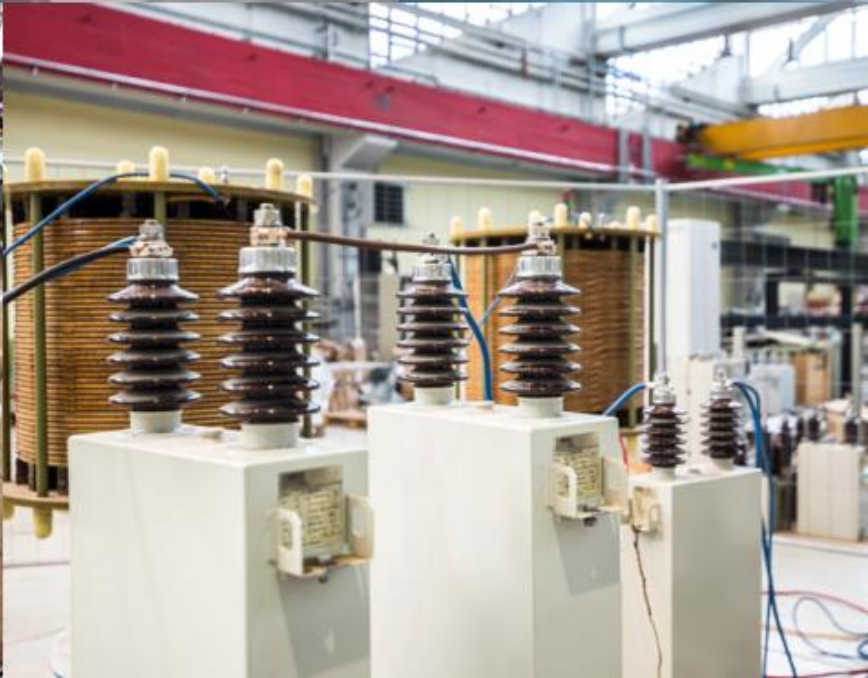
Quality control and qualification testing of insulation liquids and materials, material assessment, mutual compatibility of materials in insulating system, magnetic properties of electrical steel and other soft magnetic materials, mechanical tests (tensile tests up to 500 kN, bending, impact, hardness), NDT, metalographic examination, chemical composition, RoHS

**On-site services:**

Diagnostics of transformers (including loss measurement and PD test), generators, motors, switchgear, cables, calibration of measuring instruments









## Contact us for more information!

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