



OIL IMMERSED TRANSFORMERS

Hermetically Sealed & Conservator Type

ELTAS

Transformatör San. ve Tic. A.Ş.





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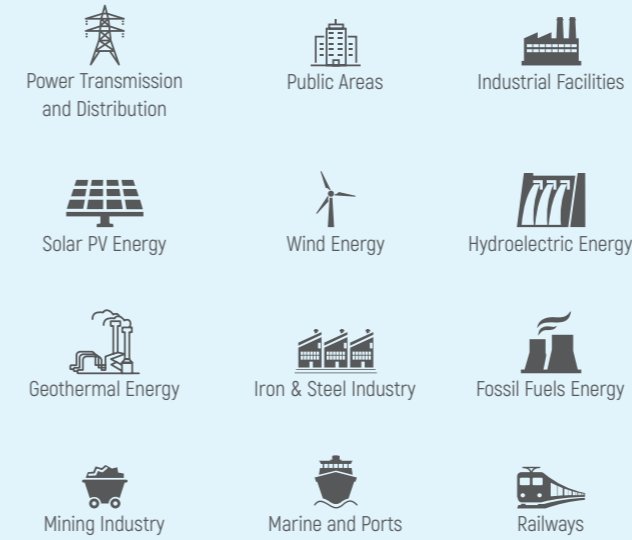
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Team are;

- Do our best
- Never compromise on quality
- Sustained developing
- Creative and innovative
- Hardworking, devoted, well-informed
- Honest, fair, transparent
- Customer-oriented
- Environment friendly

BUSINESS SECTORS



ELTAS Transformatör A.Ş. is one of the leading transformer manufacturer of Turkey with 41 years of experience.

Today with more than 10.000 transformers we produced, we are in more than 90 countries; We are in everywhere where energy exist.

ELTAS Transformatör A.Ş. strengths are unique engineering and design features and flexibility to meet all the customer requirements on time. Each power transformer is designed according to its required specification and suitable to its application area.

Product Groups:

- High Voltage Large Power Transformers up to 250 MVA at 420 kV
- Cast Resin Dry Type Transformers up to 25 MVA at 36 kV
- Oil Immersed Transformers Hermetically Sealed & Conservator Type
- Solar & Wind Application Transformers
- UL/cUL Listed Transformers
- Mobile Transformers
- Rectifier Transformers
- Special Transformers
- Earthing Transformers
- Auto Transformers
- Serial & Shunt Reactors



Oil Immersed Transformers

Oil Immersed Transformers Product Types

- Hermetically Sealed Distribution Transformers
- Conservator Type Distribution Transformers
- Renewable Energy Application Transformers
- UL/cUL Listed Transformers
- Mobile Transformers
- Rectifier Transformers
- Mono-phase Transformers
- Earthing Transformers
- Auto Transformers
- Serial and Shunt Reactors



Our Transformers can be designed and produced;

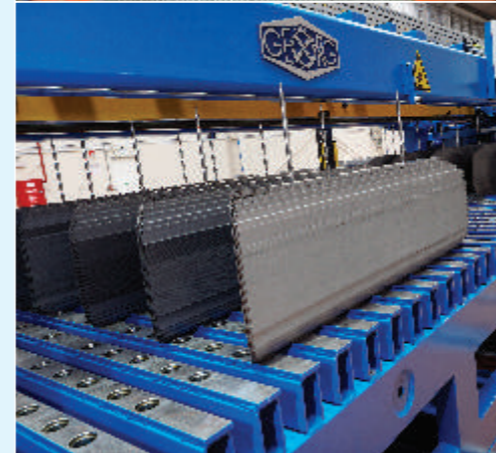
- According to International and National Standards (such as IEC 60076-1, ANSI/IEEE, BSI, DIN, etc.) or Customer Specific Standards
- with ONAN, ONAF, ODAF, OFAF, OWAF cooling systems
- mineral oil and natural & synthetic ester fluids
- with off-load tap changers or on-load tap changers
- with cable box or protection box
- with porcelain bushings, resin type plug-in bushings or busbar bushings



Windings

Windings for distribution transformers for the low voltage coils, either copper or aluminum can be used as conductor material. The windings are made of foil or a flattened and paper or Nomex insulated wire. If the coils are made of foil, the layers are insulated using a thermal upgraded paper as well as a covering made of DDP resin.

The high voltage coils are also made of copper or aluminum conductors. For the windings, an enameled or a paper insulated round or flattened type of wire is used. The layer insulation looks like a dagger, because of the stripped electrical insulation paper (kraft or thermal-upgraded, diamond patterned). The structure of this specially formed layer insulation increases the impulse voltage properties. The layer insulation also helps in achieving another important goal: to produce a rigid coil without space. In other words a coil of excellent quality.



Core

The core of transformers are made of cold rolled grain oriented silicon steel. Cores are produced by using first class quality of steel.

The choice of the material is made according to no-load values required by the customer.

Cores are slitting, cutting to length without burr and stacking by Well-Known, Next Generation, Automatical Fully Integrated Georg and Tuboly Machines in house.

Active Part & Cover

The assembly of core, coil and designed to increase the resistance against short circuit forces. The top cover, including the active part of standard transformers, is mounted to the tank with bolts. Another application is the direct assembly of active part to the tank.

The connection parts of the top cover, the high voltage bushings, and the arching horns are made of stainless materials or of materials covered by a special coating which is resistant to corrosion. The arrangement of the bushing, the accessories, the protection box or the cable box is done on the top or the side of the transformer according to customer requests.



Oil Immersed Transformers



Tank

Tanks and top covers for transformers are made of mild steel. The cooling surfaces of distribution transformers are made of corrugated walls and they also form the sides of the tank. Bottom plate, sides and frame are sealed by welding. For transformers up to 4000 kVA, corrugated cooling walls can be used as cooling surfaces.

Also, it is possible to use radiators as cooling surfaces. Every transformer tank needs to pass an oil leakage test after welding. Therefore, each tank is taken under pressure after being produced.

Drying & Oil Filling

The active parts of transformers such as core and coils are dried under high vacuum in a furnace. The process of drying varies according to transformer's type, power and voltage. Oil is filled under high vacuum.

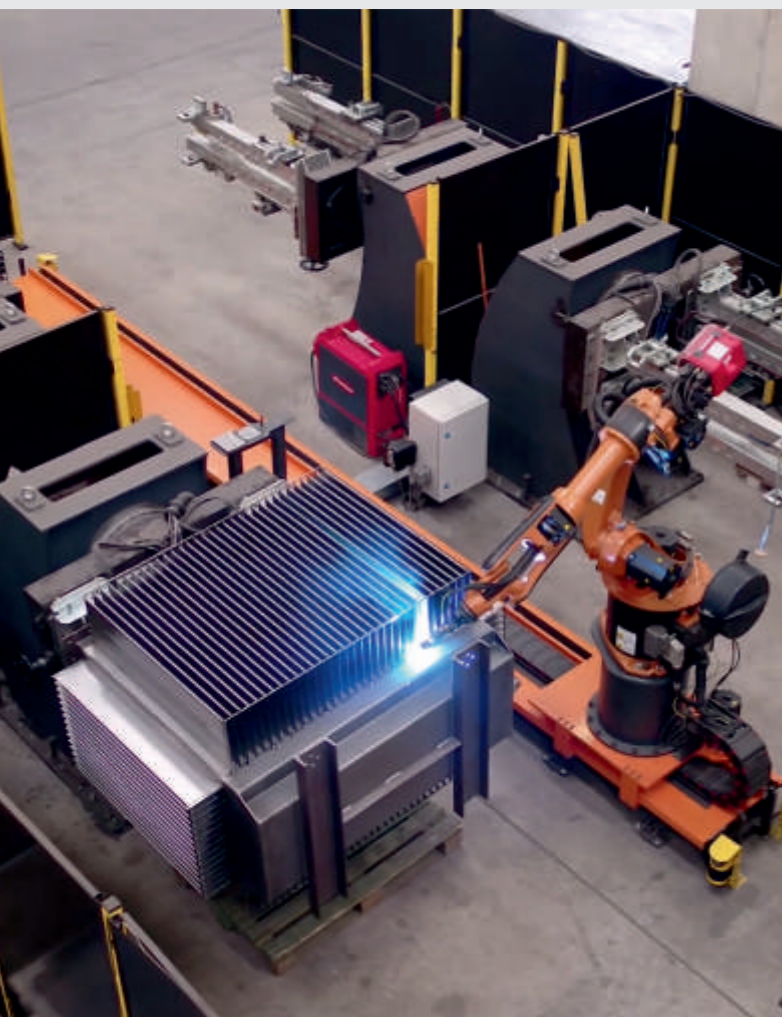


Painting

Transformers are in the colour of RAL 7033 as a standard. Transformer tanks are painted by the method of dipping or spraying. Method of painting is chosen in accordance with customer requests and working conditions of the transformer.

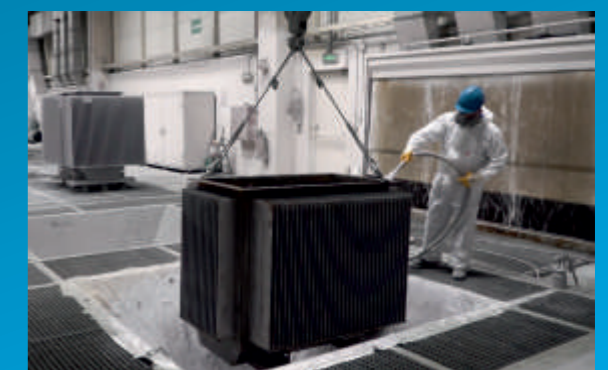


ELTAŞ A.Ş. offers different applications, different thickness of film or transformers with different colours as per customer requests. Also, if requested, hot dip galvanized tanks can be produced.



Finished tanks and top covers are sandblasted commensurate with DIN specifications.

If the customer has specific request or demands related to sandblasting, ELTAŞ A.Ş. has sufficient machinery to fulfill all these requirements. It is possible to enclose the bushings on the top cover into a protection box made of appropriate steel according to IEC 60144. According to BS 2562, the cable box can be attached to the sides of the tank.



Oil Immersed Transformers Test Laboratory

3 of Test Laboratories & Chemical Laboratory of ELTAŞ A.Ş. have been accredited within the scope of ISO/IEC 17025.

- High Voltage Transformer Test Laboratory
- Oil Immersed Distribution Transformer Test Laboratory
- Dry Type Transformer Test Laboratory
- Chemical Laboratory

Oil Immersed Distribution Transformer Test Laboratory

Oil Type Distribution Transformer Test Laboratory is able to do routine, type & special tests of transformers & shunt reactors up to 31,5 MVA 66 kV, according to IEC, IEEE, ANSI standards, domestic & foreign customer specifications.

Test area of Oil type Distribution & Medium Power Transformer Test Laboratory is 5 x 8 m (width & length).

In order to obtain the grounding resistance value below $0,5 \Omega$, grounding rods that connected to each other, piled under test area. Surface of test area was covered by aluminum plate that connected to grounding rods via different points.



Oil Type Distribution Transformers, Medium Power Transformers, Earthing Transformers, Rectifier Transformers, Booster Transformers, Single-phase Transformers & Shunt Reactors can be tested in Oil Type Distribution & Medium Power Transformer Test Laboratory.

The Following Equipments are Used in Oil Type Distribution Test Laboratory for Routine, Type & Special Tests of Transformers;

- 100 kV, 30 kVA 0,3 A single-phase testing transformer
- 400 kV, 20 kJ 4 stages lightning impulse generator
- 380 Vac supplied, 250 kVA, 0-380 Vac Variac 630 kVA 4,8/0,38 kV step-up transformer
- 55 kW - 160 kVA 50-150 Hz frequency converter generator
- 66 kV, 600 A Transformer loss measurement system
- 1500 kVA 70/7 kV step-up transformer
- 9,7 MVar 0,44 kV.....10 kV variable capacitor bank

List of Routine Tests for Oil Immersed Distribution Transformer Test Laboratory

1. Measurement of Winding Resistances (IEC 60076-1 Clause 11.2)
2. Measurement of Voltage Ratio & Check of Phase Displacement (IEC 60076-1 Clause 11.3)
3. Measurement of Short-Circuit Impedance and Load Loss (IEC 60076-1 Clause 11.4)
4. Measurement of No-Load Loss and Current (IEC 60076-1 Clause 11.5)
5. Applied Voltage Test (AV) (IEC 60076-3 Clause 10)
6. Induced Voltage Withstand Test (IVW) (IEC 60076-3 Clause 11.2)
7. Tests on On-Load Tap-Changers - Operation Test (IEC 60076-1 Clause 11.7)
8. Leak Testing With Pressure For Liquid Immersed Transformers (Tightness Test) (IEC 60076-1 Clause 11.8)
9. Check of the Ratio and Polarity of Built-In Current Transformers (IEC 60076-1 Clause 11.1.2.1)
10. Check of core and Frame Insulation for Liquid Immersed Transformers with Core or Frame Insulation (IEC 60076-1 Clause 11.12)



List of Type & Special Tests for Oil Immersed Distribution Transformer Test Laboratory

1. Determination of Capacitances Windings-To-Earth and Between Windings (IEC 60076-1 Clause 11.1.2.2)
2. Measurement of D.C. Insulation Resistance Between Each Winding to Earth and Between Windings (IEC 60076-1 Clause 11.1.2.2)
3. Measurement of Dissipation Factor ($\tan \delta$) of the Insulation System Capacitances (IEC 60076-1 Clause 11.1.2.2)
4. Measurement of No-Load Loss and Current at 90 % and 110 % of Rated Voltage (IEC 60076-1 Clause 11.5)
5. Temperature-Rise Type Test (IEC 60076-2)
6. Measurement of the Power Taken by the Fan and Liquid Pump Motors (IEC 60076-1 Clause 11.1.3)
7. Determination of Transient Voltage Transfer Characteristics (Annex B of IEC 60076-3:2000)
8. Measurement of Zero-Sequence Impedance (S) on Three-Phase Transformers (IEC 60076-1 Clause 11.6)
9. Measurement of Frequency Response (Frequency Response Analysis or FRA). The Test Procedure Shall be Agreed Between Manufacturer and Purchaser.
10. Paints and Varnishes - Cross-Cut Test (ISO 2409:2007)
11. Measurement Thickness of Paint
12. Check of Core and Frame Insulation for Liquid Immersed Transformers with Core or Frame Insulation (IEC 60076-1 Clause 11.12)
13. Insulation of Auxiliary Wiring (Auxw) (IEC 60076-3 Clause 9)
14. Line Terminal AC Withstand Test (LTAC) (IEC 60076-3 Clause 12)
15. Full Wave Lightning Impulse Test (LI) (IEC 60076-3 Clause 13.2)
16. Chopped Wave Lightning Impulse Test (LIC) (IEC 60076-3 Clause 13.3)
17. Lightning Impulse Test on a Neutral Terminal (LIN) (IEC 60076-3 Clause 13.4)
18. DIRANA (Dielectric Response Analysis - Determination of Water Content in Insulation Material) Test
19. Measurement of Excitation Current
20. Measurement of Harmonics of the No-Load Current





Oil tests and DGA (Dissolved Gas Analysis) are carried out in ELTAS A.Ş. oil laboratory as a quality control of process determination of faults in transformers, condition monitoring of transformers in service, incoming quality control of oil that is used for transformers.

The test devices and measuring methods are being used; comply with national and international norms such as IEC, ISO, ASTM, VDE, BS, JIS, TSE and TEİAŞ. Test results are annotated in accordance with international standards by our team who are experts in their field.



The tests are being performed using the state of art devices in our lab;

OIL TESTS

- Breakdown Voltage
- Interfacial Tension
- Power Factor
- Acidity
- Water Content
- Density
- Viscosity
- Color
- Aniline Point

GAS ANALYSES

- Hydrogen - (H₂)
- Methane - (CH₄)
- Ethane - (C₂H₆)
- Ethylene - (C₂H₄)
- Acetylene - (C₂H₂)
- Carbonmonoxide - (CO)
- Carbon dioxide - (CO₂)
- Oxygen - (O₂)
- Nitrogen - (N₂)

Chemical Laboratory



Quality Certificates

- Quality Management System Certificate (TS EN ISO 9001:2015)
- International Accreditation Certificate (TS EN ISO IEC 17025:2017)
- Environmental Management System Certificate (TS EN ISO 14001:2015)
- Occupational Health and Safety Management System Certificate (TS ISO 45001:2018)
- UL/cUL Certificate
- CE Conformity (Ecodesign Regulation 548-2014_IEC 60076-1 & 11)
- GOST-Russia Certificate
- Certificate of Conformity to Turkish Standards /Dry Type (TS EN 60076-11)
- Certificate of Conformity to Turkish Standards / Oil Immersed (TS EN 60076-1)
- Service Qualification Certificate (TS 12809)

International Test Certificates that we have from independent laboratories

Type Test Reports (KEMA, CESI, VNL VEIKI)

- Short Circuit Test
 - 80/100 MVA 154/33,6 kV Short Circuit Test (KEMA)
 - 50/62,5 MVA 154/33,6 kV Short Circuit Test (KEMA)
 - Oil Immersed 6000 kVA 21,2 /10,6 kV Shot Circuit Test (ICMET)
 - Oil Immersed 4000 kVA 20/0,48 kV Short Circuit Test (VNL VEIKI)
 - Dry Type 5500 kVA 34,5/0,69 kV Short Circuit Test (CESI)
 - Dry Type 2500 kVA 33/0,415 kV Short Circuit Test (KEMA)
- Lightning Impulse Test
- Temperature Rise Test
- Noise Level Test
- Special Test Reports
 - E2, C2, F1 Tests
 - The Seismic Qualification Test



Our Quality & Environment Approach

ELTAŞ A.Ş. is determined to contribute to "The EU Green Deal". We are aware of our responsibilities to protect our planet with our products and service network spread over more than 90 countries.

Our products are designed and manufactured according to **EU Eco Design Regulations** for carbon - neutral society.

Also in accordance with the "Our Vision of Sustainability", we reduce the amount of water we use in our processes day by day, and keep our waste water under control by constantly having it analyzed.

The quality of raw materials, processes, and waste management policies are improved day by day according to **Life-Cycle Assessment**.

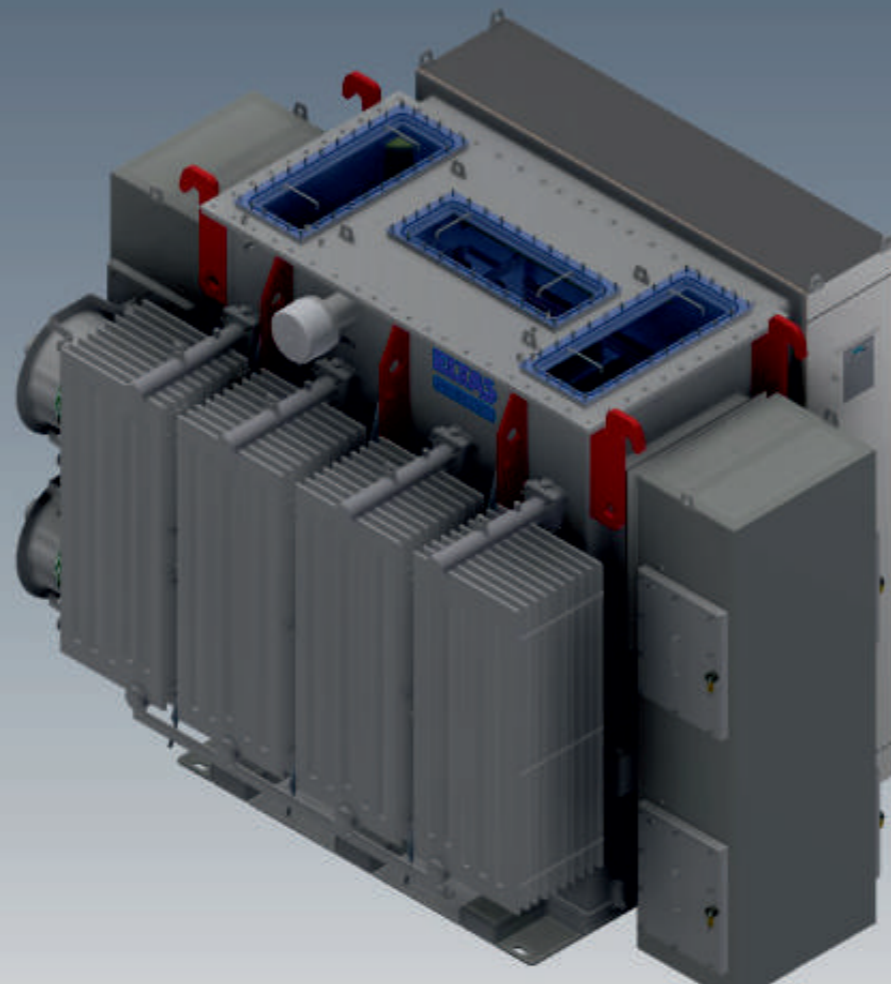


Pad Mounted Transformers

Pad mounted transformers is one of the product groups that is within ELTAS A.Ş. scope of manufacturing. As definition, pad mounted transformers which are installed over a gravel or concrete pad, have underground cable connections and have access restrictions. Generally pad mounted transformers are located in open public areas and they need to be of robust design as to prevent unwanted access.



Currently, pad-mounted transformers are designed in accordance with the latest version of ANSI/IEEE C57 and NEMA standards. Upon request, UL Listed transformers are available as well. Construction-wise LV and HV bushings are located in a cabinet which if formed of 2 compartments. Protection devices, de-energized tap changer, and other accessories are located in this cabinet.



Applications such as solar skids may require LV bushing to be installed in their own separate cabinet which can be located on short walls of the transformer (Segment 2 or Segment 4).

Type of bushings are deadfront and livefront on HV side. Livefront bushings generally have porcelain insulators and have live parts exposed. Deadfront bushings are made of epoxy and their connections are made by means of cable connectors which prevents live parts to be exposed.

Some features of pad mounted transformers are:

- Liquid options: Mineral oil, Natural ester (FR3)
- Bushings: Deadfront, Livefront
- Pressure relief valve
- Pressure vacuum gauge
- Liquid temperature gauge
- Liquid level gauge
- Drain & sampling valves
- De-energized tap changer
- Load break switch (2 or 4 positions)
- CLFs, bayonet of expulsion fuses

Additional valves, gauges (with or without contacts) are also optionally available.

ELTAS A.Ş. makes the designs in accordance with DOE 2016 where applicable. Other desired efficiency levels or characteristics can also be provided.



Renewable Energy Applications



Transformers for Solar Applications

Transformers used in solar power plants are the main product of ELTAS A.Ş. in the liquid immersed distribution transformers group. These transformers, which have been produced in large numbers, are customized according to the needs in the field. They can be designed for single or double inverter connection.

Designs and production solutions for specific brand inverters are also possible. Among these solutions, there are also transformers for "solar skid" applications, which are being preferred frequently in recent years.

These transformers, almost all of which are designed as hermetically sealed, have a static screen as standard. When the transformer is completely filled with oil, an integrated protection relay is installed as standard. Optionally, this relay can be equipped with a PT100.

Depending on the constraints such as size and cooling capacity, ELTAS A.Ş. design and production capability is 6 MVA for a single secondary transformer while it is 10 MVA for double secondary transformer. Solar transformers can be made more compact by utilizing high temperature insulation material, thus increasing thermal class of transformer.

ELTAS A.Ş. can optimize the rated power of a transformer with respect to a given load curve (solar load profile). In this case, the transformer is operated at overload during peak hours. However, since the transformer is going to rest during night hours, overall ageing rate is lower than 1. It means that transformer ageing is slower than nominal ageing rate, thus increasing transformer overall life.



In solar skid applications, the dimensions and terminals of the transformer are customized to be suitable for LV and HV switchgear connections and skid dimensions. Busbar type bushings are commonly used in LV terminals while on HV side, plug-in bushings are mainly used. Bushings can be indoor or outdoor type, depending on requirements. In accordance with the skid design, the terminal outputs can be located on the transformer cover or side wall. Some optional features are:

- Cable box
- Busduct flange
- Oil bund (10% additional capacity)
- Hydrocarbon filter for oil bund
- Bushing locking mechanism



Transformers for Wind Applications

ELTAS A.Ş. also manufactures liquid immersed transformers suitable for installation in wind turbines. Since the space inside the wind turbine is limited, the transformers which are going to be located inside have to be very compact. Liquid immersed wind turbine transformers can be designed using natural or synthetic ester oil, with air or water cooler. Air or water cooled transformers become more compact and it makes a liquid immersed transformer a perfect fit for wind applications.

If more compact designs are needed, insulation material suitable for high temperature class is used and overall dimensions can be reduced further.

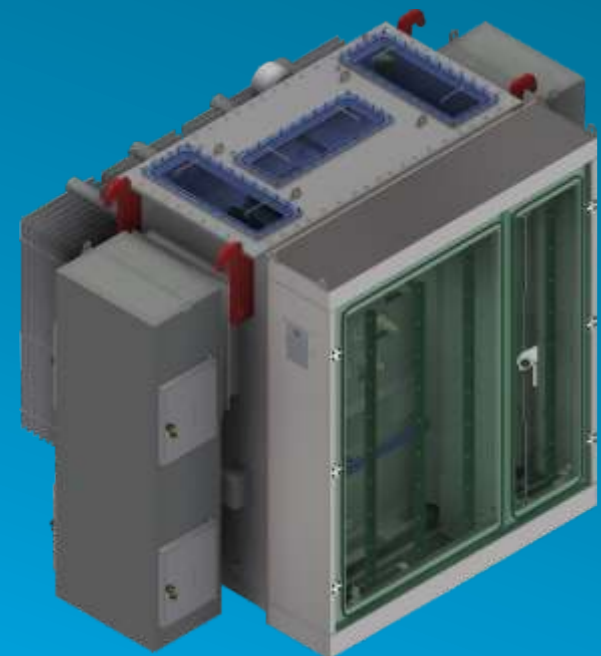
Design Research & Development

ELTAS A.Ş. works to international standards, whereby our strength lines in the engineering approach to design transformers based on the customer's specific requirements and flexibility to meet wishes on time and accurate way.

We thereby use engineering tools equipped with fully integrated design software which has been developed both in-house and externally.

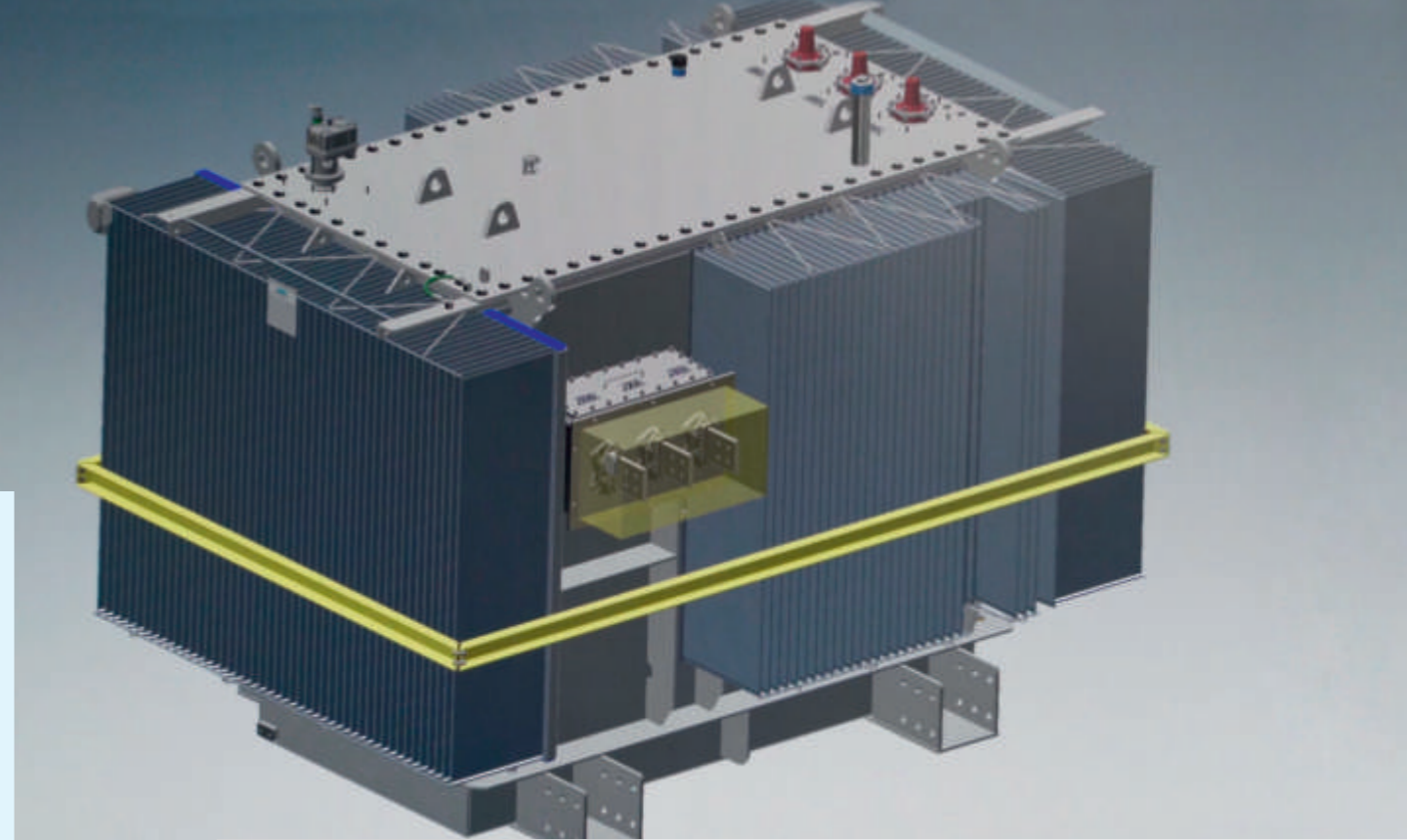
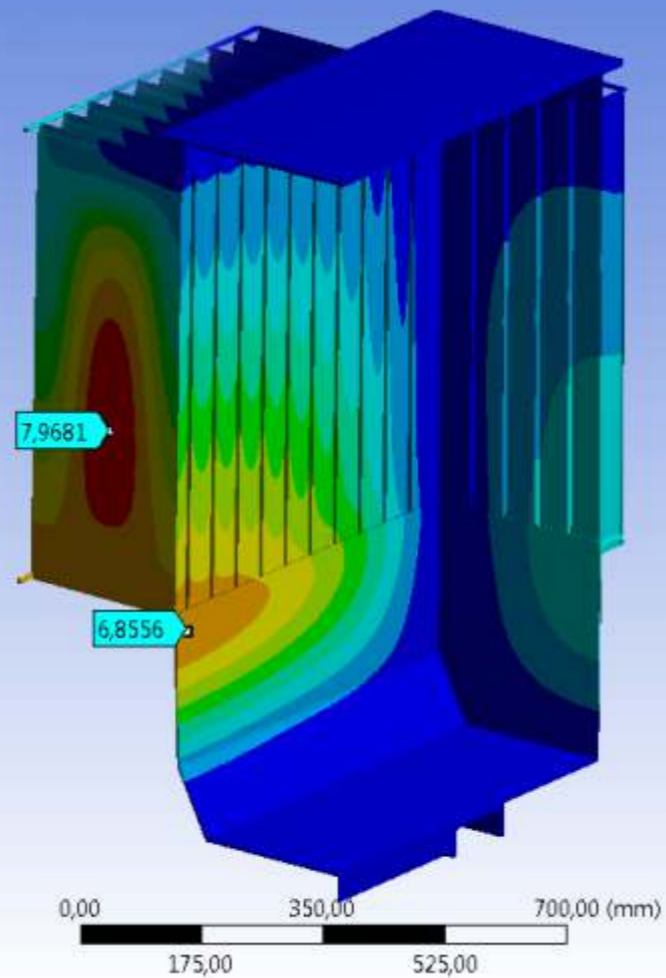
Benefits of engineering tools, we use:

- Reliable design
- Electrical stresses within safe limits
- Optimized insulation structure
- Low risk of failure
- Long lifetime
- Optimized tank design
- Lower tank weight
- Lower noise
- Increased reliability



Special Software in House are:

- The calculation of two-dimensional plane or axis symmetric electrostatic field.
- The calculation of impulse stresses on main and longitudinal insulations of Transformers. It is intended for definition of impulse voltages between any points of windings.
- The calculation of transformer tanks, yoke beams and pressing rings for mechanical strength at short circuit, pressing, lifting, vacuuming and transportation modes.
- The calculation of electrodynamic stability of transformer windings at short circuit.



3-D CAD Package

It is used for design mechanical form of transformer tank, coolers and active part. It reduces lead time and increases accuracy.

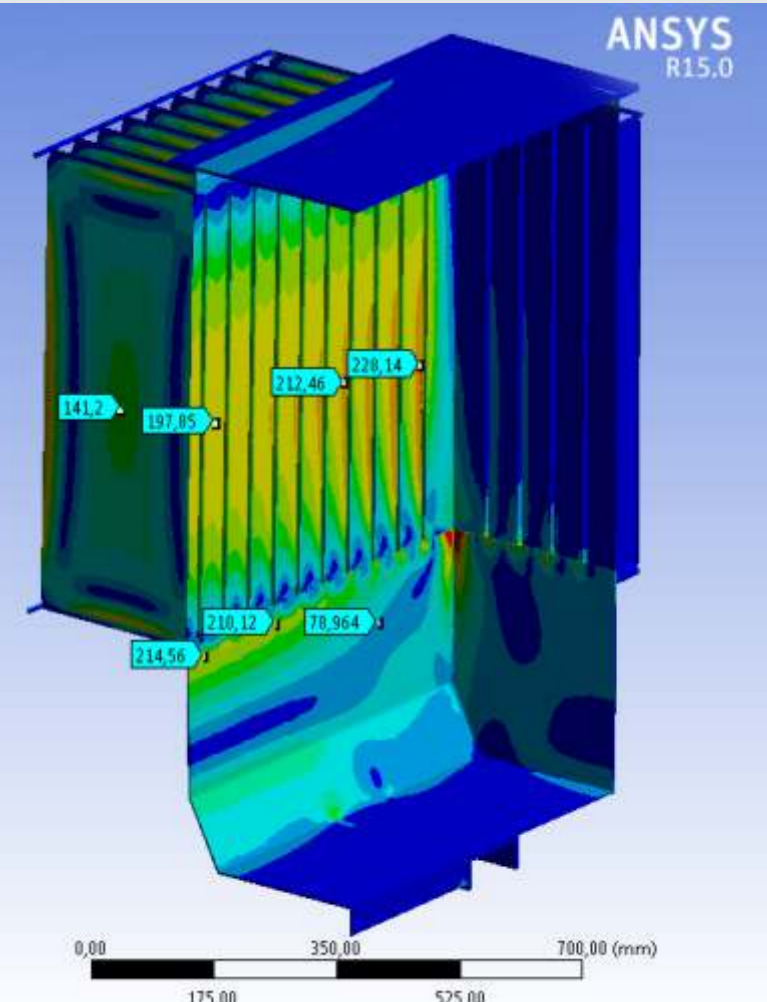
Simulation (by Ansys Fea)

It is used for mechanical analysis. The vibration levels on the end panel of a transformer tank are calculated and compared with the measured values.

In order to meet the demand of energy sector, The ELTAS A.Ş. R&D activities plays important role to ensure reliability of product and to improve techniques:

- Design optimization (considering of design relation to labor and material costs)
- loss evaluation and noise level
- distribution of voltage stresses under impulse lightning and switching surge conditions,
- behavior during short circuit conditions, both transient electrostatics and continuous thermal withstand analysis of those areas where high electrical stresses can occur,
- optimization of the insulation structure design,
- calculation of stray losses and thermal effects.

Some studies are made with international working groups such as TUBITAK , CIGRE, IEEE and transformers are tested at international laboratories when needed.



Transport & After Sales Service



One of ELTAŞ A.Ş.'s principles is to provide customers with transformers a long service life. Preventive measures for transformer's durability are carried out on-site under appropriate conditions.

Transformers are dispatched with complete or partial assembly according to their dimensions and transportation conditions.

On-site services that we provide during maintenance are as follows;

- Assembly, vacuum oil fill & testing
- Bushing & cooler changeouts
- Relocation
- Regasketing, leak repair
- Oil filtration & refurbishment
- Load tap changer maintenance
- Condition assessment
- Monitoring systems
- Spare parts management

Our transformer repair services are as follows;

- Coil replacement
- Core replacement
- Repair or replacement of mechanical accessories
- Conservator replacement
- Drying in kerosene vapor spraying vacuum furnaces
- Isolation renewal

On-site services that we provide for newly installed transformers are as follows;

- Assembly and commissioning
- Insulation resistance test (Megger)
- Turn ratio test
- Winding resistance test
- Insulation power factor
- SFRA
- Tightness under pressure test
- Discharge and filling of transformer oil under vacuum
- Dielectric strength test of oil
- Power factor of oil
- Measurement of water in oil
- Gas analysis of oil
- Functional tests of protection elements
- General checking of transformers
- Elimination of oil leaks and provision of permanent solutions
- Maintenance of low voltage and high voltage insulators, improvement of connections and replacement of insulators when necessary
- Functional tests of protection elements and replacement of defective elements with modernized protection elements
- Electrical tests of transformers
- Sampling of transformer oil and oil analysis
- Discharge of transformer oil on-site with modernized systems
- Replacement of transformer oil
- Replacement of necessary seals
- Modernization or replacement of available control panel
- Replacement and capacity increase of cooling system
- Provision of automated voltage regulator panel and its adaptation to available system
- Provision of parallel operation panel and parallel operation of transformers
- Tap changer maintenance.
- Adaptation of online monitoring modules to the transformer





in more than 90 countries,
wherever energy exist, we are there

ELTAS

Transformatör Sanayi ve Ticaret A.Ş.

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