

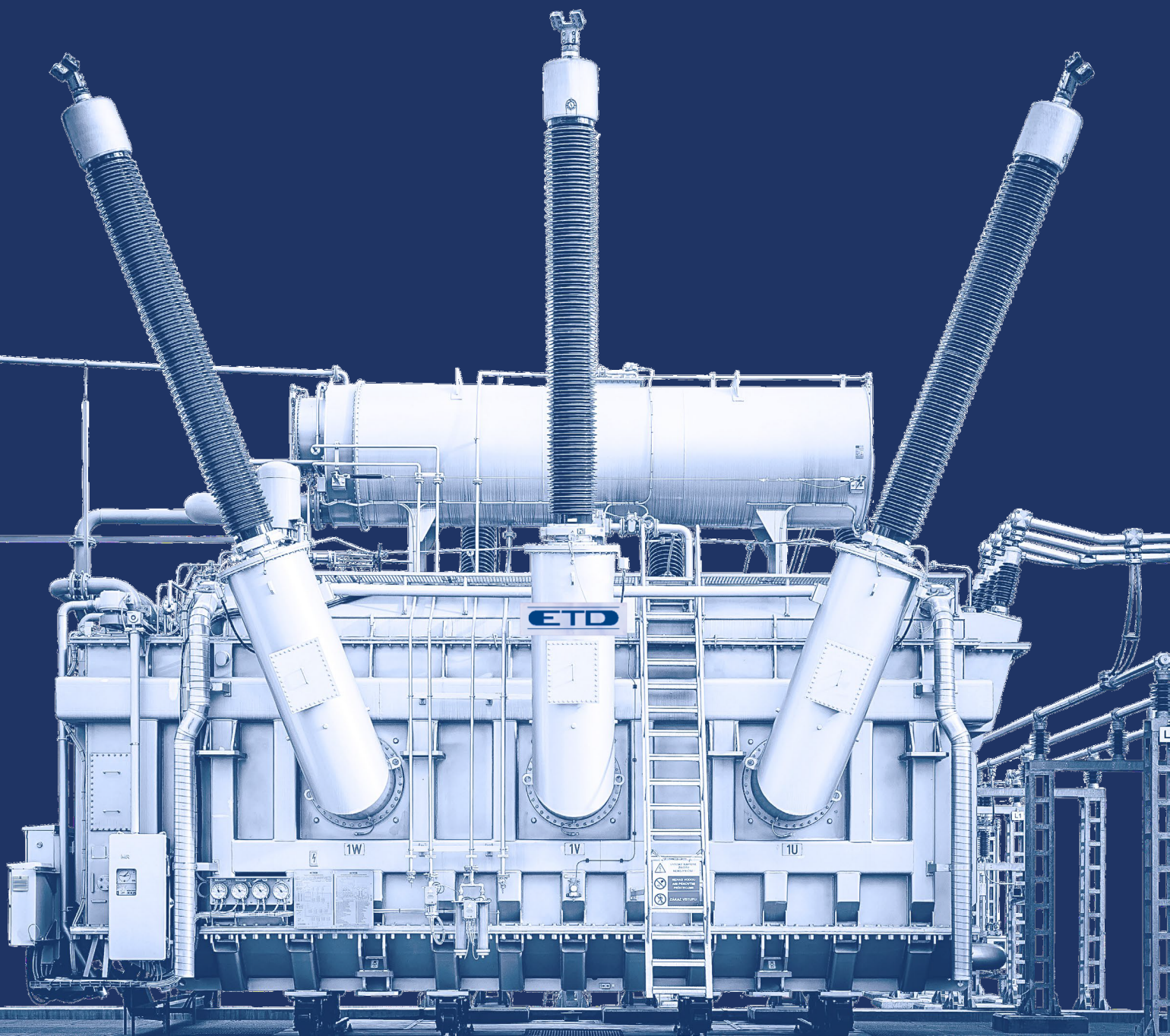
1921

ETD

2021

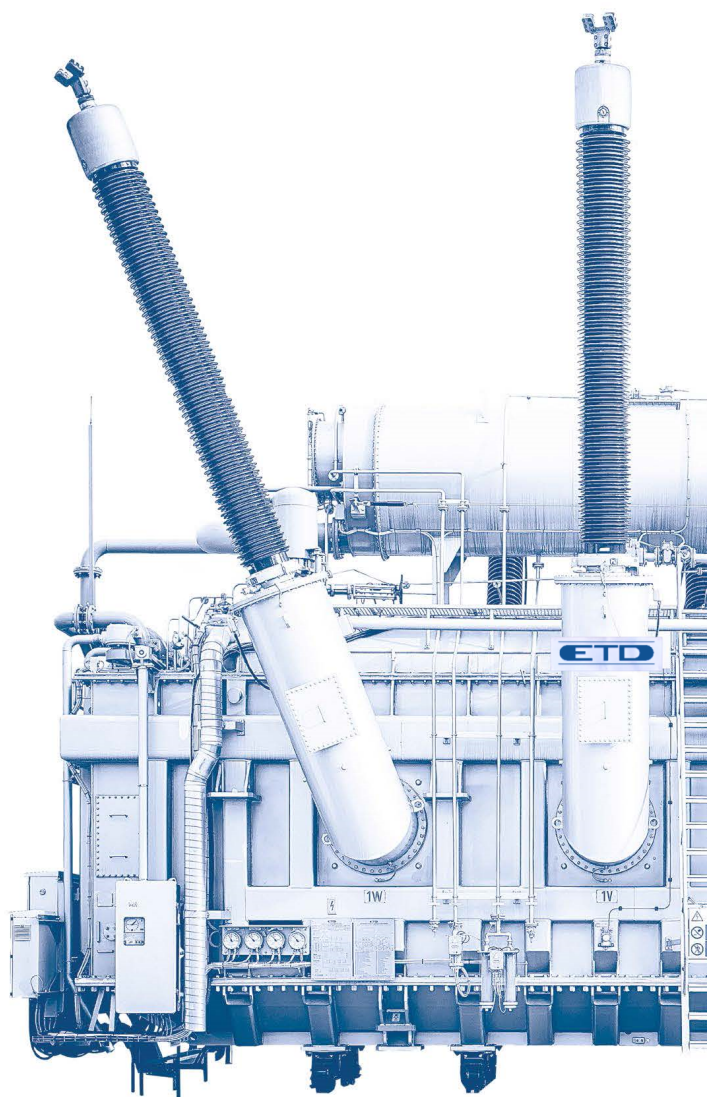
Manufacturing Trafos
in Plzeň

GENERAL INFORMATION



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IMPORTANT HISTORIC MILESTONES AT ETD TRANSFORMÁTORY A.S.

1918–20

Establishment of the Electrotechnical factory in Doudlevice (ETD) in developing Škoda Works in Plzeň.

1921

Start of production: electrotechnical assembly of engineering supplies, production of components for heavy-current electrotechnical engineering, power industry and electric traction units.

1923

Dispatch of the first power transformers of 1,150 kVA to Elektrické podniky of the city of Prague, production of rotating and non-rotating machines according to French license, electrical equipment and automation systems.

1930

Production according to own design engineer know-how under the direction of Prof. Sumec and Dr. Ing. Lammeraner.

1965

Start of traction transformer production.

1979

Manufacture of the first 570 MVA transformer with single-phase groups, manufactured for the Mělník III Power Station.

1980–90

Development of electrotechnical production under the ŠKODA brand and marketing within new global markets (application of products – thermal, hydro, nuclear power stations, substations of transmission and distribution systems, substations and special sources in industry, transportation and others).

1992

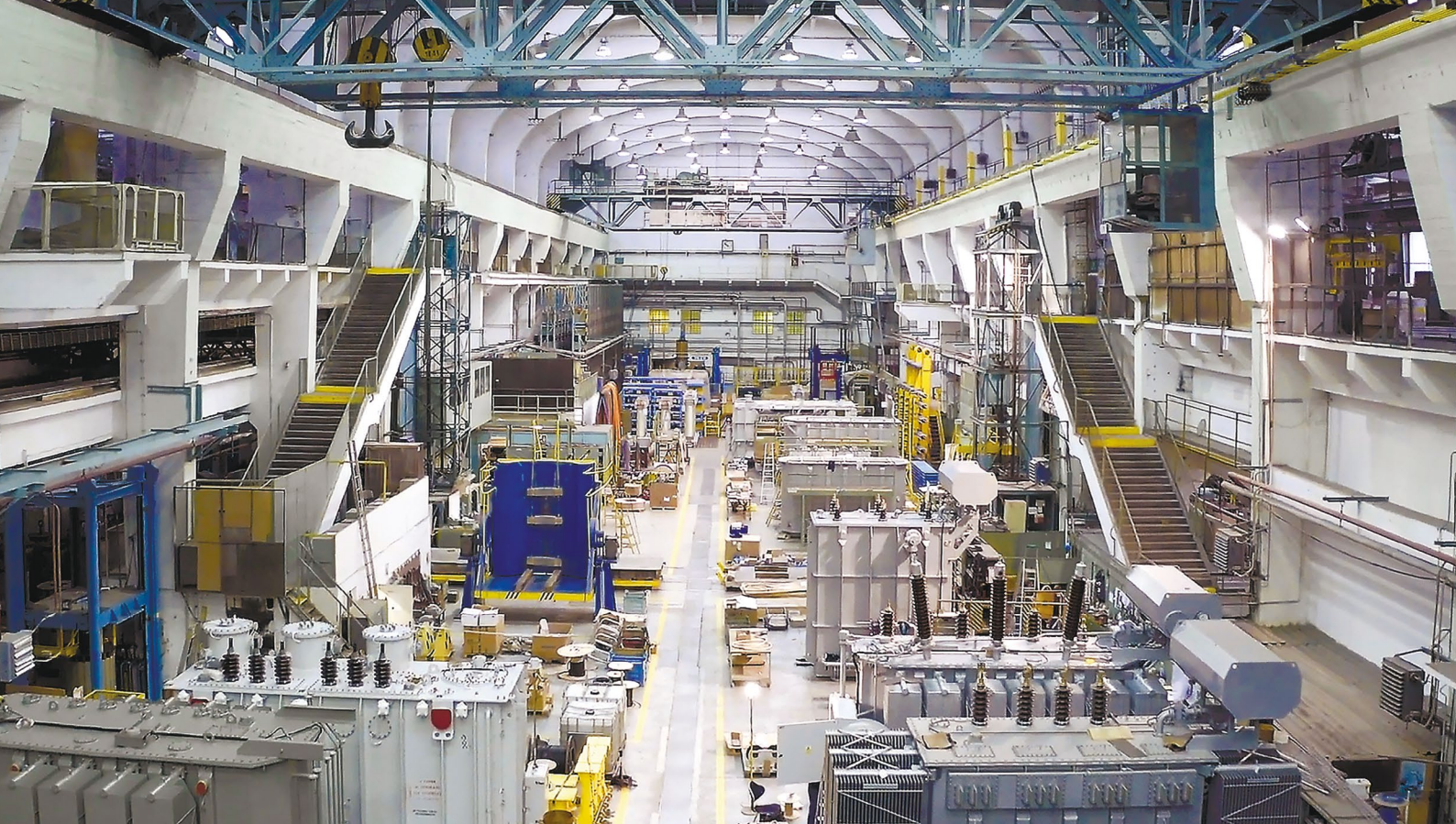
Start of specialization in the production of transformers and electrical equipment and additional production of welded and pressed pieces.

1999

Transformation of ETD into a single-field factory oriented to the production of transformers, choke coils, reactors and equipment.

2003

Certification of established quality management system under ISO 9001.

**2004**

Purchase of ETD by Slovak company BEZ TRANSFORMÁTORÝ a.s., a member of IBG Group, foundation of the company ETD TRANSFORMÁTORÝ s.r.o., and subsequent change of legal form into a joint-stock company.

2008

Purchase of Electrical Testing Laboratory, expansion of the scope of activities in the testing and measuring of electrical engineering materials and electrical equipment according to ČSN EN ISO/IEC 17025:2005.

2011

Production of a series of large 250 to 300 MVA power transformers, start of the manufacture of new special transformers for the connection of semiconductor transducers.

Production of a new electronically controlled compensation reactor.

2012

Certification of established environmental management system under ISO 14001.

2013–14

Development, production and dispatch of autotransformers with 350 MVA output power.

2014

Certification management system for health and safety at work according to BS OHSAS 18001.

2015

Development and manufacturing transformers with the 128 MVA output for seismically active regions in Chile.

2016–17

Successful supply of 350 MVA transformers for ČEPS, a.s..

Realization of a pilot project in the field of transformer replacement together with reconstruction of a 110/22 kV substation .

2019

Delivery of 250 MVA autotransformer for Slovak TSO.

2020

We become a supplier for Nuclear Power Plants: 2x 300 MVA transformers.

First delivery to Israel market.

First online FAT and online SAT tests are also performed.

PRODUCTION PROGRAM OF ETD TRANSFORMÁTORY A.S.

PRODUCTS AND SERVICES

Power transformers

- Three-phase regulating oil transformers with a power range of 10 to 320 MVA and nominal voltage up to 420 kV
- Three-phase non-regulating oil transformers with an output up to 410 MVA and voltage up to 420 kV
- Single-phase non-regulating oil transformers with a total three-phase output up to 1,200 MVA and voltage up to 420 kV
- Special regulating and non-regulating transformers according to customer requirements (e.g. voltage ratio, nominal impedance voltage, outlet configuration, cooling, etc.)

Autotransformers

- Three-phase oil transformers with an output up to 400 MVA and voltage up to 420 kV

Locomotive transformers

Furnace transformers

Traction chokes for rail vehicle loads

- Railway, underground or tram cars, trolley-buses and other special use inductors

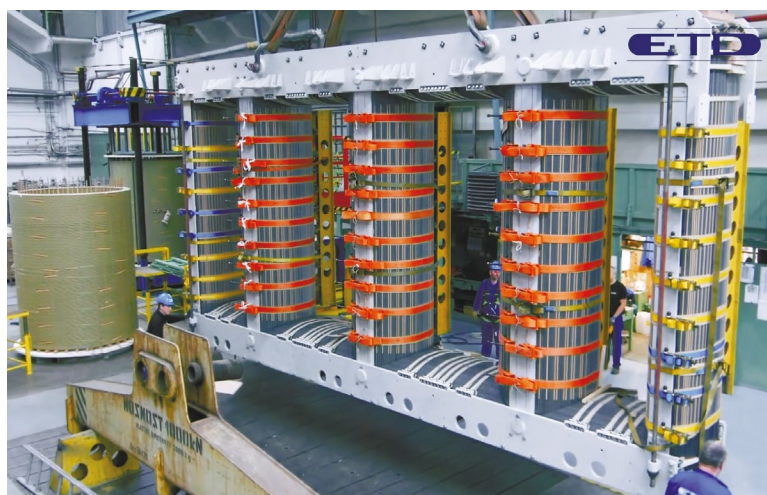
Start-up and special reactors

- Thyristor regulated (step-less)
- Voltage regulated (step-regulation)
- Non-regulated Shunt reactors

**Assembly, maintenance and 24-hour service,
provide by our highly skilled experts**

Reconstruction and repairs

- Own produced transformers
- Other producer transformers



Electrical Testing Laboratory is certified in compliance with the ČSN EN ISO/IEC 17025:2018 quality system standard by the Czech Accreditation Institute for selected types of tests specified in the Appendix of Certificate of Accreditation.

Fundamental activities are tests and measurements on all kinds of industrial devices for Czech, as well as foreign customers; particularly:

- developmental and type tests of traction accessories for DC and AC (50 Hz as well as 16.7 Hz) systems,
- type and routine tests of transformers, choking coils, compressors, resistor boxes, etc.
- developmental and type tests of LV and HV switching devices, switchgears and converters, particularly:
 - temperature rise tests,
 - tests of making and breaking capacity,
 - tests of short-circuit resistance,
 - dielectric tests,
 - measurement of ventilation and hydraulic quantities (HVAC), and all their possible combinations.

MAIN BUSINESS ACTIVITY

Development, production and supply of power transformers, induction coils, reactors and other electrical equipment including tests, installation and service.

Reconstruction and modernization of 400, 110, 22 kV substations

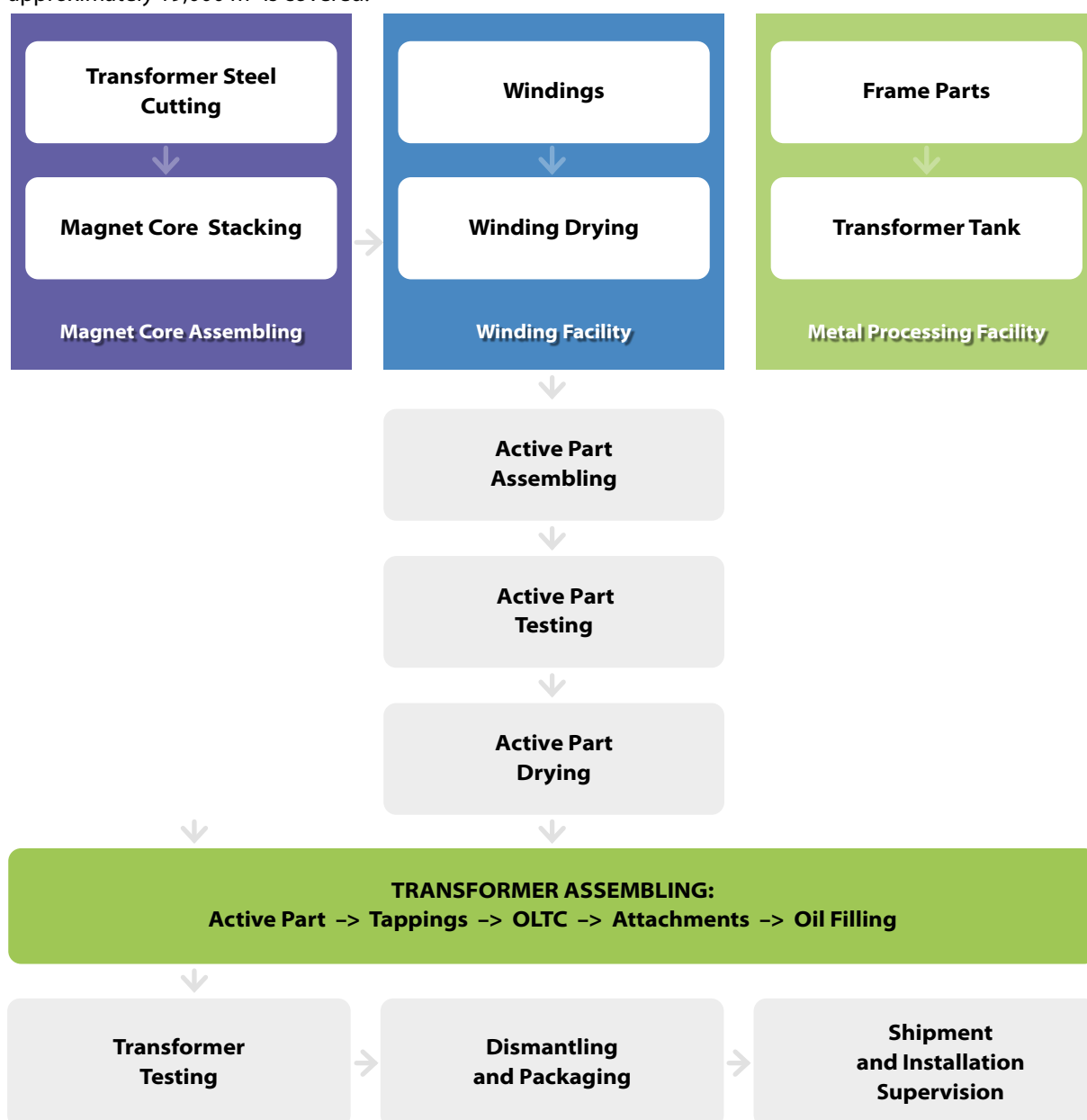
- Encapsulated technologies 110 and 22 kV (GIS)
- Control systems and protections
- Overhead and substation cable lines
- Design of power equipment
- Engineering activities in construction
- Realization of buildings
- Supply of equipment and materials
- Protection setting, testing, inspection
- Maintenance and service



POWER TRANSFORMER PRODUCTION FLOW CHART

Modern and sophisticated transformer industry machines, delivered by the leading machine producers in Europe, can be found within the production halls of ETD TRANSFORMÁTORY.

We have a total production area of 20,800 m² of which approximately 19,000 m² is covered.



OUR PERFORMANCE

Design of our transformers

All our products are the result of our own design, intertwined with 100 years of experience!

In our database we have numerous different designs. Combining our long tradition and experience with modern and approved computer software, we are able to implement new materials and technological processes.

This gives us the opportunity to find solution for every specific requirement, never mind how tough it might be!

Our transformers meet all new standards and regulations including ECO Design norms, which helps to reduce our Carbon Footprint globally!

Core assembly

For magnetic cores ETD use steel sheets of high-grade magnetic orientation HI-B and laser treated magnetic steel. Magnetic core is stacked by overlapping of individual steel sheets according to the step-lap system. With accurate cutting and careful magnetic steel stacking, low no-load loss, low no-load current, low amplitudes of the in-rush current and low noise level is obtained. Automated magnetic core bandaging machines ensure extra strength on core limbs for further noise reduction.

Windings production

The windings are made from electrolytic copper of high purity or electrotechnical aluminum upon client request. They are manufactured in different variants, depending on transformer type, power, voltage.



Some used winding types include: single-layer or multilayer windings; interleaved windings; helical windings; continuous disc windings.

During the drying process, the windings are continually pressed with a force higher than that encountered during transformer operation, which ensures that the windings are dynamically stable and that there is no operational shrinkage of the insulation. This eliminates the need to press the windings and ensures reliable operation of the transformer over its entire service life.

Active part assembly

Before assembly all windings are pre-dried and physically inspected to ensure they match the requested dimensions. A special clamp design and insulation system ensure that in case of network short-circuit, the transformer will withstand it without any consequences for its stable and continues work. The implemented Active Part assembly technology

is proven by our 100 years of production and operation of our transformers under all working conditions.

Tank

Tanks are designed with reinforced plane walls to withstand full vacuum and 70 kPa overpressure. We can manufacture two types of tanks: the classic tank and bell-shaped tank.

Corrosion protection of the tank and equipment is standardized and is defined in dependence on climatic conditions in which the transformer will operate or according to customer requirements.

Testing Laboratory and quality assurance

All transformers produced by ETD TRANSFORMÁTORY pass 100% control within quality control testing labs. Together with this and our intermediate control points during the production process, we ensure the high quality and reliability of our products.

ECO-DESIGN REGULATION AND ITS IMPACT ON ETD TRANSFORMÁTORŮ A.S.

Legislation and implementation objectives

On June 11, 2014, EU Commission Regulation No. 548/2014 on implementing Directive 2009/125/EC concerning Ecodesign with regard to small, medium and large power transformers, entered into force in all 28 countries of the European Union.

This new legislation regulates the maximum level of loss (or minimum efficiency) for transformers placed on the market or put into service from July 1, 2015, and purchased after June 11, 2014, within the EU.

After June 11, 2014, manufacturers and customers should not engage in new framework contracts for transformers that do not meet the minimum requirements outlined in the Regulation.

Framework contracts signed before June 11, 2014, can run till the end date, even with deliveries after July 1, 2015. Ecodesign objectives include improved energy efficiency and general environmental

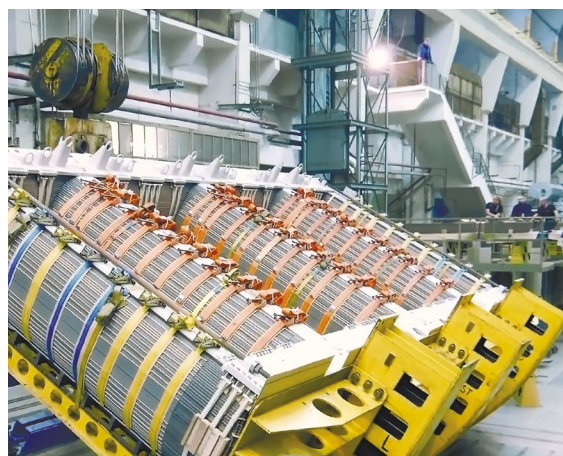
compatibility, thus reducing CO₂ emissions. The Ecodesign Regulation is focused on reducing transformers' electrical losses (1st step in 2015 / 2nd step in 2021), and to clarify and make the indication of performance more visible.

Impact on transformer design

With the new Regulation, the maximum level of loss for distribution transformers is set throughout the EU, and for the first time a minimum efficiency requirement is given for power transformers over 3.15 MVA.

Tolerances on guaranteed losses, as prescribed in IEC 60076-1, are no longer considered.

The Regulation establishes Ecodesign requirements for power transformers with a minimum power rating of 1 kVA used in 50 Hz electricity transmission and distribution networks or for industrial applications. Some new definitions are introduced for the purpose of the Regulation below.



Transformer de initiation in the Regulation	Highest voltage for equipment (Um)	Rated power (Sr)
Small power transformer	$U_m \leq 1.1 \text{ kV}$	Any
Medium power transformer	$1.1 \text{ kV} < U_m \leq 36 \text{ kV}$	$5 \text{ kVA} \leq U_m \leq 40 \text{ MVA}$
Large power transformer	$U_m \leq 36 \text{ kV}$ Any	$S_r \geq 5 \text{ kVA}$ $S_r \geq 40 \text{ MVA}$



Power transformers (medium power transformers > 3150 kVA and large power transformers)

For medium power transformers with rated power > 3150 kVA and ≤ 40 MVA, as well as large power transformers, the Regulation does not directly define the maximum no-load and load losses. It defines minimum Peak Efficiency Index (PEI), in (%):

$$PEI = 1 - \frac{2(P_o + P_{co})}{sr \sqrt{\frac{P_o + P_{co}}{P_k}}}$$

where:

P_o – the no-load losses measured at rated voltage and rated frequency, on the rated tap;

P_{co} – the electrical power of the cooling system for no-load operation;

P_k – the measured load losses at rated current and rated frequency on the rated tap corrected to the reference temperature acc. EN 60076-1;

sr – the rated power of the transformer on which P_k is based.

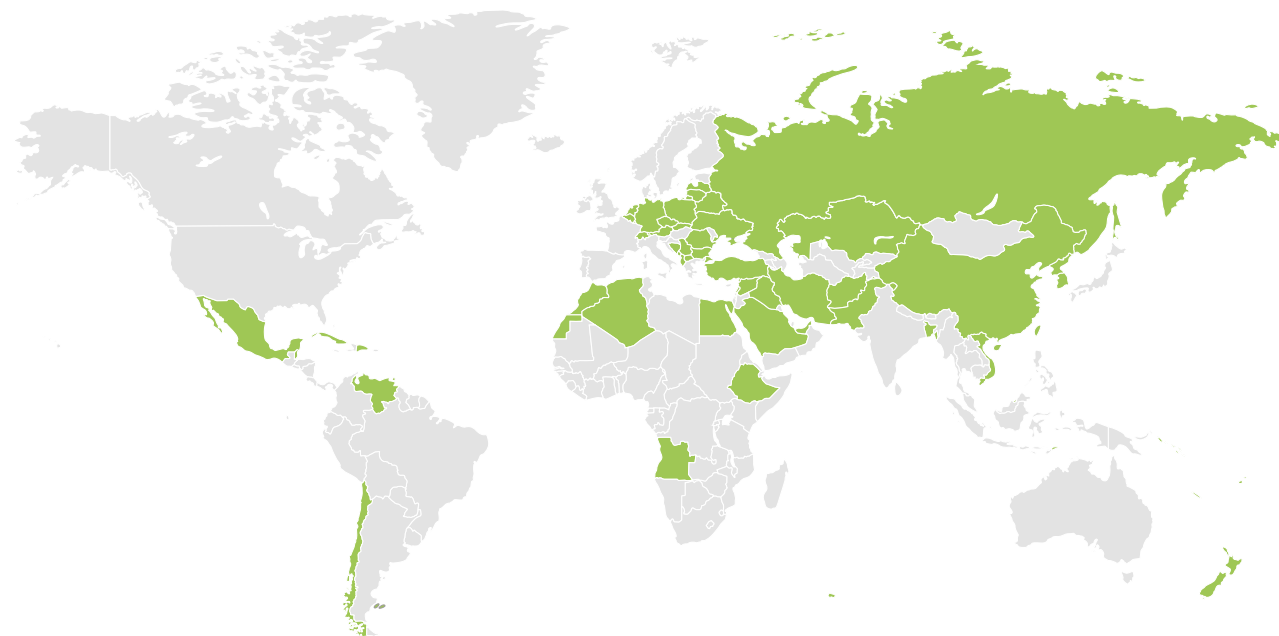
Following market trends and customer requirements in previous years, ETD TRANSFORMÁTORÝ a.s. has placed significant effort into the design of transformers with increased efficiency. We are already producing and delivering transformers according to the first and second stage of the EcoDesign regulations.

Also, in the past years we have supplied transformers for various EU customers with the same or lower losses

than those required by the EcoDesign directive. At the moment we are able to design and deliver transformers according to Tier 2, even also with better PEI upon customer request.

Rated power (MVA)	Tier 1 (1.7.2015)	Tier 2 (1.7.2021)
≤ 4	99.465	99.532
5	99.483	99.548
6.3	99.510	99.571
8	99.535	99.593
10	99.560	99.615
12.5	99.588	99.640
16	99.615	99.663
20	99.639	99.684
25	99.657	99.700
31.5	99.671	99.712
40	99.684	99.724
50	99.696	99.734
63	99.709	99.745
80	99.723	99.758
≥ 100	99.737	99.770

GEOGRAPHY OF DELIVERIES



Czech Republic	Lithuania	Egypt	Dominican Republic	Bangladesh
Slovak Republic	Macedonia	United Arab Emirates	Denmark	Morocco
Poland	Bulgaria	Bahrain	Countries of former	Ethiopia
Germany	Romania	Angola	Yugoslavia	Lebanon
Austria	Ukraine	Venezuela	Afghanistan	China
Switzerland	Belarus	Mexico	Iraq	Korea
Holland	Russia	Chile	Iran	Vietnam
Latvia	Kazakhstan	Cuba	Pakistan	Algeria

PRODUCT RANGE

Three-phase transformers	6.3 – 450 MVA, up to 420 kV
Autotransformers	up to 450 MVA, up to 420 kV
Single-phase transformers	up to 1,200 MVA, up to 420 kV
Shunt reactors	up to 200 MVA _r , up to 500 kV
Other products	Start-up reactors Saturation reactors Special reactors Traction transformers Chokes Furnace transformers

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General contacts

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This catalog is subject to further changes in terms of technical details due to our continuous improvement, without prior notification. Therefore, please refer to our specialists to obtain the latest information.