

BEZ TRANSFORMÁTORY

MANUFACTURING TRANSFORMERS SINCE 1902



DISTRIBUTION TRANSFORMERS TECHNICAL CATALOGUE

CAST RESIN DRY-TYPE TRANSFORMERS

ecoTEC²

MANUFACTURING TRANSFORMERS SINCE 1902

MORE THAN 250 000 PRODUCTS OVER THE LAST 50 YEARS

BEZ production site located in Bratislava, the Slovak Republic, enjoys over than 100 years of world-wide experience and more than 250 000 products over the last 50 years. BEZ ambitiously works to design and manufacture products with the highest quality and flawless functionality.

BEZ products are widely represented in the world electrical equipment market. The advanced expertise ensures products reliability at a wide range of applications and environmental conditions. Our transformers are custom designed to meet their specific requirements such as stringent conditions of nuclear power plants, specifics of hydropower plants, infrastructure projects, Oil&Gas sites, as well as solar and wind farms.



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WE ARE INTRODUCING NEW PRODUCT LINE

ecoTEC²

Number 2 stands for Ecodesign 2 directive

ECO represents conformity to Ecodesign standard, same as our Company ecological vision to reduce carbon footprint

TEC is a shortcut for our transformer technology "transformers epoxy casted". Where HV winding or both HV and LV windings are fully cast in epoxy resin.

TEC is also a derivative of the word Technology, which represents our 120 years-lasting passion to produce transformers with the highest technological standard

ADVANCED EPOXY CASTED ECOLOGICAL TRANSFORMER

The transformers fulfill all requirements of application from the heavy industry up to renewables:

- Resistance to significant load changes
- Ecodesign 2
- High temperature endurance
- Possibility of higher harmonic loading (THD – total harmonic distortion)
- Ambient temperature from -50 °C to +50 °C (deserts or arctics)
- Up to 8 secondary terminals
- Transformer protecting enclosure with optional IP coverage
- Pole mounted variants for protected natural areas

- Monitoring functions
- Seismic and vibration endurance
- Corrosive protection C5M available
- ANAF cooling ready
- Compact dimensions while keeping losses to a minimum.

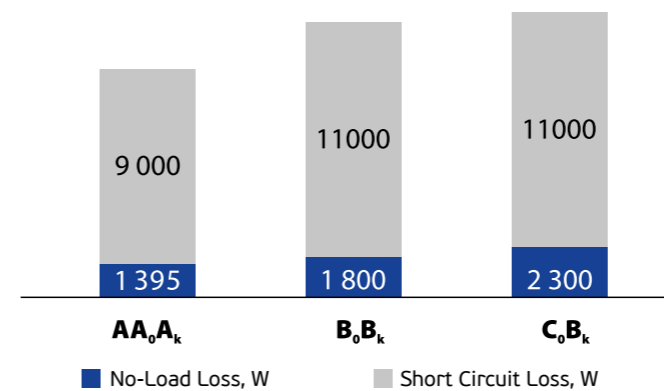
ecoTEC² is suitable for following applications photovoltaic, light and heavy industry, commercials and residential buildings, distribution systems, wind turbines, power grids, gas and oil, e-mobility, smart grids.

ecoTEC² product line contain following reference types: TSE, aTSE, TUSE, aTUSE

ECODESIGN TRANSFORMER

BEZ offers Ecodesign Cast Resin Dry-Type Transformers and Oil-Filled Transformers that meet the requirements of No-Load and Short Circuit Loss imposed by the new Regulation.

In accordance with 2019/1783 and 548/2014 EU Regulation maximum No-Load and Short Circuit Loss applies to transformers in the market or commissioned in EU after publishing the Regulation, of which Tier 1 begins on 1 July 2015, and Tier 2 has been released on 1 July 2021.



Note: Total Loss for BEZ Cast Resin Dry-Type Transformers, Rated Power 1000 kVA

Compared to standard transformers, Ecodesign transformers have lower total loss. This means that they have lower operating costs, which converts into significant cost savings throughout equipment service life. Low total loss also result in reducing CO₂ emissions. On the other hand, standard transformers require less space and have lower weight.

AA₀A_k (Ecodesign Tier 2 - 2021)
Energy Efficient (average total loss 20% less than C₀B_k)
Low Operating Costs Eco-friendly

C₀B_k
Weights less (average weight 10% less than A₀A_k)
Requires less space (average overall size 5% less than A₀A_k)

	AA ₀ A _k (Ecodesign 2)	C ₀ B _k
Rated Power, kVA	1000	1000
No-Load Loss, W	1395	2300
Short Circuit Loss, W	9000	11000
Loss Cost, € per year	8136	10778

Note: operating costs for BEZ Cast Resin Dry-Type Transformers for 30 years subject to electricity cost 0.16 Euro per 1 kWh, and transformer load factor of 0,7; 1 kWh equals to 0,513 kg of CO₂



Total Savings €79 260
= 4 x Price



Saving on CO₂ emissions
230 Ton (450 MWh)



Payback term in favor of more energy-efficient transformer, due to price difference: 2 years



QUALITY MANAGEMENT

BEZ is driven by the fundamentals of Quality Management System. It is evidenced by the corresponding ISO 9001:2016 and ISO 45001:2019 Certificates.

In addition to that, BEZ established the integrated management system including ISO 14001:2016 to ensure the environment requirements for all manufactured products. At the same time, we always try

to go beyond these standards and continuously improve our processes and methods.

Careful use of all resources being environmentally friendly within the production workflow is the principal task of every employee.

BEZ guarantees that our products are safe at each stage of their life cycle.



ISO 9001 Quality Management System



ISO 14001 Environmental Management System



ISO 45001 Occupational Health and Safety Management System

DESIGN FEATURES

Magnetic Core

Steel cutting and step-lap stacking ensure low loss. Increased section area ensures stable operation in case of overloads. Quality of material, cutting and assembling technique allow reducing noise

Temperature sensors in LV windings

2 PTC thermistors or PT 100/phase

Tie Rods

Reinforced base frame made of thick sheet steel. Hot-dip galvanized metal parts ensure corrosion protection

No Load Tap Changer

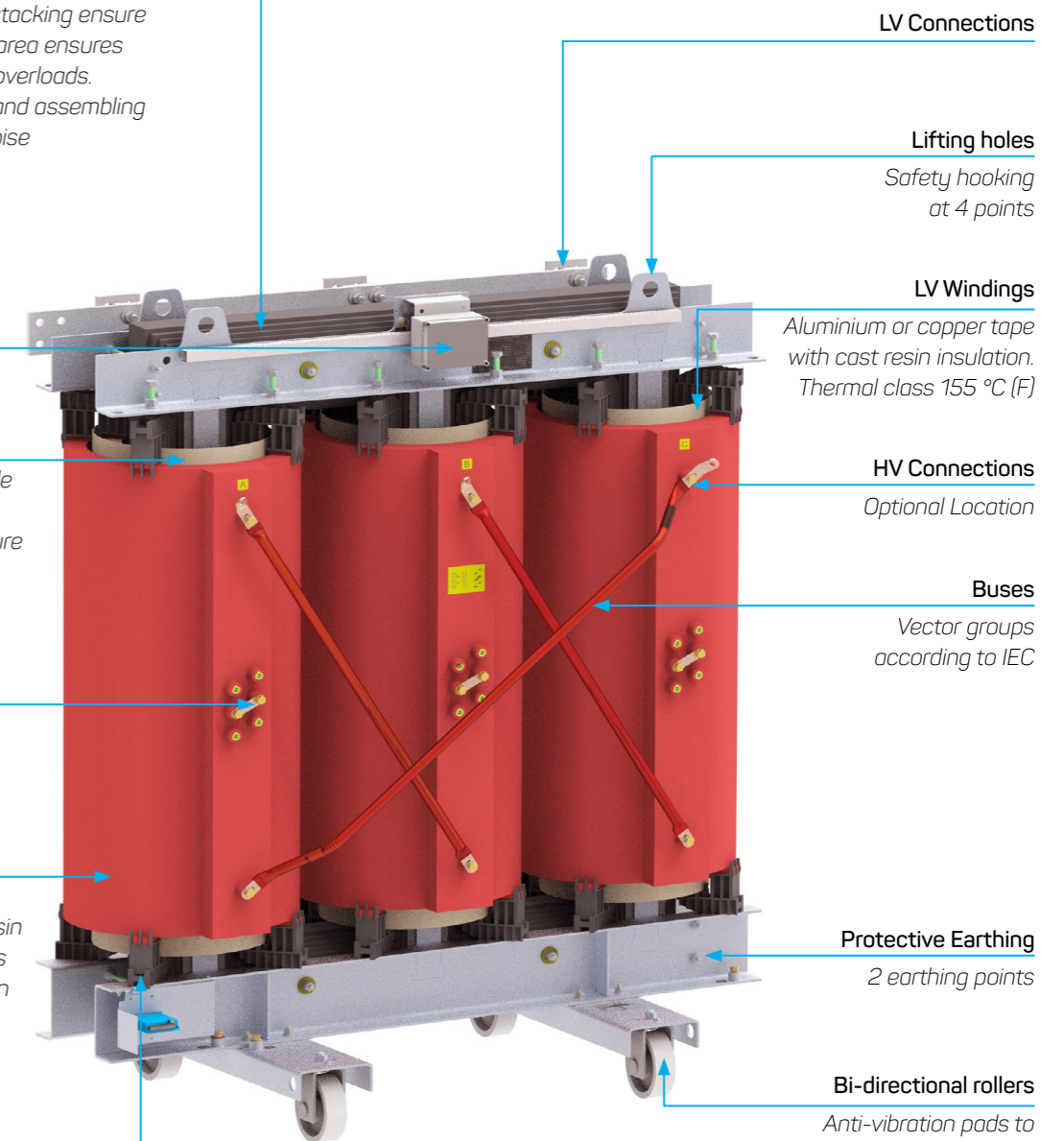
Adjusts voltage $\pm 2 \times 2.5 \%$

HV Windings

Aluminium or copper strip, cast in resin. Due to cast resin insulation, the transformer is maintenance-free. Insulation of thermal class 155 °C (F) withstands winding temperature rise of 100 K

Fastening Inserts

Fix Windings and reduce vibration impact and thermal expansion



LV Connections

Lifting holes
Safety hooking at 4 points

LV Windings
Aluminium or copper tape with cast resin insulation. Thermal class 155 °C (F)

HV Connections
Optional Location

Buses
Vector groups according to IEC

Protective Earthing
2 earthing points

Bi-directional rollers
Anti-vibration pads to provide higher level of vibration damping, optional

CAST RESIN DRY-TYPE TRANSFORMERS

WIDE RANGE OF APPLICATION

BEZ transformers are designed to operate in harsh environment. Protective Enclosure (up to IP54) allows installing transformers in area with a lot of dust, and protecting from moisture.

BEZ Transformers also comply with Climatic Class C2, Environmental Class E2, and Fire Category F1 and withstand thermal shock of -45 °C.

BEZ manufactures various types of Cast Resin Transformers: Single-phase Transformers, Rectifier Transformers, Excitation Transformers, Amorphous Transformers.

RELIABILITY

Transformers are manufactured according to STN EN IEC 60076-11 and STN EN 50588-1, which guarantees excellent product quality. Highly professional production standards are supported by ISO 9001, ISO 14001 and ISO 45001 certificates.

The company works only with trusted suppliers and uses high quality materials. The transformers with thermal class 155 °C (F) means that their insulation can withstand the temperature rise of 100 K.

PRODUCT COMPARISONS

Characteristics	Cast resin (Epoxy)	Oil immersed	Dry types
Self extinguishing in case of fire	YES	NO	NO
Inflammability	NO	YES	YES
Need for anti fire structures (oil collection pit, anti-flame walls)	NO	YES	YES
Hygroscopicity of the insulation material	NO	YES	YES
Risk of environmental pollution	NO	YES	YES
Great resistance to withstand short-circuit currents	YES	NO	NO
Special commissioning procedures	NO	NO	YES
Regular maintenance	NO	YES	YES
Environmental pollution risk due to leak of liquid	NO	YES	NO
Withstanding humid, tropical and saline environments	YES	YES	NO
Ability to withstand different variations of overloads	YES	NO	NO
Reliability with minimal requirement for specialized labour for installation	YES	NO	NO
Installation close to the load centre and reduction of the system and management costs	YES	NO	NO

ECO-FRIENDLY

Epoxy resin is used as insulation in all BEZ Cast Resin transformers. This material is safer than transformer oil, in terms of fire hazard, as well as opportunities for disposal.

In addition, the transformers are designed in accordance with 2019/1783 and 548/2014 EU Regulation, therefore they have reduced loss, which leads to a reduction in CO₂ emissions.



GENERAL CHARACTERISTICS

Standard	EN IEC 60076-11, EN 50588-1		
Power, kVA	up to 22kV: 25 – 6300* up to 35kV: 100 – 4000*		
High Voltage, kV	6 - 35*		
Tapping HV	± 2 x 2,5 % off-load		
Low Voltage, V	400/231; 420/242		
Frequency, Hz	50; 60		
Insulation levels	up to 12 kV: Um 12 kV LI/AC 75/28 Um 7,2 kV LI/AC 60/20 Um 1,1 kV LI/AC - /3	up to 24 kV: Um 24 kV LI/AC 125/50 Um 17,5 kV LI/AC 95/38 Um 1,1 kV LI/AC - /3	up to 36 kV: Um 36 kV LI/AC 170/70*
Vector Group	Yyn0; Dyn1; Dyn11		
Cooling	AN; AN/AF (rated power + 40 % with fans)		
Degree of Protection	IP00; IP21; IP31; IP33		
Ambient Temperature, °C	-25...40; (-45...40; -60...40 optional)		
Altitude, m	≤ 1000		
Thermal Class	155 °C (Class F) – Temperature rise 100 K		
Fire Category	F1		
Climatic Class	C2		
Environment Class	E2		
Thermal Shock Resistance, °C	up to -45		
Partial Discharge	≤ 10 pC		
Seismic Stability, MSK-64	up to 8		

Other parameter values upon customer's request.
Please contact us to find out more details regarding specific requirements.

* - Products above 24 kV and 3150 kVA are part of the portfolio, but not listed in this catalogue. Please contact our sales representative for a specific solution.

SELECT PARAMETERS FOR YOUR ORDER

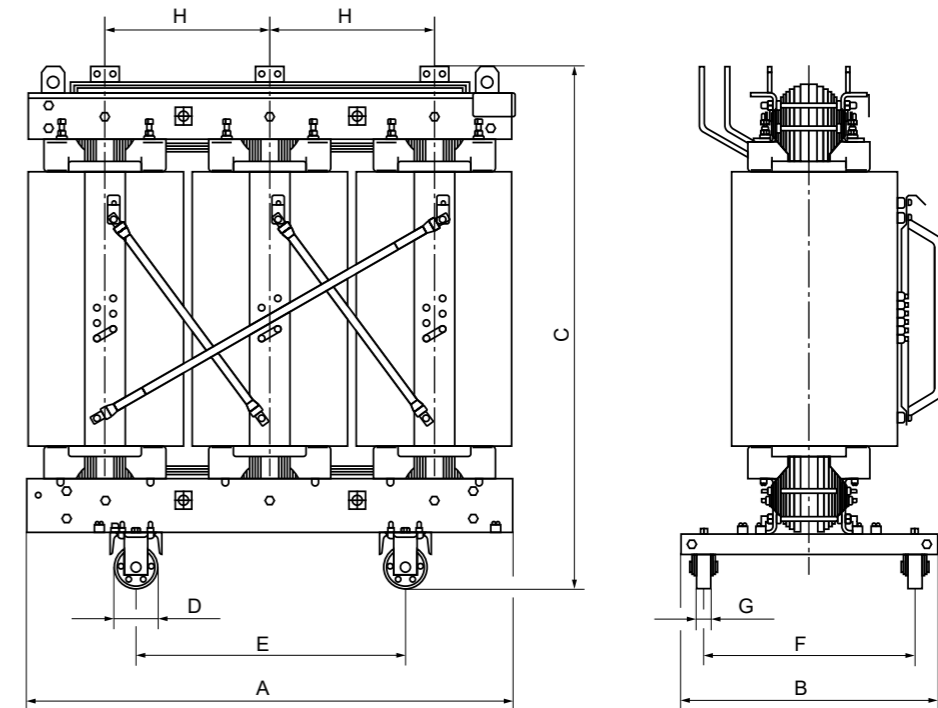
High Voltage	Power	Level of losses	Winding material	Ecodesign	Page
up to 12 kV	100-3150 kVA	loss AA ₀ A _k max	Al winding	Tier 2 - Ecodesign 2021	Page 9
up to 24 kV	100-3150 kVA	loss AA ₀ A _k max	Al winding	Tier 2 - Ecodesign 2021	Page 10
ecoTEC²					
up to 12 kV	50-630 kVA	loss A ₀ B _k max	Al winding	Tier 1 - Ecodesign 2015	Page 11
up to 12 kV	800-3150 kVA	loss A ₀ A _k max	Al winding	Tier 1 - Ecodesign 2015	Page 12
up to 24 kV	50-630 kVA	loss A ₀ B _k max	Al winding	Tier 1 - Ecodesign 2015	Page 13
up to 24 kV	800-3150 kVA	loss A ₀ A _k max	Al winding	Tier 1 - Ecodesign 2015	Page 14

Power, kVA												
50	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
AA ₀ A _k * (Tier 2 - Ecodesign 2021)												
						A ₀ A _k * (Tier 1 - Ecodesign 2015)						
A ₀ B _k * (Tier 1 - Ecodesign 2015)												

* in accordance with 2019/1783 and 548/2014 EU Regulation
Losses for ecodesign are maximum

up to 12 kV 100-3150 kVA loss AA₀A_k max Al winding Tier 2 - Ecodesign 2021 **ecoTEC²**

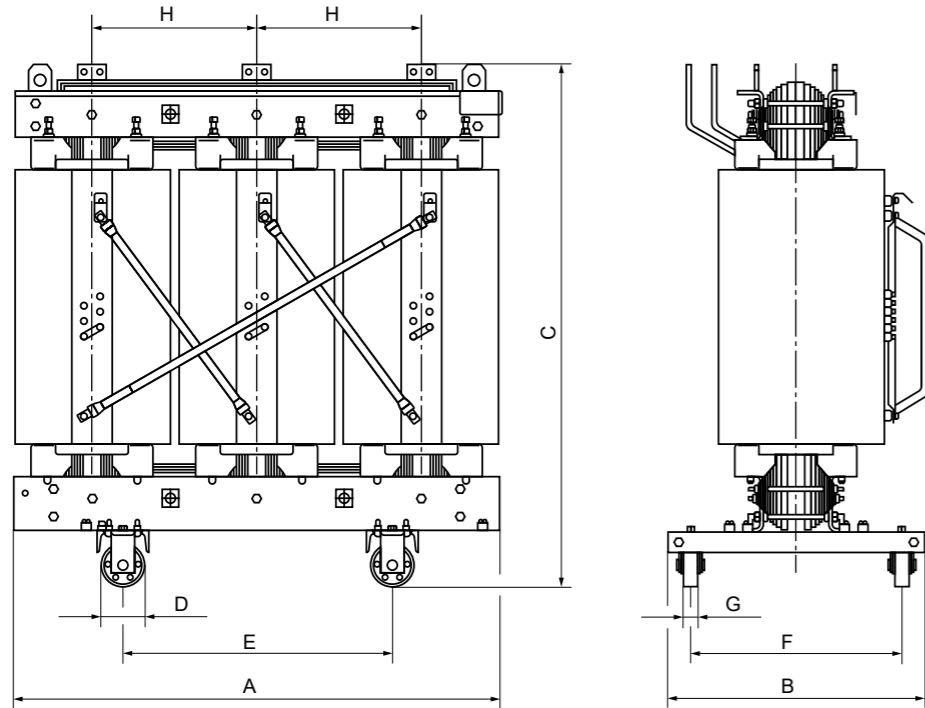
Main Electrical Characteristics													
Rated Power	kVA	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
Type	aTSE	698/10	718/10	738/10	758/10	778/10	788/10	798/10	808/10	818/10	828/10	838/10	848/10
No-Load Loss	P ₀ (W)	252	360	468	675	990	1170	1395	1620	1980	2340	2790	3420
No-Load Current	I ₀ (%)	0,6	0,5	0,4	0,3	0,25	0,23	0,2	0,19	0,18	0,15	0,1	0,1
Short Circuit Loss	P _{k75°C} (W)	1565	2260	2955	3915	6175	6955	7825	9565	11305	13915	16520	19130
	P _{k120°C} (W)	1800	2600	3400	4500	7100	8000	9000	11000	13000	16000	19000	22000
Impedance Voltage	u _{k120°C} (%)	6	6	6	6	6	6	6	6	6	6	6	6
Sound Level													
Pressure (1m)	L _{PA} dB(A)	35	38	41	44	45	46	49	51	52	54	55	58
Power	L _{WA} dB(A)	50	53	56	59	61	63	64	66	67	69	70	73
Total Weight	m (kg)	620	745	1015	1560	1755	2260	2400	3050	3640	4270	5125	7500



Dimensions (IP00)													
Rated Power	kVA	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
Type	aTSE	698/10	718/10	738/10	758/10	778/10	788/10	798/10	808/10	818/10	828/10	838/10	848/10
A (mm)		1150	1150	1240	1310	1380	1470	1470	1610	1720	1820	1900	2150
B (mm)		685	680	695	820	830	980	980	970	980	1340	1330	1400
C (mm)		1070	1195	1270	1560	1670	1775	1855	1890	2015	2290	2330	2590
D (mm)		125	125	125	125	125	160	160	160	160	200	200	200
E (mm)		520	520	520	670	670	820	820	820	820	1070	1070	1070
F (mm)		520	520	520	670	670	820	820	820	820	1070	1070	1070
G (mm)		40	40	40	40	40	50	50	50	50	70	70	70
H (mm)		340	370	405	485	465	495	495	540	575	590	640	690

up to 24 kV 100-3150 kVA loss AA₀A_k max Al winding Tier 2 - Ecodesign 2021 **ecoTEC²**

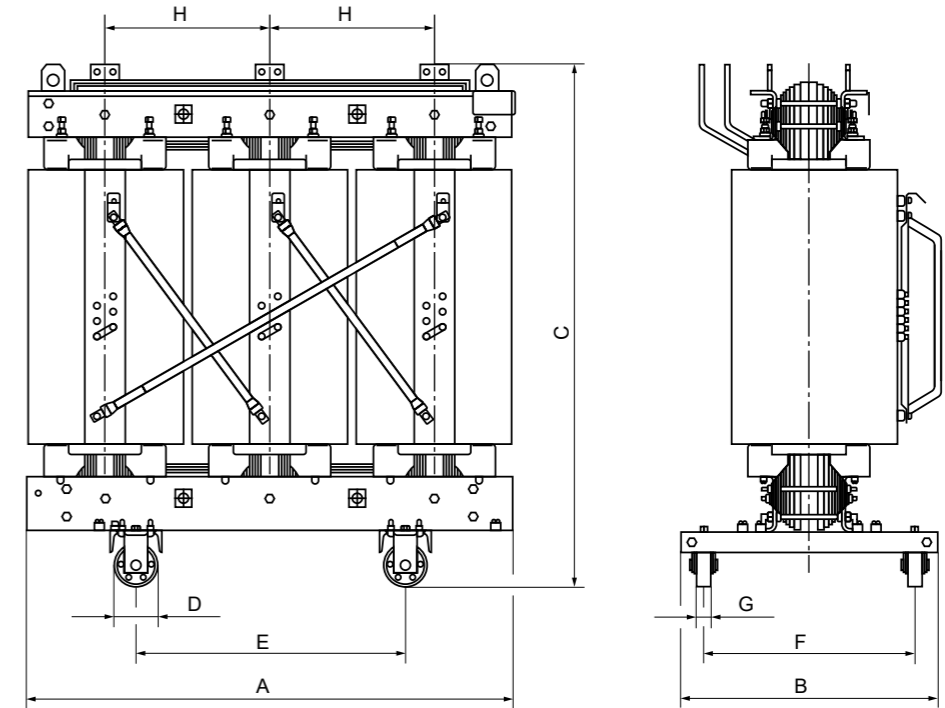
Main Electrical Characteristics													
Rated Power	kVA	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
Type	aTSE	698/22	718/22	738/22	758/22	778/22	788/22	798/22	808/22	818/22	828/22	838/22	848/22
No-Load Loss	P ₀ (W)	252	360	468	675	990	1170	1395	1620	1980	2340	2790	3420
No-Load Current	I ₀ (%)	0,6	0,5	0,4	0,3	0,25	0,23	0,2	0,19	0,18	0,15	0,1	0,1
Short Circuit Loss	P _{k 75°C} (W)	1565	2260	2955	3915	6175	6955	7825	9565	11305	13915	16520	19130
	P _{k 120°C} (W)	1800	2600	3400	4500	7100	8000	9000	11000	13000	16000	19000	22000
Impedance Voltage	u _{k 120 °C} (%)	6	6	6	6	6	6	6	6	6	6	6	6
Sound Level													
Pressure (1m)	L _{PA} dB(A)	35	38	41	44	45	46	49	51	52	54	55	58
Power	L _{WA} dB(A)	50	53	56	59	61	63	64	66	67	69	70	73
Total Weight	m (kg)	785	970	1280	1765	2130	2560	2875	3450	4200	4700	6035	6805



Dimensions (IP00)													
Rated Power	kVA	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
Type	aTSE	698/22	718/22	738/22	758/22	778/22	788/22	798/22	808/22	818/22	828/22	838/22	848/22
A (mm)		1150	1190	1300	1450	1480	1550	1610	1720	1780	1850	2000	2170
B (mm)		690	690	750	840	845	980	970	970	975	1270	1325	1400
C (mm)		1190	1325	1430	1660	1780	1890	1930	2035	2205	2360	2545	2580
D (mm)		125	125	125	125	160	160	160	160	160	200	200	200
E (mm)		520	520	520	670	670	820	820	820	820	1070	1070	1070
F (mm)		520	520	520	670	670	820	820	820	820	1070	1070	1070
G (mm)		40	40	40	40	40	50	50	50	50	70	70	70
H (mm)		390	405	440	490	500	525	545	580	605	620	680	730

up to 12 kV 50-630 kVA loss A₀B_k max Al winding Tier 1 - Ecodesign 2015

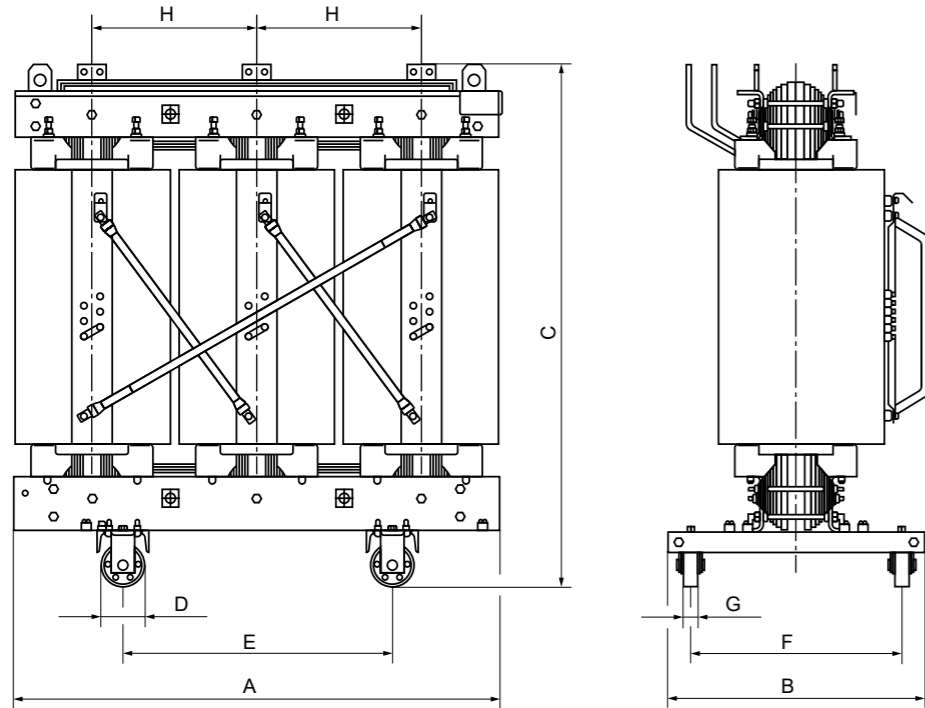
Main Electrical Characteristics								
Rated Power	kVA	50	100	160	250	400	630	
Type	aTSE	667/10	697/10	717/10	737/10	757/10	777/10	
No-Load Loss	P ₀ (W)	200	280	400	520	750	1100	
No-Load Current	I ₀ (%)	0,5	0,4	0,35	0,3	0,3	0,3	
Short Circuit Loss	P _{k 75°C} (W)	1450	1750	2500	3300	4750	6600	
	P _{k 120°C} (W)	1700	2050	2900	3800	5500	7600	
Impedance Voltage	u _{k 120 °C} (%)	6	6	6	6	6	6	
Sound Level								
Pressure (1m)	L _{PA} dB(A)	35	37	39	42	44	46	
Power	L _{WA} dB(A)	49	51	54	57	60	62	
Total Weight	m (kg)	400	610	865	1335	1600	2280	



Dimensions (IP00)								
Rated Power	kVA	50	100	160	250	400	630	
Type	aTSE	667/10	697/10	717/10	737/10	757/10	777/10	
A (mm)		950	1090	1120	1340	1390	1480	
B (mm)		650	710	730	750	820	835	
C (mm)		1000	1060	1225	1305	1370	1660	
D (mm)		100	100	100	100	125	125	
E (mm)		430	430	520	570	670	670	
F (mm)		430	430	520	570	670	670	
G (mm)		40	40	40	40	40	40	
H (mm)		310	365	370	445	465	495	

up to 12 kV 800-3150 kVA loss $A_0 A_k$ max Al winding Tier 1 - Ecodesign 2015

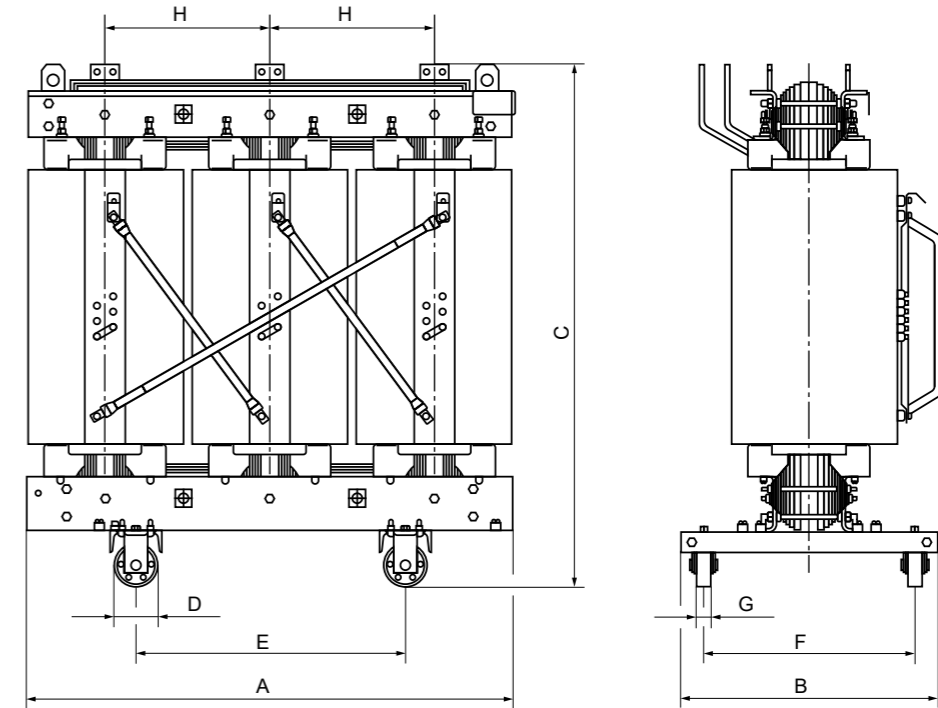
Main Electrical Characteristics								
Rated Power	kVA	800	1000	1250	1600	2000	2500	3150
Type	aTSE	787/10	797/10	807/10	817/10	827/10	837/10	847/10
No-Load Loss	P_0 (W)	1300	1550	1800	2200	2600	3100	3800
No-Load Current	I_0 (%)	0,35	0,3	0,3	0,28	0,25	0,22	0,2
Short Circuit Loss	$P_{k75^\circ C}$ (W)	6950	7800	9550	11300	13900	16500	19100
	$P_{k120^\circ C}$ (W)	8000	9000	11000	13000	16000	19000	22000
Impedance Voltage	$u_{k120^\circ C}$ (%)	6	6	6	6	6	6	6
Sound Level								
Pressure (1m)	L_{pA} dB(A)	48	49	51	52	54	55	58
Power	L_{WA} dB(A)	64	65	67	68	70	71	74
Total Weight	m (kg)	2640	2800	3260	3890	4900	5380	7400



Dimensions (IP00)								
Rated Power	kVA	800	1000	1250	1600	2000	2500	3150
Type	aTSE	787/10	797/10	807/10	817/10	827/10	837/10	847/10
A (mm)		1570	1600	1660	1750	1880	1940	2120
B (mm)		970	970	970	970	1270	1270	1270
C (mm)		1710	1780	1950	2050	2320	2400	2600
D (mm)		150	150	150	150	200	200	200
E (mm)		820	820	820	820	1070	1070	1070
F (mm)		820	820	820	820	1070	1070	1070
G (mm)		50	50	50	50	70	70	70
H (mm)		525	535	555	585	625	650	710

up to 24 kV 50-630 kVA loss $A_0 B_k$ max Al winding Tier 1 - Ecodesign 2015

Main Electrical Characteristics								
Rated Power	kVA	50	100	160	250	400	630	
Type	aTSE	667/22	697/22	717/22	737/22	757/22	777/22	
No-Load Loss	P_0 (W)	200	280	400	520	750	1100	
No-Load Current	I_0 (%)	0,5	0,4	0,35	0,3	0,3	0,3	
Short Circuit Loss	$P_{k75^\circ C}$ (W)	1450	1750	2500	3300	4750	6500	
	$P_{k120^\circ C}$ (W)	1700	2050	2900	3800	5500	7600	
Impedance Voltage	$u_{k120^\circ C}$ (%)	6	6	6	6	6	6	
Sound Level								
Pressure (1m)	L_{pA} dB(A)	35	37	39	42	44	46	
Power	L_{WA} dB(A)	49	51	54	57	60	62	
Total Weight	m (kg)	550	880	1160	1335	1920	2220	

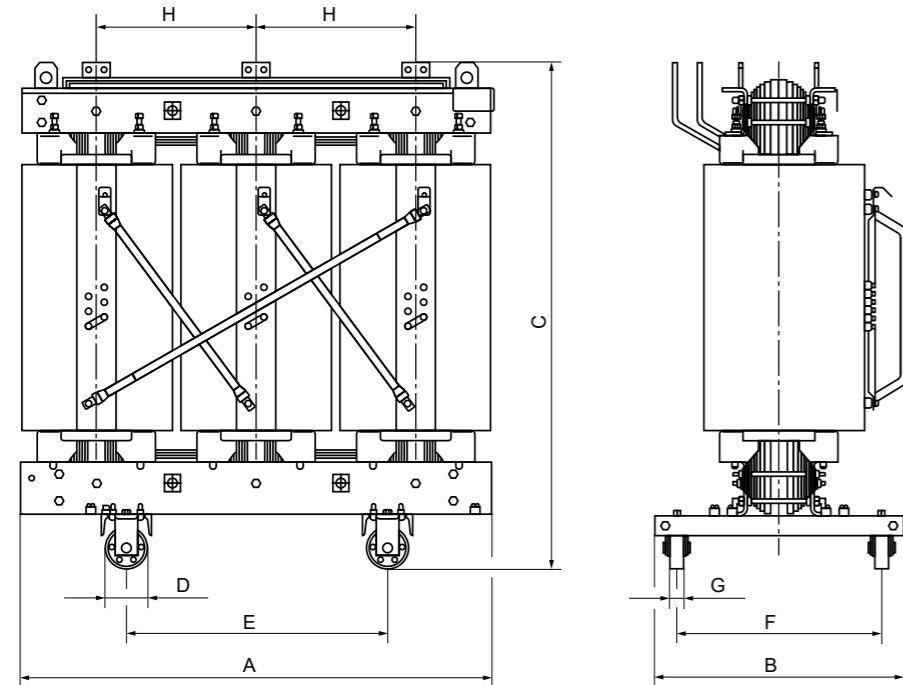


Dimensions (IP00)								
Rated Power	kVA	50	100	160	250	400	630	
Type	aTSE	667/22	697/22	717/22	737/22	757/22	777/22	
A (mm)		1050	1165	1240	1360	1610	1620	
B (mm)		750	780	800	730	750	850	
C (mm)		1080	1310	1240	1330	1495	1810	
D (mm)		100	100	100	100	125	125	
E (mm)		460	520	670	590	730	670	
F (mm)		460	520	670	460	670	670	
G (mm)		40	40	40	40	40	40	
H (mm)		350	390	415	450	550	510	

up to 24 kV 800-3150 kVA loss $A_0 A_k$ max

Al winding Tier 1 - Ecodesign 2015

Main Electrical Characteristics								
Rated Power	kVA	800	1000	1250	1600	2000	2500	3150
Type	aTSE	787/22	797/22	807/22	817/22	827/22	837/22	847/22
No-Load Loss	P_0 (W)	1300	1550	1800	2200	2600	3100	3800
No-Load Current	I_0 (%)	0,35	0,3	0,3	0,28	0,25	0,22	0,2
Short Circuit Loss	$P_{k,75^\circ\text{C}}$ (W)	6950	7800	9550	11300	13900	16500	19100
	$P_{k,120^\circ\text{C}}$ (W)	8000	9000	11000	13000	16000	19000	22000
Impedance Voltage	$u_{k,120^\circ\text{C}}$ (%)	6	6	6	6	6	6	6
Sound Level								
Pressure (1m)	L_{pA} dB(A)	48	49	51	52	54	55	58
Power	L_{WA} dB(A)	64	65	67	68	70	71	74
Total Weight	m (kg)	2640	2990	3370	4090	4980	5730	7510



Dimensions (IP00)								
Rated Power	kVA	800	1000	1250	1600	2000	2500	3150
Type	aTSE	787/22	797/22	807/22	817/22	827/22	837/22	847/22
A (mm)		1590	1660	1700	1830	1890	1980	2150
B (mm)		970	970	970	970	1270	1270	1270
C (mm)		1870	1920	2060	2215	2380	2490	2640
D (mm)		150	150	150	150	200	200	200
E (mm)		930	930	930	930	1070	1070	1070
F (mm)		730	730	730	730	1070	1070	1070
G (mm)		50	50	50	50	70	70	70
H (mm)		540	560	575	610	640	670	725

ACCESSORIES

Transformer is delivered ready to run upon easy installation and commissioning.

Basic configuration of transformer includes all necessary components for their normal operation.

Optional components are provided to expand func-

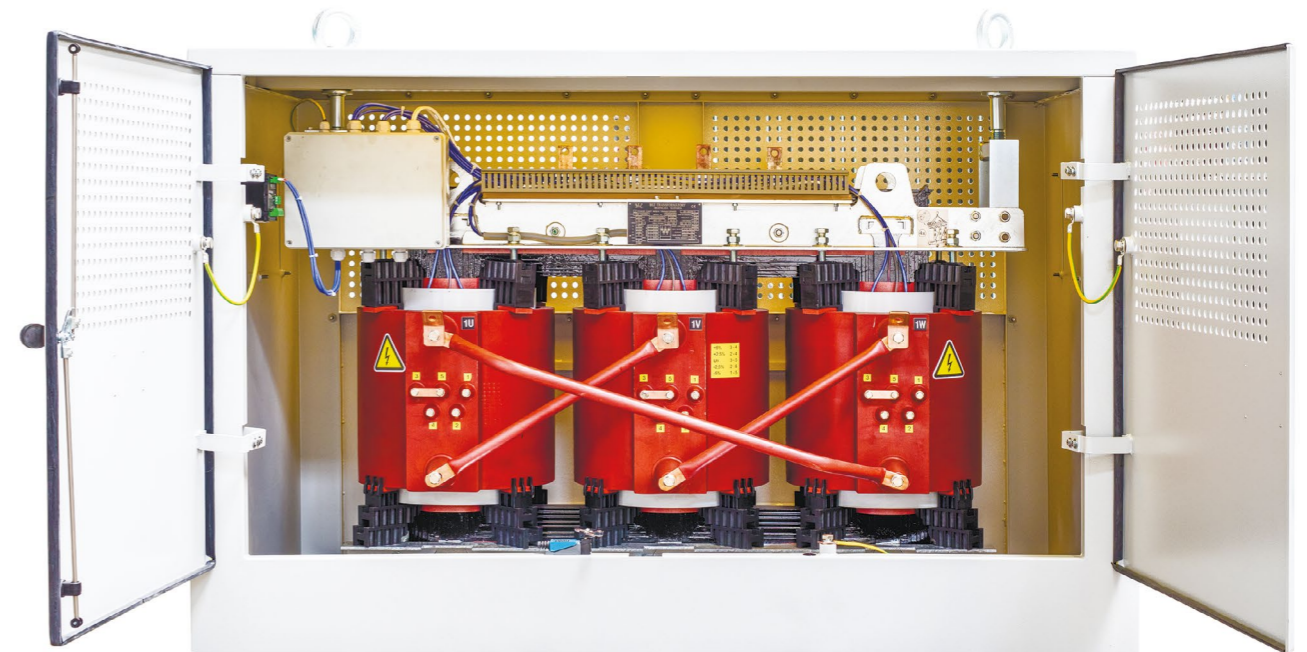
tions, increase monitoring capabilities and meet specific requirements to the equipment. Requirements to any transformer are determined at the stage of work order preparation or datasheet filling.

BASIC CONFIGURATION

- No Load Tap Changer
- 4 Bi-Directional Flat Rollers
- 4 Lifting Lugs
- 4 Dragging Eyes on the underbase
- 2 Earthing Points
- 1 Rating Plate (at HV side)

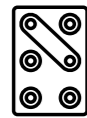
OPTIONAL COMPONENTS

- Protecting Enclosure
- Temperature Sensors
- Temperature Monitoring Device
- Dial Thermometer
- AF Cooling System
- Antivibrations Pads



BASIC CONFIGURATION

OPTIONAL COMPONENTS



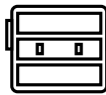
No Load Tap Changer

NLTC allows adjusting with preliminary de-energizing of the equipment.



Rollers

The rollers may be positioned in the longitudinal or transverse direction to ensure relocation to any place.



Protecting Enclosure

Protecting enclosures are made for operation of the transformer both indoors and outdoors, depending on the level of protection IP



Temperature Sensors

Temperature sensors are installed in the LV windings: 2 PTC thermistors or PT 100/phase



Temperature Control Unit

Temperature monitoring device is intended to control the temperature of transformer. If a transformer equipped with fans, then, in case of overheating, it will switch on the cooling fans and safety alarm. If temperature rise continues, and the temperature exceeds the limit, it will initiate emergency shutdown.



Dial Thermometer

The temperature inside the transformer is shown by a pointer on the dial



AF Cooling System

If operating conditions of transformer fall beyond standards, or extra power or overload capacity is required, it is recommended to apply additional cooling system. Fans under each phase winding would force the airflow through the cooling channels.



Anti-Vibrations Pads

BEZ Transformers' design ensures partial vibration damping due to their structural elements. To decrease vibration, additional set of vibration absorbers may be installed. Standard option includes rubber pads decreasing the transient vibrations of equipment.

OTHER SERVICES

- Direct sales support
- Customer modifications made by our R&D
- Consulting services
- Supervised Installation on site
- Noise level tests
- Special tests in our laboratory
- Simulations and calculations
- Development of the new transformers
- Payback calculations
- Aftersale service
- Warranty service, including warranty repair
- Revisions and repairs

INSTALLATION AND OPERATION

PROTECTING ENCLOSURE

The transformer enclosure is made of steel plate. Manholes at HV side, provide access to HV terminals and tapping control.

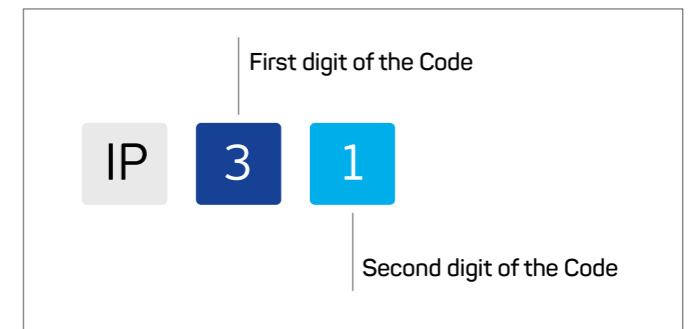
The casing is equipped with two brackets designed to lift enclosure without transformer, and removable studs designed to lift enclosure with transformer.

After inserting transformer into enclosure, HV and LV terminals are connected through holes with a removable cover. Holes in the cable gland are made at the customer site, depending on specific conditions.

It should be remembered that all cable glands must be sealed tight in accordance with the specified degree of protection. HV cable can also be connected through the bottom of enclosure.

To protect against unauthorized opening of manholes, at the request of the customer, enclosure can be equipped with a door switch with contacts to ensure alarm or safety interlock circuits.

IP Code consists of two digit: first digit indicates the level of protection from external penetration; second digit indicates protection from water penetration. Lower digit means lower requirement to transformer's protection.



FIRST DIGIT OF THE CODE

Protection from contact or penetration of foreign matters to active parts.

0	No protection	Unprotected from contact or penetration of foreign matters and items
1	Protection from penetration of large items	Protected from contact with back of hand and penetration of foreign items, Ø > 50mm
2	Protection from penetration of medium items	Protected from finger access to active parts and penetration of foreign items, Ø > 12,5 mm
3	Protection from penetration of small items	Protected from tool access to active parts and penetration of foreign items, Ø > 2,5 mm
4	Protection from penetration of foreign matters	Protected from wire access to active parts and penetration of foreign items, Ø > 1 mm
5	Dust Protection	Full protection from any contact with active parts. Dustproof configuration

SECOND DIGIT OF THE CODE

Protection from water penetration.

0	No protection	Unprotected from water penetration
1	Vertical Dropping	Protected from impact of vertical dropping
2	Angled Dropping	Protected from impact of angled dropping if the casing is inclined in any direction at the angle through 15 °
3	Precipitation	Protected from water splashes in any direction
4	Blanket spraying	Protected from water splashes in any direction

CAST RESIN TRANSFORMERS IN METAL PROTECTION ENCLOSURE

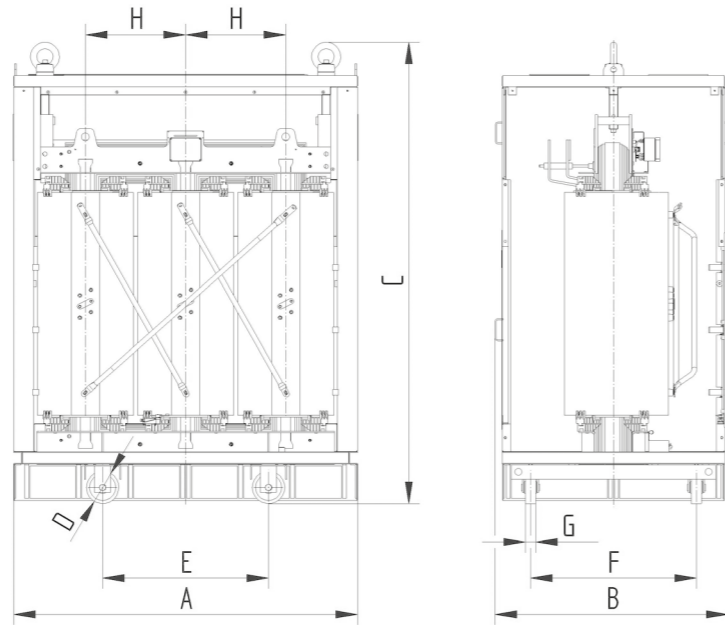
All enclosures are unique and designed for each transformer power levels to keep the design and size of the enclosure as compact as possible.

Transformers and enclosures are delivered assembled together. It is also possible to choose the transformer with the disassembled enclosure, to be assembled on site.

Transformers in enclosures have the same design and parameters like standard transformers and can be recognized with letter A in the end of a transformer type name (aTSE 798/22 = no enclosure; aTSE 798/22A = enclosure).

Standard IP coverage for the enclosure is IP21, higher IP ratings are also available.

Enclosure colour: RAL 7032, 5001



up to 12 kV IP21

compatible with **ecoTEC²**

Power (kVA)	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
aTSE	698/10A	718/10A	738/10A	758/10A	778/10A	788/10A	798/10A	808/10A	818/10A	828/10A	838/10A	848/10A
A	1520	1520	1820	1850	1920	1700	1700	1920	2100	2120	2500	2650
B	1060	1060	1170	1220	1200	1170	1170	1280	1280	1500	1500	1500
C	1645	1645	1645	1900	2120	2280	2280	2365	2430	2710	2800	3000
D	125	125	125	125	125	125	160	160	160	200	200	200
E	520	520	520	670	670	670	820	820	820	1070	1070	1070
F	520	520	520	670	670	670	820	820	820	1070	1070	1070
G	40	40	40	40	40	50	50	50	50	70	70	70
H	340	370	405	485	465	495	495	540	575	590	640	720

up to 24 kV IP21

compatible with **ecoTEC²**

Power (kVA)	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
aTSE	698/22A	718/22A	738/22A	758/22A	778/22A	788/22A	798/22A	808/22A	818/22A	828/22A	838/22A	848/22A
A	1520	1650	1750	1950	2150	2200	2300	2400	2450	2500	2650	2850
B	1060	1100	1170	1220	1370	1200	1350	1330	1330	1400	1500	1600
C	1645	1800	1855	2100	2180	2350	2350	2600	2600	2750	3000	3050
D	125	125	125	125	125	125	160	160	160	200	200	200
E	520	520	520	670	670	670	820	820	820	1070	1070	1070
F	520	520	520	670	670	670	820	820	820	1070	1070	1070
G	40	40	40	40	40	50	50	50	50	70	70	70

STANDARD FITTINGS

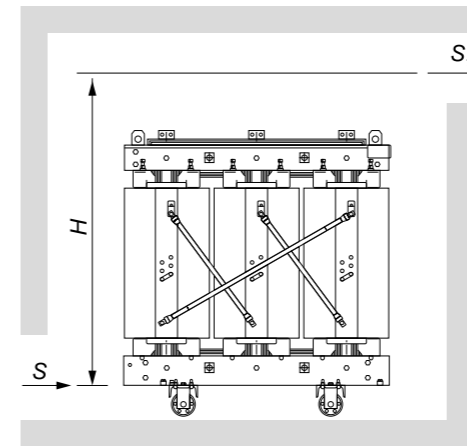
- Terminals on the top of enclosure
- 4 bi - directional flat rollers
- 4 lifting holes
- 4 haulage holes on the underbase
- 2 earthing points
- 1 rating plate (on HV site).

OPTIONAL FITTINGS

- Temperature sensors in the LV windings – 2 PTC thermistors or PT 100/phase
- Temperature monitoring device with alarm and tripping contacts and cooling fans control
- Dial thermometer
- AF cooling system (+ 40 %) with the fans
- Antivibrations pads
- Placement of the LV/HV terminals.

ADDITIONAL FACTORS OF TRANSFORMERS OPERATION

INDOOR VENTILATION



To calculate indoor ventilation system, one needs to consider air intakes and outlets, and, if necessary, capacity of air forced cooling.

Input Data for Calculation:

P_k – Short Circuit Loss at 120 °C, kW;

P_o – No Load Loss, kW;

H – Air Intake and Outlet Height Difference, m;

k – coefficient addressing transformer's Protection Degree;

Protection Degree IP00: k=1

Protection Degree IP21 – IP54: k=0,5

Air Intake Area S, in m², upon deduction of the area of grates, is determined by the following equation:

$$S = \frac{0,18 \times (P_k + P_o)}{k \times \sqrt{H}}$$

Air Outlet Area S₁, in m², upon deduction of the area of grates, is determined by the following equation:

$$S_1 = 1,1 \times S$$

Air Intake and Outlet Areas are calculated by the above equations at average ambient temperature, 20 °C and altitude above sea level up to 1000 m.

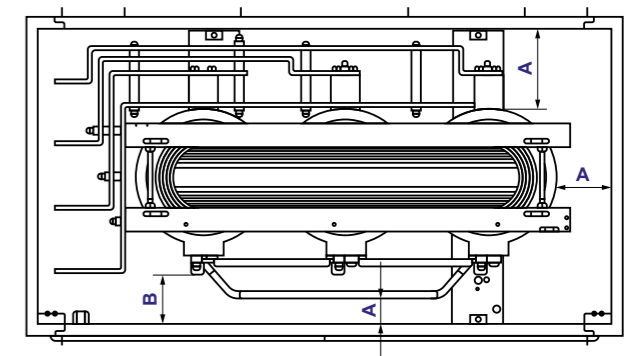
If the required Air Intake and Outlet Areas are not available, the air forced ventilation shall be provided at the transformer location.

Required vent system capacity, m³/min:

$$V = 4,5 \times (P_k + P_o)$$

MINIMUM CLEARANCES

When designing a room for transformer, it is mandatory to observe the insulation distance X from walls of the room to the extreme points of the winding leads



Maximum Voltage (kV)	BIL (kV)	A (mm)	B (mm)
up to 7,2	60	60	95
up to 12	75	60	125
up to 17,5	95	80	165
up to 24	125	120	225
up to 36	170	200	325

NOTE: Basic Impulse Level (BIL)

THERMAL PROTECTION

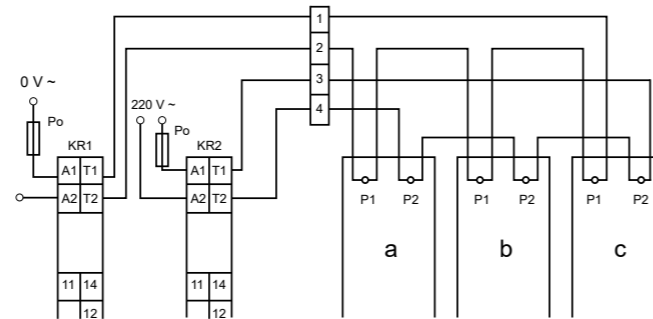
To protect against overheating, transformer is equipped with thermal protection relay built into the LV winding. The wires of the temperature sensors are routed to the terminals of the thermal relay. The relay is located on the frame of transformer. Two-stage thermal protection: the first stage signals on approaching to maximum permissible operating temperature. The second stage is set to maximum allowable temperature. The relay can be removed and placed in Switchgear or Control Cabinet.

Upon request of customer, the above relay can be replaced with an MSF 220 V device of 230 V AC, or an MSF 220 VU device for universal voltage of 24 – 240 V AC/DC. These devices must be built into the Switchgear or Control Cabinet, as due to ambient temperature in the range -20 °C to 55 °C, permissible for devices, they cannot be mounted on a transformer.

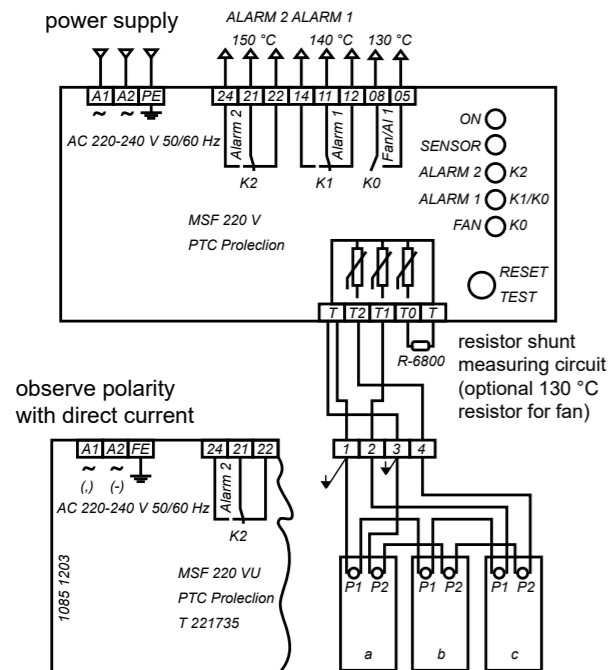
- If temperature exceeds 130 °C, overheat relay would start a fan.
- If temperature exceeds 140 °C, Alarm 1 contact would change its position.
- If temperature exceeds 150 °C, Alarm 2 contact would change its position.



Thermal relay connection diagram, equipment de-energized



MSF 220 V (MSF 220 VU) protection device connection diagram, equipment de-energized



Relay KR1 – Alarm 1
Relay KR2 – Alarm 2
P1, P2 – Thermistors
A1, A2 – Voltage source
Po – Fuse
Contacts 220 V; 2,5 A
Relay de-energized 11-12 closed
Relay energized 11-14 closed if temperature within threshold
Relay energized 11-12 closed, in the event of temperature rise
Thermal protection relays are usually supplied to customer's request with the following supply voltage:
Voltage Fuse
220 V ~ (AC) 32 mA
110 V = (DC) 80 mA
When power supply of thermal protection 220 V = (DC) two 100 V relays must be connected in series (terminal A2 of the first relay connected to terminal A1 of the second relay). Voltage is applied through 80 mA fuse to terminal A1 of the first relay and terminal A2 of the second relay.

TERMINALS

	LV Terminal											HV Terminal					
	100kVA - 250kVA	400kVA - 800kVA	1000kVA - 2500kVA	3150kVA								50-250 kVA		315-2500 kVA		3150 kVA	
(kVA)	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150					
a	14	14	14	14	18	18	18	18	18	18	18	18					
b	40	40	60	80	100	100	100	120	120	120	125	160					
c	5	5	5	8	10	10	12	12	15	16	20	20					
d	20	20	30	20	30	30	25	30	30	30	32,5	30					
e	15	15	20	20	30	30	25	30	30	30	32,5	40					
f	-	-	-	40	40	40	50	60	60	60	60	80					
g	-	-	-	40	40	40	50	60	60	60	60	50					
h	-	-	-	-	-	-	-	-	-	-	-	50					

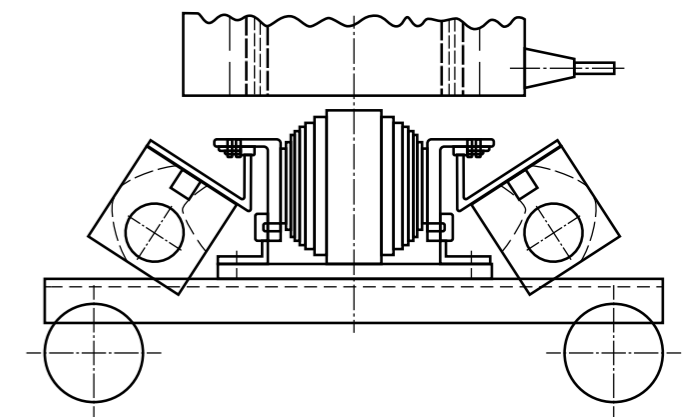
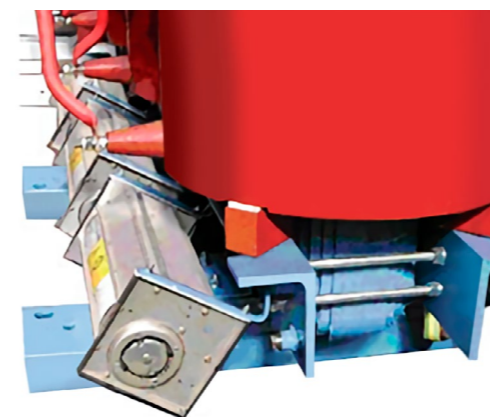
Company reserves the right to modify data without notice.

FORCED VENTILATION

If it is necessary to increase power of transformer, fans (two per each phase) are installed on transformer, which ensure air circulation in ventilation ducts of winding.

Fans are used in two types of overloads – 25 % and 40 %, respectively. The fan performance is selected

so that when the transformer is operated with 25 or 40 % overload, its temperature would not exceed the limit. Thus, this operating mode for transformer is not emergency. The duration of operation in this mode is determined only by service life of fans.



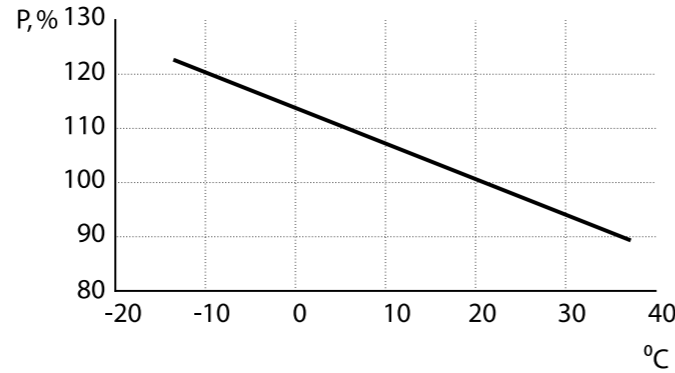
OVERLOAD CAPACITY

PERMISSIBLE LOAD VS AMBIENT TEMPERATURE

BEZ transformers are successfully operated under the rated conditions regardless the duration of the previous loads at the ambient temperature up to +40 °C.

The chart, below, clarifies permissible continuous load at various ambient temperature.

Therefore, even if ambient temperature exceeds the specified value (i.e., +60 °C), transformer would keep running at loads not exceeding those in the chart. This is also true for running at low temperatures.

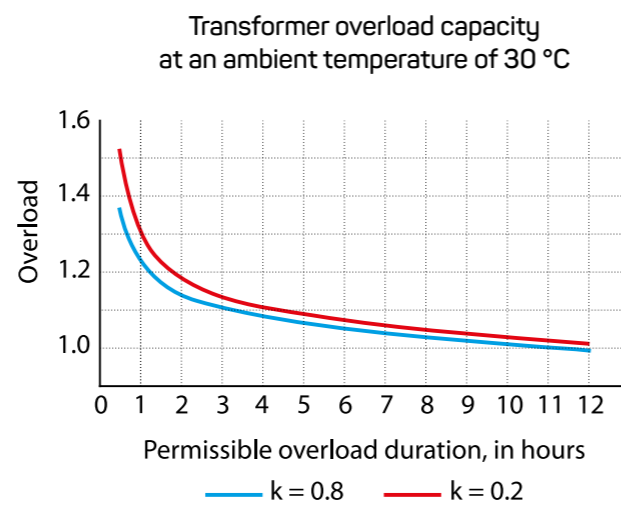
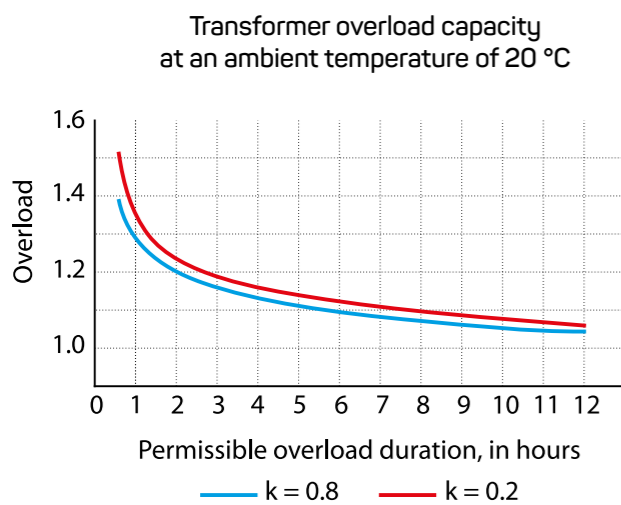
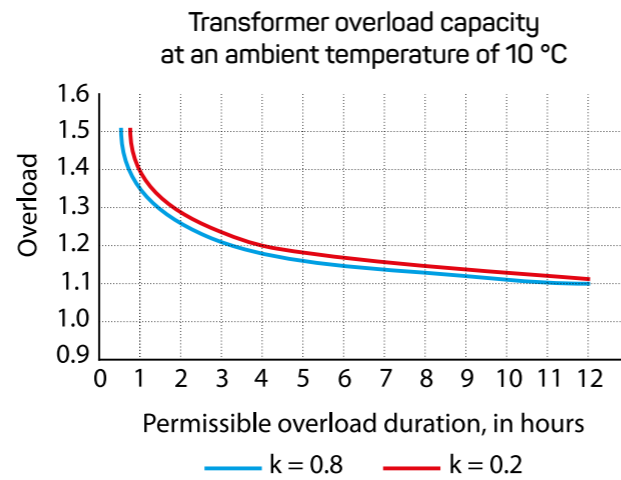


PERMISSIBLE OVERLOAD CURVES

The chart below presents time dependent transformer overload vs. permissible overload curves within the set mode.

Overload duration is determined basing on overload level, average annual temperature and transformer load factor specified in the chart, below.

Transformer overload capacity at an ambient temperature of 10 °C, 20 °C and 30 °C.



E - C - F CLASSES

STN EN IEC 60076-11 defines alphanumeric codes for environmental, climate and fire resistance classes. BEZ manufactures transformers of the following classes:

- Environmental Class E2
- Climatic Class C2
- Fire Classification F1

	Symbol	Definition
Environmental Class	E0	There is no condensation on the transformer and pollution is negligible. This condition takes place in indoor installation in a dry and clean environmental.
	E1	Occasional condensation can appear on the transformer. There could be pollution in a small quantity.
	E2	Condensation and pollution are of a consistent quantity with combination of both.
Climatic Class	C1	transformer can work at ambient temperature above -5 °C, but it can withstand -25 °C during transportation and installation.
	C2	Outdoor installation. transformer can work, be transported and stored at temperature below -25 °C.
	C3	Transformer is designed for operation, transportation and storage at ambient temperatures up to -45 °C.
	C4	Transformer is designed for operation, transportation and storage at ambient temperatures up to -60 °C.
Fire Classification	F0	The risk of fire is not expected and no measures are taken to limit inflammability.
	F1	The transformer is subject to the risk of fire and reduced inflammability is required. Fire on the transformer must be extinguished within laid-down limits.





For individual class setup, please contact our sales representatives.

ORDER FORM: CAST RESIN DRY-TYPE TRANSFORMER

PLEASE CHOOSE THE REQUIRED PARAMETERS OR FILL IN THE BLANKS

Company Name _____
 Contact _____
 Phone _____
 Email _____
 Type _____
 Quantity _____

_____	Rated Power, kVA	50	100	160	250	400	630	800	1000	1250	1600	2000	2500	3150
_____	High Voltage, kV	6	10	15	20	22	35							
_____	Low Voltage, V	400/231	420/242											
_____	Frequency, Hz	50	60											
_____	Impedance Voltage, %	6	4											
_____	Vector Group	Yyn0	Dyn1	Dyn11										
_____	No Load Loss, W													
_____	Short Circuit Loss 120 °C, W													
_____	MAX./MIN. Ambient Temperature °C	40/-5	40/-25	40/-45										
_____	Altitude, m	≤1000												

Location <input type="checkbox"/> Outdoors <input type="checkbox"/> Under roof <input type="checkbox"/> Indoors	Degree of Protection <input type="checkbox"/> IP00 No Enclosure, Standard Busbars <input type="checkbox"/> IP21 Protection Enclosure <input type="checkbox"/> IP31 Protection Enclosure <input type="checkbox"/> IP33 Protection Enclosure, Outdoors Application	Bushing Layout <input type="checkbox"/> HV – on the left LV – on the right  <input type="checkbox"/> LV – on the left HV – on the right  <input type="checkbox"/> HV, LV – on the top  <input type="checkbox"/> HV, LV – on the bottom  <input type="checkbox"/> Other: _____
Winding Material <input type="checkbox"/> Aluminum, Al <input type="checkbox"/> Copper, Cu	HV Bushings (left to right) <input type="checkbox"/> A - B - C (standard) <input type="checkbox"/> C - B - A (mirror) <input type="checkbox"/> Other: _____	LV Bushings (left to right) <input type="checkbox"/> c - b - a - 0 (standard) <input type="checkbox"/> 0 - a - b - c (mirror) <input type="checkbox"/> Other: _____
Cooling <input type="checkbox"/> AN <input type="checkbox"/> AN/AF	Temperature Sensors <input type="checkbox"/> PT 100/phase <input type="checkbox"/> 2 PTC Thermistors	Temperature Control Unit <input type="checkbox"/> MSF 220 VU <input type="checkbox"/> MSF 220 V <input type="checkbox"/> MSF 220 K <input type="checkbox"/> T-154 <input type="checkbox"/> Other: _____
Optional Components	<input type="checkbox"/> Dial Thermometer <input type="checkbox"/> Anti-Vibrations Pads	

Additional Requirements _____

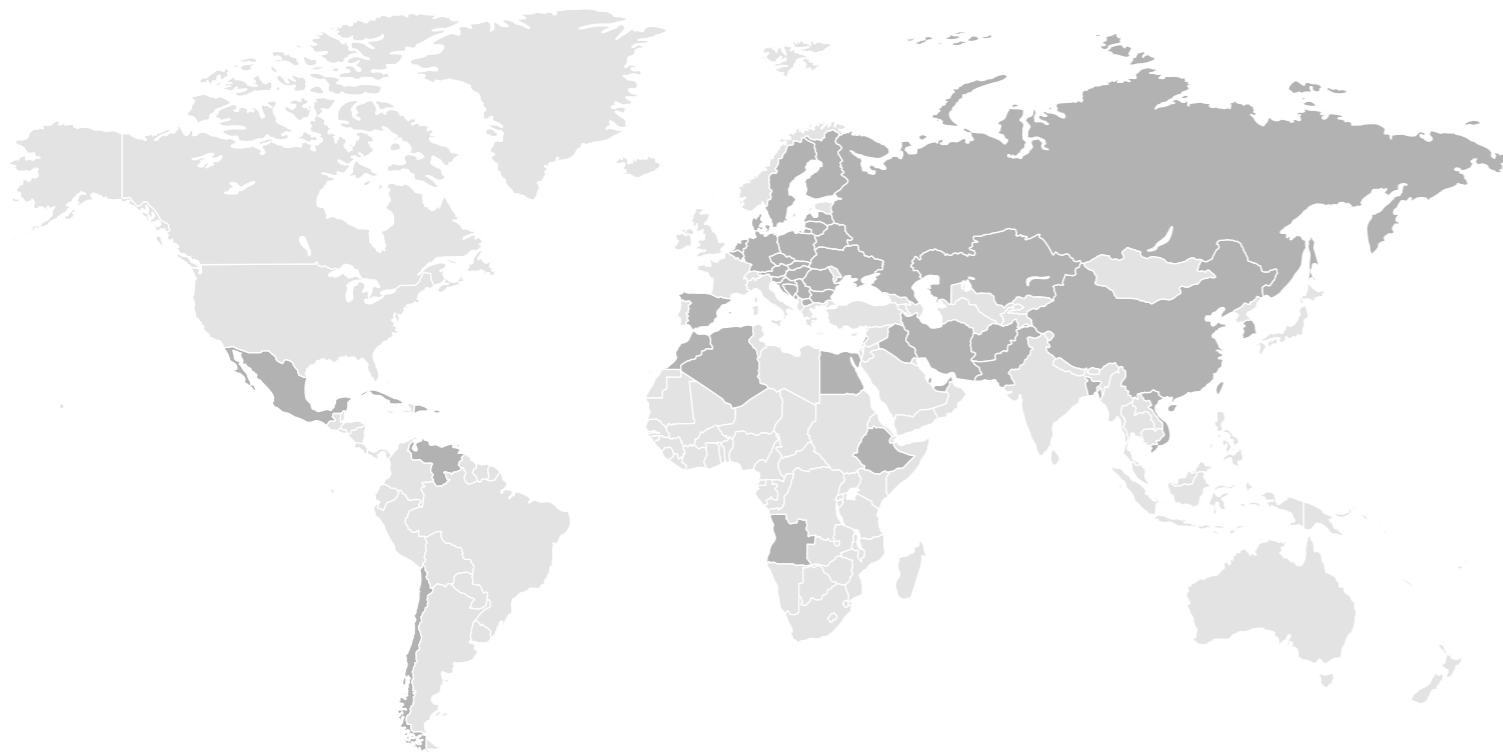
Other parameter values - upon customer's request.



TRADITION, RELIABILITY, QUALITY

SINCE 1908

Our solutions are used in more than 50 countries around the globe, more than 250 000 transformers were manufactured and delivered to customers.



Czech republic, Slovak republic, Poland, Germany, Austria, Switzerland, Holland, Latvia, Lithuania, Croatia, Slovenia, Serbia, Northern Macedonia, Bosnia and Herzegovina, Montenegro, Finland, Belgium, Hungary, Spain, Bulgaria, Romania, Ukraine, Belarus, Russia, Kazakhstan, Egypt, United Arab Emirates, Bahrain, Angola, Venezuela, Mexico, Chile, Cuba, Dominican republic, Denmark, Afghanistan, Irak, Iran, Pakistan, Bangladesh, Maroco, Ethiopia, Lebanon, China, Korea, Vietnam, Algeria.

PRODUCT RANGE

APPLICATION: ENERGY * INDUSTRIAL ENTERPRISES
OIL & GAS * METALLURGY
* BUILDING INDUSTRY * TRANSPORT



CAST-RESIN TRANSFORMERS
50 kVA to 6300 kVA | up to 36 kV



OIL-FILLED HERMETICALLY SEALED TRANSFORMER
25 kVA to 3150 kVA | up to 36 kV



SPECIAL TRANSFORMERS
Single-phase Transformers, Rectifier Transformers, Excitation Transformers, Amorphous Transformers



OIL-FILLED POWER TRANSFORMER
4 MVA to 16 MVA | up to 36 kV

BEZ TRANSFORMÁTORY

MANUFACTURING TRANSFORMERS SINCE 1902

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