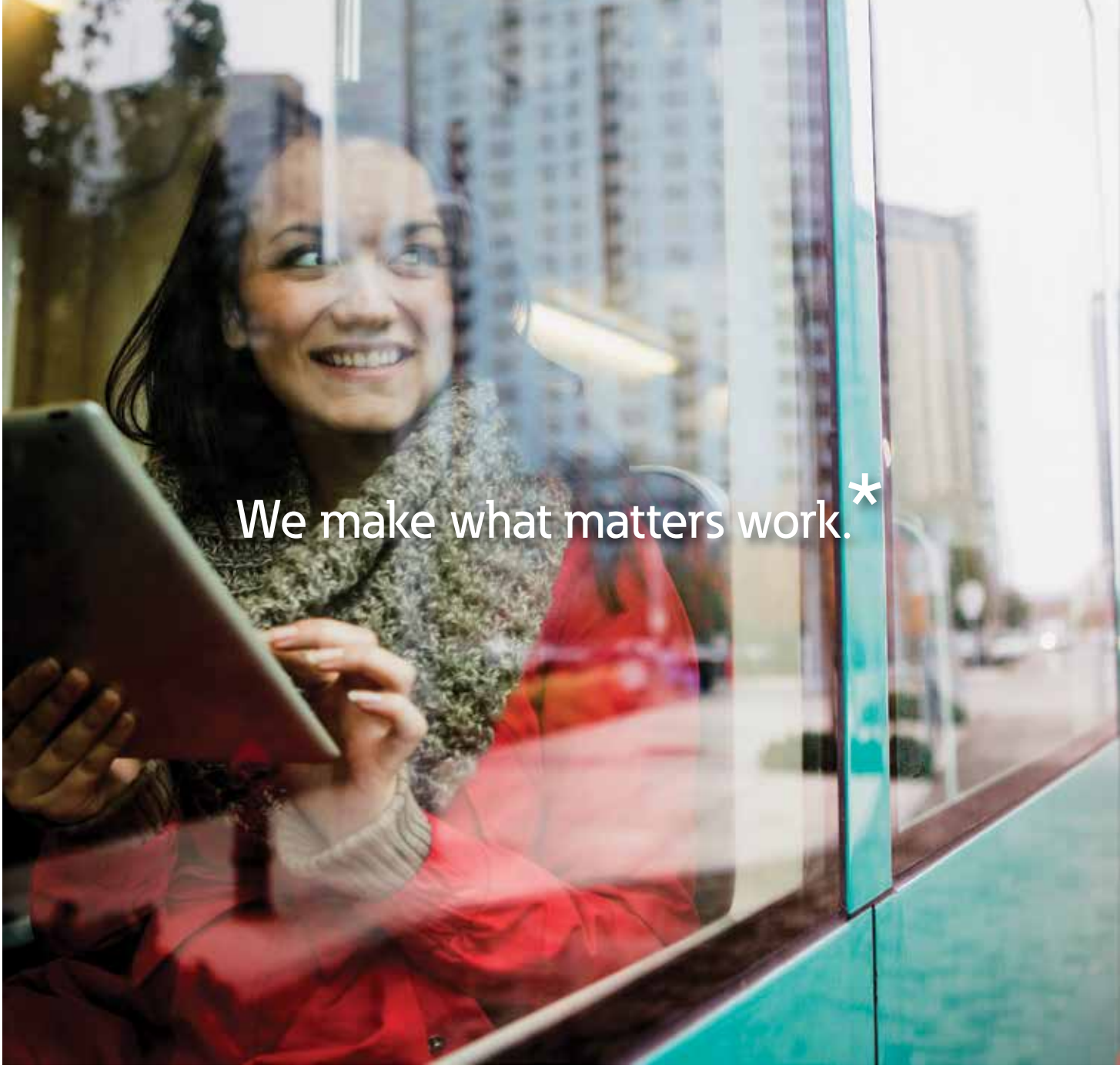
Distribution Transformers

ULUSOY
LIQUID IMMERSED TRANSFORMER

EATON
Powering Business Worldwide



* Every day, people depend on things like technology, transportation, energy and infrastructure to keep their daily lives on track. But without power, none of it would be possible. That's why companies around the world turn to Eaton. We're dedicated to improving people's lives and the environment with innovative technologies that help manage power more safely, reliably and sustainably. To meet today's challenges, and tomorrow's. Because this is what really matters. And we're here to make sure it works.

To learn more go to: Eaton.com/whatmatters

We make what matters work.

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Introduction

Eaton manufactures liquid immersed distribution transformers in accordance with various global and industrial standards and customer requirements with a power range from 25 kVA to 5000 kVA and a maximum voltage level of 36 kV. Requests between 5000 kVA and 10.000 kVA are evaluated on a project basis. Transformers are manufactured and tested to meet IEC 60076 and can be further customized upon customer requests.

Eaton designs and manufactures customized transformers according to various global and industrial standards using state-of-the-art machinery.

Standards

Liquid immersed transformers are manufactured in accordance with the following national and international standards:

- IEC
- IEEE
- CENELEC EN
- TS EN
- DIN EN 50588-1

Areas of use

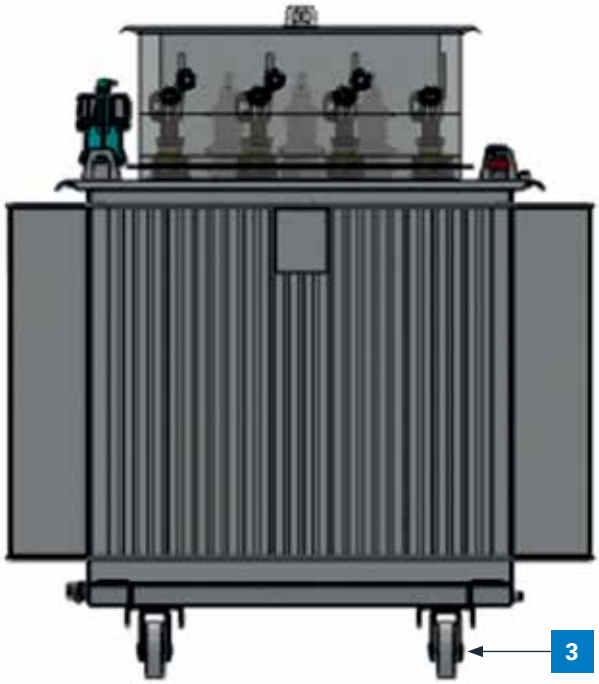
- Distribution transformer
- Solar power plant transformer
- Wind turbine transformer
- Earthing transformer
- Dual voltage transformer
- Rectifier transformer
- Multi winding transformer
- EV charging transformers
- Data center application transformers

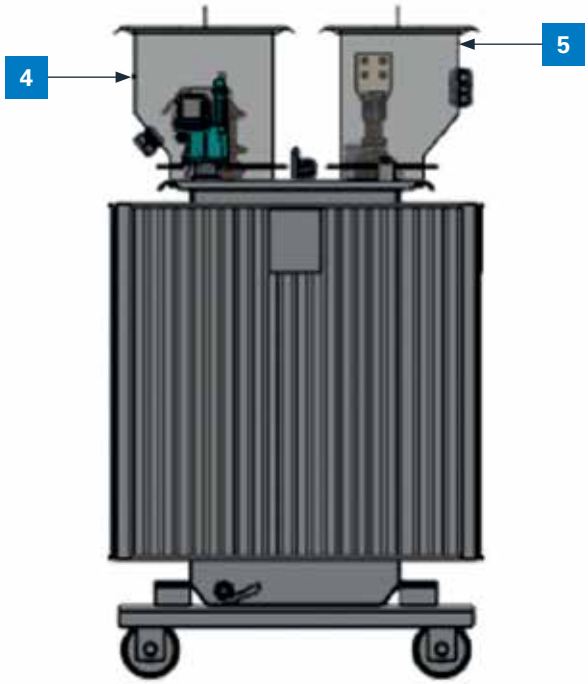
Rated frequency	Hz	As per request (50 Hz / 60 Hz)
Rated power	kVA	Up to 5000 kVA (Requests between 5000 kVA and 10000 kVA are evaluated on a project basis)

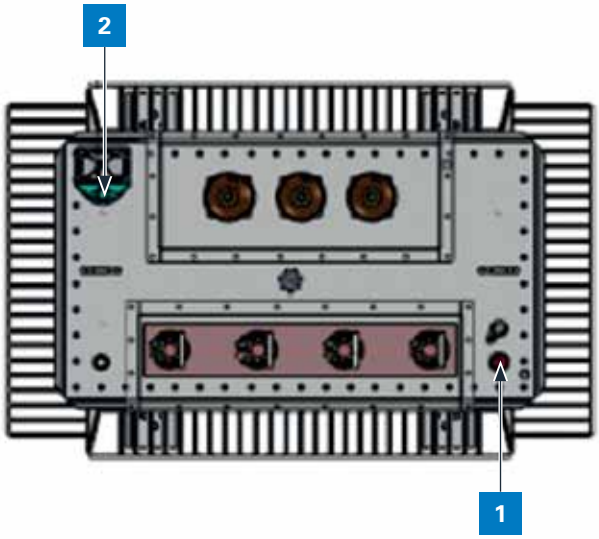
Max system voltage	kV	Up to 36 kV
Insulation system		Conventional insulation system, high-temperature insulation system, hybrid, fully-hybrid, semi-hybrid, mix-hybrid
Cooling material		Mineral, vegetable ester, synthetic ester liquids
Cooling system		ONAN, ONAN/ONAF, KNAN, KNAN/KNAF

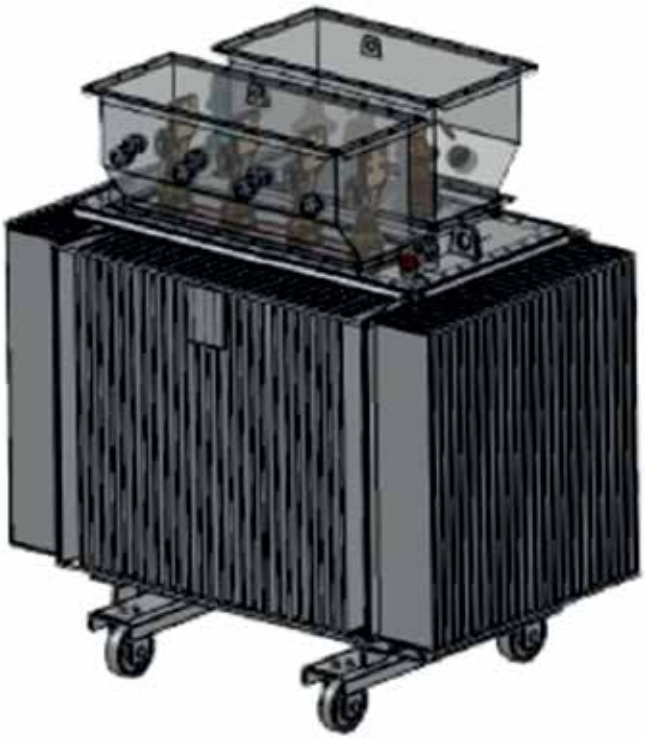
Parts

Hermetically sealed transformer









1 Pressure relief valve

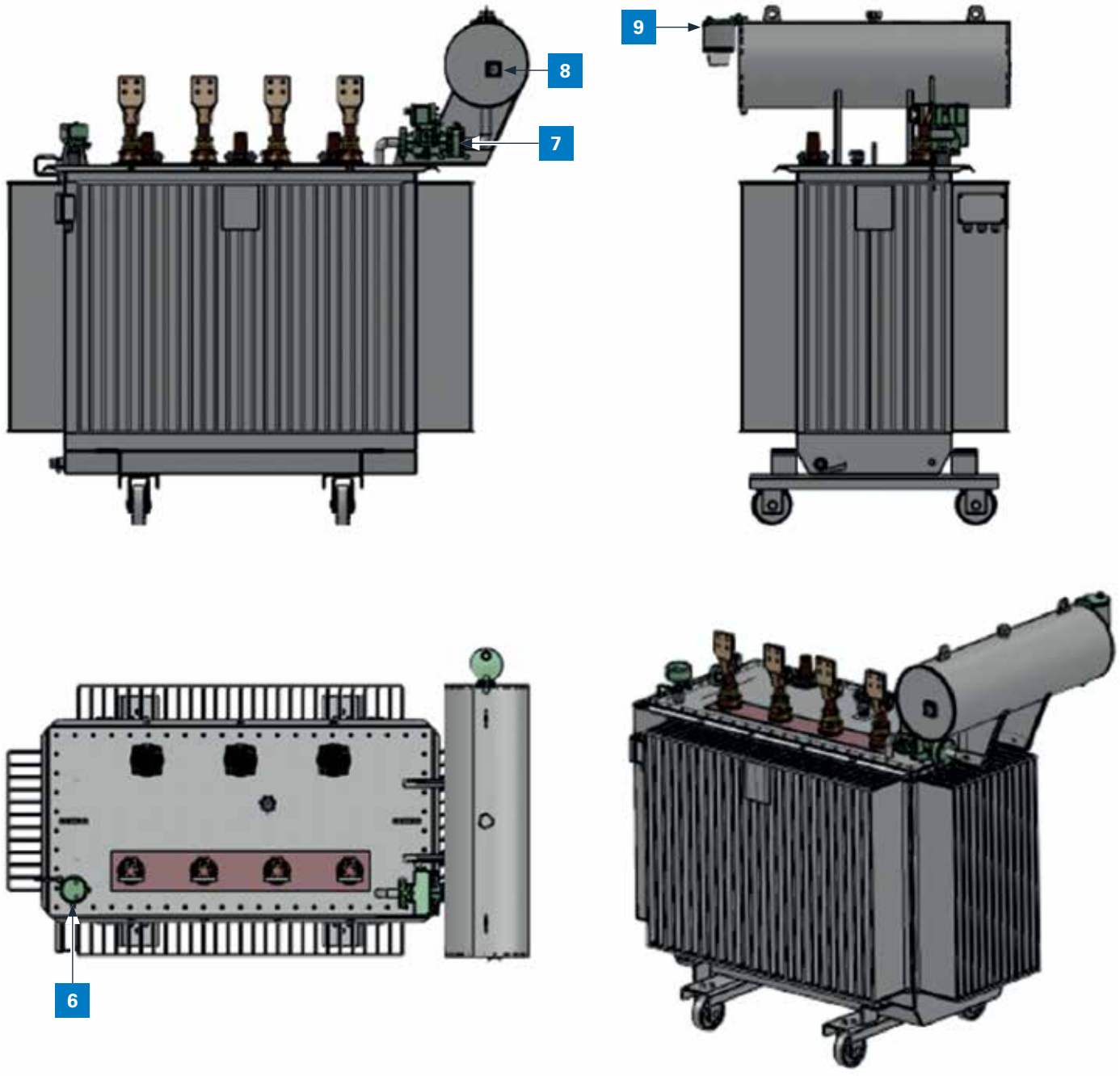
2 Hermetic protection relay

3 Wheels

4 High voltage cable box

5 Low voltage cable box

Free-breathing transformers with conservator



6	Contact liquid temperature thermometer	8	Magnetic liquid level indicator
7	Buchholz relay	9	Dehumidifier

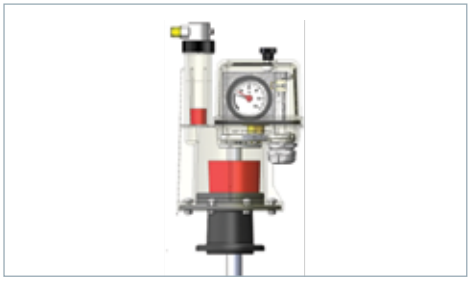
Accessories

Pressure relief valve

A pressure relief valve is a preferred circuit element in hermetic designs. It protects the transformer tank in case of sudden pressure increase. It is mounted on the cover. If the tank is exposed to the internal pressure to which the valve is set, the valve opens and allows the liquid to drain, compensates for the pressure, and prevents the body from rupturing. Contact use is optional.

Hermetic protection relay

Hermetic protection relays are used in hermetic transformers. The relay shows gas discharge, liquid temperature and internal pressure in the body. These relays are generally used in transformers larger than 500 kVA. There are two contacts on the relay for each of the following: gas discharge, boiler pressure and liquid temperature. It provides alarm and trip warnings according to the set limit values.

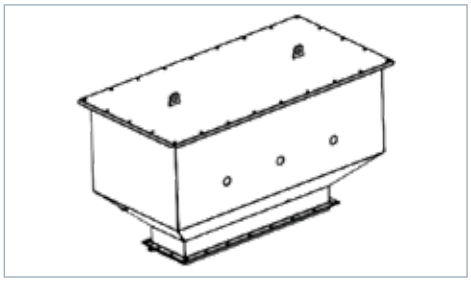


Wheels

Wheels strong enough to bear the transformer weight are available in various diameters and shipped with the transformer as per customer request.

High voltage cable box

This is a mechanical enclosure that protects the transformer's high voltage bushing connections from the environment. It can be designed in accordance with various IP classes as per customer request.



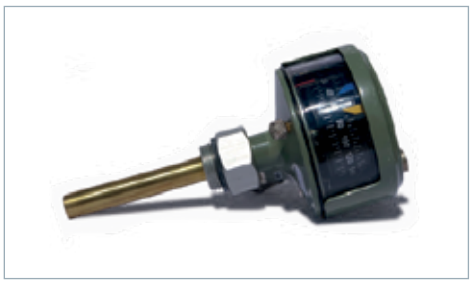
Low voltage cable box

This is a mechanical enclosure that protects the transformer's low voltage bushing connections from the environment. It can be designed in accordance with various IP classes as per customer request.

Contact liquid temperature thermometer

There is an indicator showing the maximum temperature reached by the liquid in the transformer. It can be reset with the button at the bottom. Liquid temperatures of up to 120°C can be measured. It operates via a contact. The electrical value of micro switches can be set as 5 A, 250 VAC or 0.2 A, 250 VDC.

If the transformer's liquid temperature needs to be measured without using a contact, a dial type thermometer should be used.

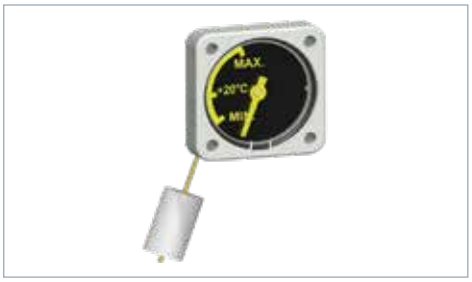


Buchholz relay

The Buchholz relay is connected with pipes between the transformer tank and the liquid expansion tank. It is used in the transformer to monitor gas and liquid movements. It provides warnings in case of failures that cause small gas accumulations, sudden liquid fluctuations and liquid leaks within the transformer.

Magnetic liquid level indicator

The magnetic liquid level indicator allows the liquid level in the liquid expansion tank to be monitored. The liquid level is displayed with a magnetically coupled float to indicate when the transformer liquid requires changing. Contact liquid level indicators can be used as per customer request.



Dehumidifier

When the liquid volume changes, the dehumidifier connected to the liquid expansion tank traps moisture in the air that passes through it, preventing moisture from entering the liquid. The size of the dehumidifier depends on the amount of liquid.

Liquid immersed transformer manufacturing technology

Windings

Windings are manufactured with the latest technology and fully automated machines. Electrolytic copper or aluminum conductors are used in low voltage and high voltage windings in accordance with standards and as per customer request. Windings are divided into low voltage and high voltage windings.

Types of conductors according to the voltage level and the load loss value:

- In low voltage coils: foil (sheet metal) or paper insulated rectangular section
- In high voltage coils: round or rectangular conductors with enamel or paper insulation.

DDP (Diamond Dotted Presspaper) with high impact and electrical resistance and specially produced kraft paper are used as insulation materials in windings. In high voltage windings, graded insulation is provided with edge strips and floor seals. This results in more compact coils with higher impulse resistance. Radial and axial clamps are applied to the coils to prevent short circuit forces.

Core

The transformer core is composed of cold rolled grain oriented electrical steel (CRGO). Sheet types are selected according to the guaranteed no-load loss and sound level.

Sheet metal is cut sharply to avoid burrs on high precision machines and is stacked using the step-lap method to minimize losses and noise.

Active part

The active part is created by placing the coils concentrically on the core legs and stacking the upper yoke sheets to complete the core frame. Chocks and clamping devices hold the coils in place. Active part is completed by bushings and tap changer connections made ready for the first preliminary tests.

Tank

Tanks are available in two types: flat and corrugated wall. The tank and cover are made of mild steel. Corrugated walls that form the front and side surfaces of the tank also form the transformer cooling surface.

Tank welds are leak-proof. When tank production is complete, it is tested for leakage.

Surface treatment and painting

Tanks are sand-blasted and cleaned with special chemicals before painting. Top coat paint colors RAL7033 - RAL9006 are used (all RAL colors can be changed as per customer request). Corrosion classes are specified in the table on page 11. Transformers in the desired corrosion class can be produced as per customer request.

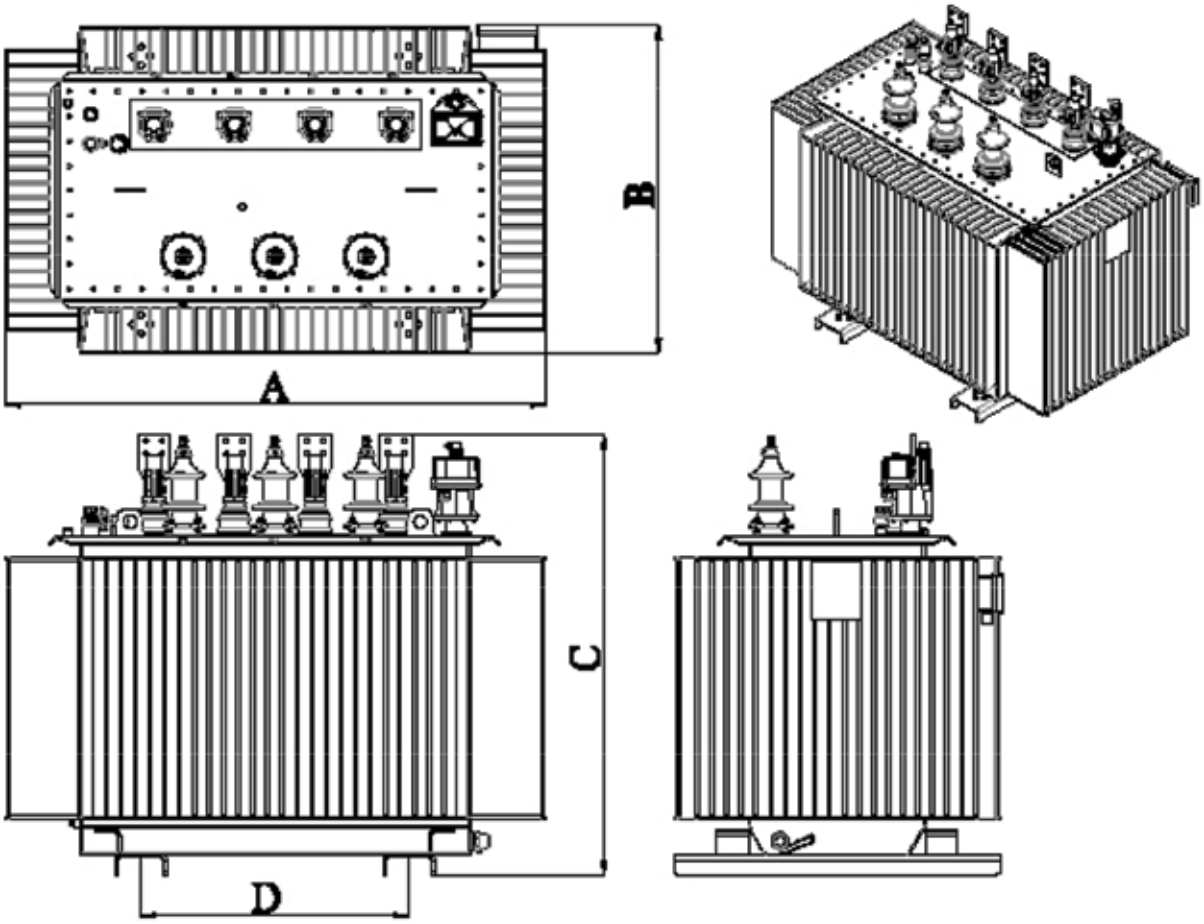
*Upon customer request, it can be hot-dip galvanized for use at the seaside and in humid climates.

Corrosion category	Examples of suitable environmental conditions in temperate climate (for informational purposes)	
	Open spaces	**Closed spaces**
C1		Ventilated and heated buildings E.g.: offices, stores, schools, hotels, etc.
C2	Low pollution and mostly rural areas	Unheated buildings where condensation may occur. E.g.: warehouses, gyms, etc.
C3	Urban and industrial environments, areas where a certain degree of sulfur dioxide pollution is present, seaside areas with low salinity, etc.	Manufacturing rooms with a certain amount of air pollution and high humidity. E.g.: food production factories, laundries, breweries, dairy farms, etc.
C4	Industrial and marine areas with a certain degree of salinity, etc.	Buildings and areas with constant condensation and heavy pollution, etc.
C5-I	Industrial areas, etc., with aggressive atmospheric conditions and excessive humidity.	Buildings or areas with constant condensation and pollution, etc.
C5-M	Coastline and high sea areas with high salinity, etc.	Buildings and areas with constant condensation and heavy pollution, etc.

Drying and liquid filling

In liquid immersed transformers, the insulation materials must be dried before liquid filling. This drying process directly affects the quality of the transformer. Drying process starts with heating windings by electrically or by hot-air. This drying process is completed vacuum drying where the drying and filling process occurs under a maximum vacuum pressure of 0.1 mbar. After drying is completed, liquid filling process automatically starts.

Technical information



Ecodesign EU No. 548/2014 (Tier 2) AL - AL.

Rated voltage (kV)	Rated power (kVA)	No-load loss P0 (W)	Load loss Pk (W)	Short circuit impedance, Ucc (%)	Sound pressure level (db(A))	Width (mm)	Length (mm)	Height (mm)
7.2 - 12 kV	25	63	600	4.00	36	570	930	1040
	50	81	750	4.00	38	670	910	1060
	100	130	1250	4.00	40	670	1030	1180
	160	189	1750	4.00	43	730	1170	1300
	250	270	2350	4.00	46	790	1190	1390
	315	324	2800	4.00	48	790	1230	1420
	400	387	3250	4.00	49	810	1290	1470
	500	459	3900	4.00	50	830	1310	1560
	630	540	4600	4.00	51	830	1370	1640
	800	585	6000	6.00	52	970	1510	1670
	1000	693	7600	6.00	54	990	1550	1770
	1250	855	9500	6.00	55	990	1550	1780
	1600	1080	12000	6.00	57	1110	1650	1840
	2000	1305	15000	6.00	59	1090	1950	1940
	2500	1575	18500	6.00	62	1150	2070	2040
	3150	1980	23000	6.00	63	1170	2050	2080

Dimensions and weights are approximate. May vary by order.

Rated voltage (kV)	Rated power (kVA)	No-load loss P0 (W)	Load loss Pk (W)	Short circuit impedance, Ucc (%)	Sound pressure level (db(A))	Width (mm)	Length (mm)	Height (mm)
17.5 - 24 kV	25	63	600	4.00	36	570	970	1140
	50	81	750	4.00	38	650	970	1210
	100	130	1250	4.00	40	690	1030	1180
	160	189	1750	4.00	43	750	1170	1300
	250	270	2350	4.00	46	790	1210	1390
	315	324	2800	4.00	48	810	1290	1420
	400	387	3250	4.00	49	830	1350	1470
	500	459	3900	4.00	50	830	1390	1560
	630	540	4600	4.00	51	850	1410	1640
	800	585	6000	6.00	52	990	1550	1670
	1000	693	7600	6.00	54	1030	1590	1770
	1250	855	9500	6.00	55	1090	1630	1780
	1600	1080	12000	6.00	57	1090	1690	1840
	2000	1305	15000	6.00	59	1130	2030	1940
	2500	1575	18500	6.00	62	1170	2050	2040
	3150	1980	23000	6.00	63	1230	2170	2080

Dimensions and weights are approximate. May vary by order.

Rated voltage (kV)	Rated power (kVA)	No-load loss P0 (W)	Load loss Pk (W)	Short circuit impedance, Ucc (%)	Sound pressure level (db(A))	Width (mm)	Length (mm)	Height (mm)
36 kV	25	72	660	4.50	39	570	930	1150
	50	93	825	4.50	41	610	970	1250
	100	149	1375	4.50	43	710	1050	1440
	160	217	1750	4.50	46	770	1170	1490
	250	310	2350	4.50	49	810	1230	1630
	315	372	2800	4.50	51	830	1270	1670
	400	445	3250	4.50	52	830	1350	1720
	500	527	3900	4.50	53	850	1330	1790
	630	621	4600	4.50	54	870	1390	1860
	800	672	6000	6.00	55	1010	1470	1870
	1000	796	7600	6.00	57	1010	1530	1950
	1250	983	9500	6.00	58	1090	1550	1970
	1600	1242	12000	6.00	60	1110	1610	2040
	2000	1500	15000	6.00	62	1110	1890	2120
	2500	1811	18500	6.00	65	1190	2070	2230
	3150	2277	23000	6.00	66	1250	2170	2290

Dimensions and weights are approximate. May vary by order.

BS-EN 464-1:2007 E0Dk Loss + IEC Tolerance. AL - AL

Voltage (kV)	Power (kVA)	Idle loss (W)	Load loss (W)	Short circuit impedance (%)	Noise level (db)	Length A (mm)	Width B (mm)	Height C (mm)
7.2 - 12 kV	25	150	900	4.00	51	830	620	970
	40	180	1150	4.00	53	910	620	960
	50	190	1350	4.00	55	870	620	1100
	63	240	1650	4.00	57	790	620	1110
	100	320	2150	4.00	59	790	650	1220
	160	460	3100	4.00	62	890	750	1140
	250	650	4200	4.00	65	1190	810	1130
	400	930	6000	4.00	68	1330	930	1350
	630	1300	8400	4.00	70	1350	910	1490
	800	1400	10500	6.00	71	1550	1050	1500
	1000	1700	13000	6.00	73	1590	1070	1630
	1250	2100	16000	6.00	74	1610	1070	1700
	1600	2600	20000	6.00	76	1750	1170	1790
	2000	3250	23750	6.00	78	1850	1190	1900
	2500	3500	32000	6.00	81	1870	1170	2030
	3150	3600	34000	6.00	84	2250	1190	2120

Dimensions and weights are approximate. May vary by order.

Voltage (kV)	Power (kVA)	Idle loss (W)	Load loss (W)	Short circuit impedance (%)	Noise level (db)	Length A (mm)	Width B (mm)	Height C (mm)
17.5 - 24 kV	25	150	900	4.00	51	870	620	1080
	40	180	1150	4.00	53	930	620	1080
	50	190	1350	4.00	55	910	620	1210
	63	240	1650	4.00	57	810	620	1230
	100	320	2150	4.00	59	830	710	1280
	160	460	3100	4.00	62	930	770	1230
	250	650	4200	4.00	65	1110	810	1270
	400	930	6000	4.00	68	1310	910	1490
	630	1300	8400	4.00	70	1370	870	1600
	800	1400	10500	6.00	71	1550	1030	1600
	1000	1700	13000	6.00	73	1550	1050	1730
	1250	2100	16000	6.00	74	1590	1090	1800
	1600	2600	20000	6.00	76	1750	1150	1900
	2000	3250	23750	6.00	78	1870	1190	1990
	2500	3500	32000	6.00	81	1870	1190	2130
	3150	3600	34000	6.00	84	2270	1190	2220

Dimensions and weights are approximate. May vary by order.

BS-EN 464-1:2007 C0Ck Loss + IEC Tolerance. AL - AL

Voltage (kV)	Power (kVA)	Idle loss (W)	Load loss (W)	Short circuit impedance (%)	Noise level (db)	Length A (mm)	Width B (mm)	Height C (mm)
36 kV	25	165	990	4.50	48	970	620	1220
	40	207	1265	4.50	50	990	630	1240
	50	230	1450	4.50	52	950	620	1330
	63	269	1684	4.50	54	850	620	1420
	100	380	2350	4.50	56	890	750	1420
	160	520	3350	4.50	59	990	810	1390
	250	780	4250	4.50	62	1130	850	1410
	400	1120	6200	4.50	65	1250	890	1630
	630	1450	8800	4.50	67	1250	910	1740
	800	1700	10500	6.00	68	1470	990	1760
	1000	2000	13000	6.00	68	1610	1070	1860
	1250	2400	16000	6.00	70	1590	1050	1930
	1600	2800	19200	6.00	71	1730	1130	2030
	2000	3400	24000	6.00	73	1890	1170	2120
	2500	4100	29400	6.00	76	1930	1230	2220
	3150	4500	32000	6.00	80	2250	1230	2390

Dimensions and weights are approximate. May vary by order.

Tests

Routine tests

- Measurement of winding resistance
- Measurement of voltage ratio and check of phase displacement
- Measurement of short-circuit impedance and load losses
- Measurement of no-load losses and current
- Dielectric routine test (IEC 60076-3)
- Insulation resistance

Type tests

- Temperature rise test
- Lightning impulse test
- Measuring noise levels

Special tests

- Determining capacity between windings and ground and capacity between windings
- Measuring zero component impedance in three-phase transformers
- Short circuit withstand test
- Measuring harmonics of no load current
- Measuring insulation resistance to earth of windings and/or measuring the loss factor (loss angle tangent)
- Tank pressure test

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