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Distribution Transformers

Powering Business Worldwide

Energizing a world that demands more.

We deliver:

- **Electrical solutions** that use less energy, improve power reliability and make the places we live and work safer and more comfortable
- **Hydraulic and electrical solutions** that enable machines to deliver more productivity without wasting power
- **Aerospace solutions** that make aircraft lighter, safer and less costly to operate, and help airports operate more efficiently
- **Vehicle drivetrain and powertrain solutions** that deliver more power to cars, trucks and buses, while reducing fuel consumption and emissions

Discover today's Eaton.

Powering business worldwide

As a global power management company, we help customers worldwide manage the power needed for buildings, aircraft, trucks, cars, machinery and businesses.

Eaton's innovative technologies help customers manage electrical, hydraulic and mechanical power more reliably, efficiently, safely and sustainably.

We provide integrated solutions that help make energy, in all its forms, more practical and accessible.

With 2018 sales $21.6 billion, Eaton has approximately 99.000 employees around the world and sells products in more than 175 countries.

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ULUSOY CAST RESIN DRY TYPE TRANSFORMER

ULUSOY CAST RESIN DRY TYPE TRANSFORMER

Eaton offers high quality and performance Cast Resin Dry Type Transformers for several applications. Transformers can be used at high altitude and marine environment under hard conditions through their accordance with special and international standards. It provides general security for environment with its non-flammable, self-extinguished, toxic gas-free structure and low noise level.

Ulusoy Cast Resin Dry Type Transformers are humidity proof and suitable for operating in humid and extremely polluted environments. They are ideal transformers to work at -40°C and more than %95 humidity level.

STANDARDS

Ulusoy Cast Resin Dry Type Transformers are manufactured in accordance with the national and international standards given below:

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

ADVANTAGES OF DRY TYPE TRANSFORMER

Health and Security

- Non-flammable, self-extinguished.
- Humidity resistance.
- No cause for environmental pollution.
- Insulation materials do not include halogen and nitrogen.

Useability and Cost

- Less need of maintenance. (once a year)
- No risk of leaking.
- Maintenance service on site.
- Installation possibility close to consumption points.
- Less transportation and installation cost.
- Self extinguishing property.

Life and Durability

- Transformer's nominal power can be increased up to %40 with ventilation.
- Long maintenance life because of low partial discharge.
- Resistance to high impulse voltage and short circuit withstand with its high insulation level.
- High performance under short time overload according to oil immersed type distribution transformers.
- High mechanical resistance against short circuit.

USE OF DRY TYPE TRANSFORMER

Ulusoy Dry Type Transformers have a wide range of usage. They can be used at distribution networks, co-generation systems, rectifier and traction applications.

- Indoor and outdoor transformer centers
- Industrial and Oil Refineries
- Oil Platforms
- Power Plants
- Schools
- Hospitals
- Airports
- Shopping Malls
- Wind Mill Turbines
- Solar Power Plants

PRODUCT TYPES

Standard and special transformers are manufactured according to the requirements of the market.

TRANSFORMER PRODUCTION

Rated Frequency	Hz	Specified according to requirement
Rated Power	kVA	up to 5000kVA
Rated Voltage		
MV Winding	kV	up to 36kV
LV Winding	V	Specified according to requirement
Environmental Class		E0 / E1 / E2 / E3
Climate Class		C1 / C2 / C3
Fire Class		F0 / F1

Climate Class

C1: Dry type transformers can not be energized under –50°C. They can be stored and transported in weather conditions up to -25°C.

C2: Dry type transformers can be energized, stored and transported under in weather conditions up to –25°C.

C3: Dry type transformers can be energized at a temperature of -25°C. They can be transported and stored at a temp. of -40°C.

Environmental Class

E0: No concentration on the transformer, ignorable pollution, installation in clean and dry place.

E1: Low concentration and less pollution

E2: Transformer is exposed to continuous concentration or high pollution or both at the same time.

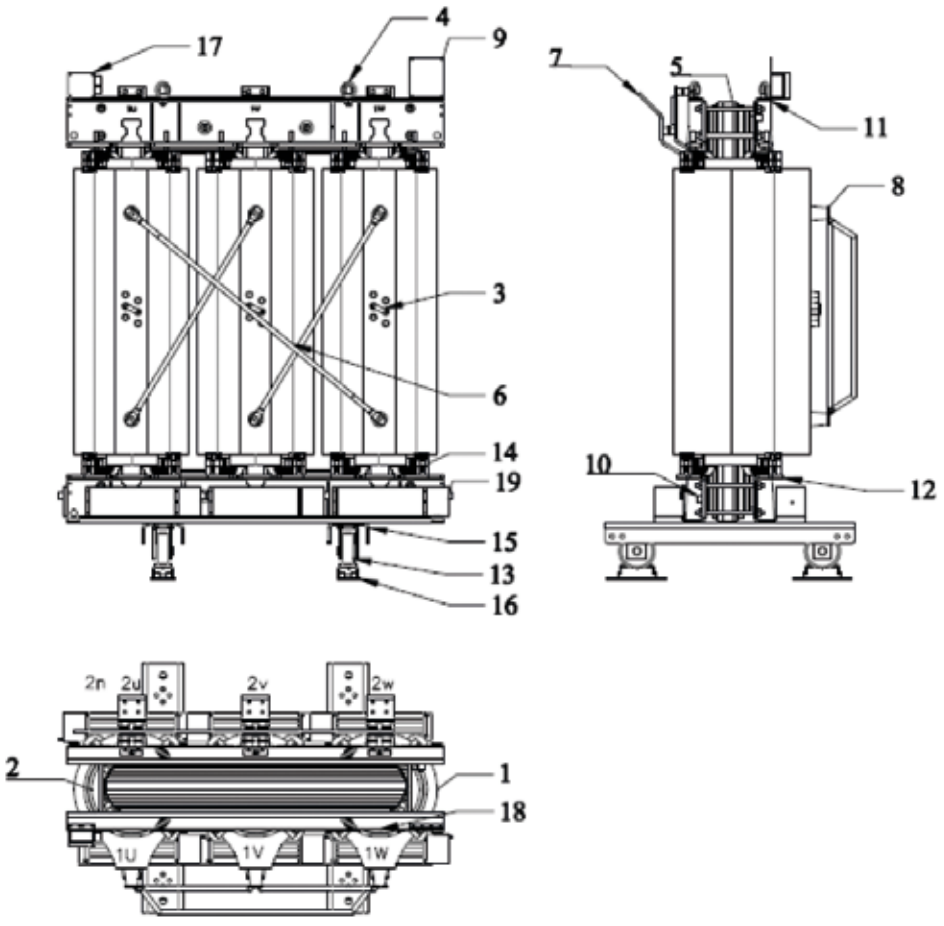
E3: Transformer is subject to continuous condensation and high pollution.

Fire Resistance Class

F0: No fire probability and no precautions for fire.

F1: Transformer is exposed to fire probability and reducing the flammability is mandatory. Fire on the transformer has to be extinguished in a specific period.

PARTS



1. HV Winding
2. LV Winding
3. Tap Changer Terminal
4. Lifting Lugs
5. Core
6. Delta Connection Rods
7. LV Terminal
8. HV Terminal
9. Sign Plate
10. Earthing Link
11. Top Yoke Clamp
12. Bottom Yoke Clamp
13. Wheels
14. Wedges
15. Base
16. Anti-vibration Pad
17. Terminal Box
18. PT100
19. Fan

ACCESSORIES

Standard Accessories

- Adjustable wheels in two directions
- Lifting Lugs
- Earthing Link
- Temperature Control Relay
- PT100 Thermal Sensor and Relay

Optional Accessories

- PTC Thermometer (can be used instead of PT100)
- Cooling Fans (can increase transformer power temporarily)
- Fan Control Relay (to keep the temperature at adjusted level)
- Socket Link for HV Connections
- Enclosures
- HV Search Arrestors
- Anti-Vibration Pads

USE OF DRY TYPE TRANSFORMERS UNDER HARD OPERATING CONDITIONS

1. Temperature Control System (Standard)

Temperature control system is used to measure and control the over temperature which is not allowed due to higher ambient temperature and overloading. The temperature sensors (PT 100 or PTC) are placed to hottest area in the LV winding. The sensors must be connected to temperature relay which is given with transformer. The relay has alarm, trip and fan on/off contacts. The temperature reachs the set values for all functions, it is possible to have alarm, trip and fan on/off signal from relay.

2. Ventilation System (Optional)

Ulusoy Cast Resin Dry Type Transformer's capacity can be increased 40% by adding fans which are selected with special design. The fans are switched on and off automatically via sensors in the LV winding.

3. Anti-Vibration Pads (Optional)

It is recommended to use anti-vibration pads to insulate the transformer body against noise transmission in building, shopping center etc. applications.

4. Enclosures (Optional)

Ulusoy Cast Resin Dry Type Transformers are manufactured IPOO (without enclosure) as standard. The enclosures against solid materials, water and dust are manufactured according to customer request as per IEC 60529. The standard type enclosures are:

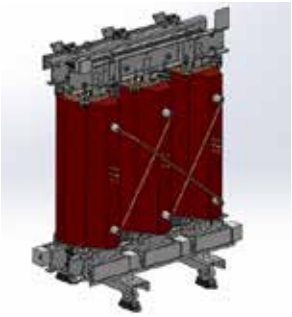
- IP 20 Indoor
- IP 23 Indoor and Outdoor
- IP 33 Indoor and Outdoor

The enclosures with higher protection degree are also available as per request.

DRY TYPE TRANSFORMER PRODUCTION TECHNOLOGY

High Voltage Winding

The HV windings are made of rectangular or round aluminum or copper wire with F (or optional H Class) insulation material. The selection of insulation and type of conductor are depended on the customer request. The HV windings are casted under vacuum to obtain voidless structure and cured slowly to have crackless coils. Due to Ulusoy Cast Resin Dry Type Transformers have very low partial discharge, they have very long life time.

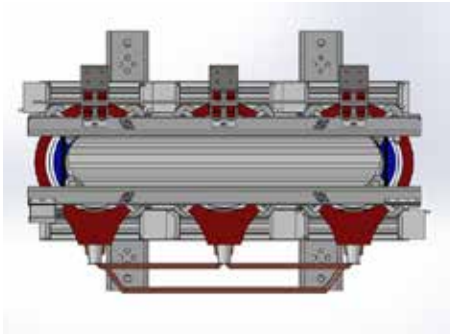


Low Voltage Winding

The foil winding technology is used for LV winding because of its technical advantages. LV winding is made of aluminum or copper foils according to customer request. This technique reduces axial forces under short circuit and F or H (depends on customers request) class prepreg insulation materials are used in order to control radial short circuit forces. The coils are cured after winding to have dielectric strength against industrial and atmospheres conditions.

Core

The core is made of highest quality, cold rolled, grain oriented silicon steel. The cores are stacked with step-lap technology and designed with low magnetic induction to obtain lower no-load losses, noise level and exciting current. The cores are protected against corrosion by resin coating and high temperature resistant painting.



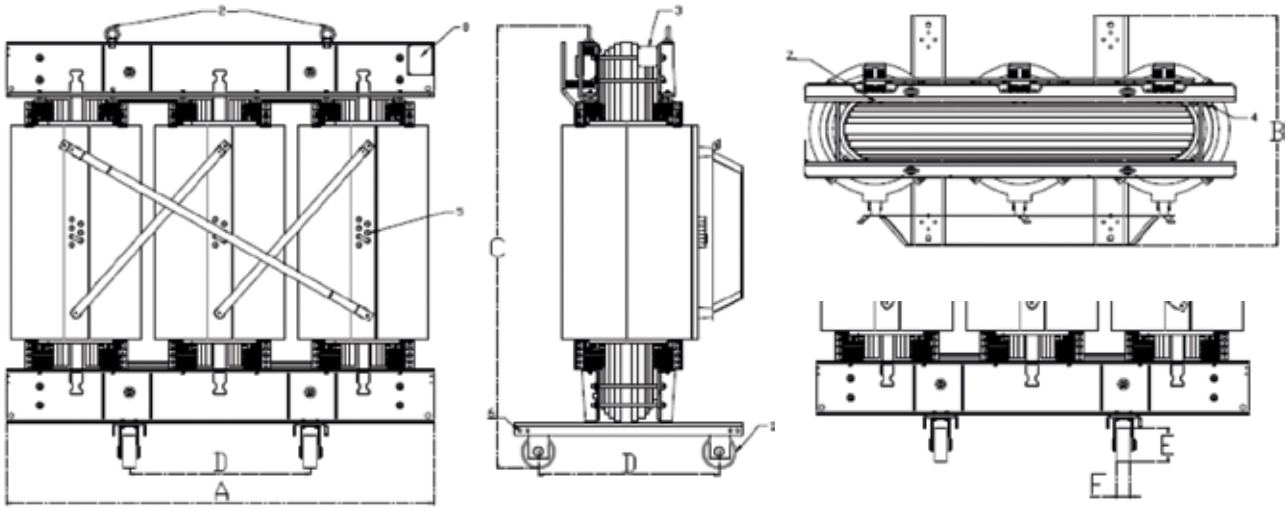
Installation

The frames are used for coil assembly in Cast Resin Dry Type Transformers. They hold the core and coils together. The coils are supported by wedges made of plastic with reinforced by glass fibre against short circuit and vibration. The wheels enable the transformer to be moved either length wise or side wise. All steel parts are coated with epoxy and painted against corrosion. The painting method is selected according to ambient condition of transformer.

Casting

High quality epoxy resin components are used for casting of HV windings under vacuum for dry type transformers. Quartz sand is suitable for filling material. The thermal classes of epoxy resin and insulation material used in windings are identified as F or H according to customer requirements.

TECHNICAL SPECIFICATIONS



Dry Type Transformers Manufactured According to Ecodesign EU directive No. 548/2014 (Tier 1) Terms

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	D (mm)	E (mm)	F (mm)	Total Weight (kg)
7,2 - 12	250	520	3800	6	59	1260	750	1260	520	125	40	1090
	400	750	5500	6	61	1370	950	1360	670	160	50	1370
	630	1100	7600	6	63	1440	950	1540	670	160	50	1790
	800	1300	8000	6	64	1530	1100	1620	670	160	50	2220
	1000	1550	9000	6	65	1610	1100	1640	820	160	50	2550
	1250	1800	11000	6	67	1650	1100	1740	820	160	50	2950
	1600	2200	13000	6	68	1760	1100	1850	820	160	50	3560
	2000	2600	16000	6	72	1820	1200	2190	1070	200	70	4360
	2500	3100	19000	6	73	1930	1200	2300	1070	200	70	5230
	3150	3800	22000	6	76	2030	1200	2280	1070	200	70	5770

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	D (mm)	E (mm)	F (mm)	Total Weight (kg)
17,5 - 24	250	520	3800	6	59	1460	750	1380	520	125	40	1470
	400	750	5500	6	61	1440	950	1640	670	160	50	1730
	630	1100	7600	6	63	1520	950	1640	670	160	50	2050
	800	1300	8000	6	64	1590	1100	1800	670	160	50	2620
	1000	1550	9000	6	65	1740	1100	1770	820	160	50	2980
	1250	1800	11000	6	67	1770	1100	1860	820	160	50	3440
	1600	2200	13000	6	68	1800	1100	2070	820	160	50	3950
	2000	2600	16000	6	72	1860	1200	2200	1070	200	70	4520
	2500	3100	19000	6	73	2020	1200	2220	1070	200	70	5310
	3150	3800	22000	6	76	2100	1200	2320	1070	200	70	6100

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	D (mm)	E (mm)	F (mm)	Total Weight (kg)
36	250	598	4180	6	59	1550	750	1800	520	125	40	1960
	400	825	6050	6	61	1610	950	1840	670	160	50	2280
	630	1265	8360	6	63	1640	950	1970	670	160	50	2550
	800	1495	8800	6	64	1720	1100	2010	670	160	50	3070
	1000	1782	9900	6	65	1770	1100	2060	820	160	50	3440
	1250	2070	12100	6	67	1850	1100	2120	820	160	50	3940
	1600	2530	14300	6	68	1900	1100	2270	820	160	50	4500
	2000	2990	17600	6	72	2000	1200	2380	1070	200	70	5290
	2500	3565	20900	6	73	2090	1200	2520	1070	200	70	6230
	3150	4370	24200	6	76	2260	1200	2530	1070	200	70	7610

Dry Type Transformers Manufactured According to BS EN 50541-1:2011 Terms

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	D (mm)	E (mm)	F (mm)	Total Weight (kg)
7,2 - 12	250	820	3500	6	65	1280	750	1160	520	125	40	990
	400	1150	4900	6	68	1380	950	1310	670	160	50	1330
	630	1500	7300	6	70	1440	950	1450	670	160	50	1720
	800	1800	9000	6	71	1530	1100	1550	670	160	50	2120
	1000	2100	10000	6	73	1600	1100	1620	820	160	50	2470
	1250	2500	12000	6	75	1650	1100	1700	820	160	50	2770
	1600	2800	14500	6	76	1760	1100	1790	820	160	50	3380
	2000	3600	18000	6	78	1810	1200	2060	1070	200	70	4010
	2500	4300	21000	6	81	1870	1200	2230	1070	200	70	4690
	3150	5300	26000	6	83	2010	1200	2350	1070	200	70	5630

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	D (mm)	E (mm)	F (mm)	Total Weight (kg)
17,5 - 24	250	880	3800	6	65	1360	750	1280	520	125	40	1110
	400	1200	5500	6	68	1480	950	1380	670	160	50	1460
	630	1650	7600	6	70	1630	950	1470	670	160	50	1990
	800	2000	9400	6	72	1600	1100	1640	670	160	50	2240
	1000	2300	11000	6	73	1680	1100	1670	820	160	50	2590
	1250	2800	13000	6	75	1750	1100	1790	820	160	50	3110
	1600	3100	16000	6	76	1820	1100	1950	820	160	50	3620
	2000	4000	18000	6	78	1910	1200	2060	1070	200	70	4270
	2500	5000	23000	6	81	2040	1200	2110	1070	200	70	5090
	3150	6000	28000	6	83	2130	1200	2310	1070	200	70	6190

±10 tolerance on dimensions and weight.

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	D (mm)	E (mm)	F (mm)	Total Weight (kg)
36	250	1280	4000	6	67	1510	750	1470	520	125	40	1370
	400	1650	5700	6	69	1560	950	1660	670	160	50	1760
	630	2200	8000	6	71	1660	950	1790	670	160	50	2330
	800	2700	9600	6	72	1730	1100	1910	670	160	50	2730
	1000	3100	11500	6	73	1770	1100	2030	820	160	50	3120
	1250	3600	14000	6	75	1810	1100	2120	820	160	50	3620
	1600	4200	17000	6	76	1870	1100	2270	820	160	50	4280
	2000	5000	21000	6	78	1980	1200	2380	1070	200	70	5090
	2500	5800	25000	6	81	2080	1200	2470	1070	200	70	6010
	3150	6700	30000	6	83	2240	1200	2480	1070	200	70	7230

±10 tolerance on dimensions and weight.

TESTS

Tests in accordance with national and international standards can be performed with high quality and sensible test equipments in our laboratory. Routine, type and special tests given below are performed according to TS 267 EN 60076-1.

Accreditation works are going on to gain international validity.

Routine Tests

- Measurement of winding resistance
- Measurement of voltage ratio and verification of phase displacement
- Measurement of short circuit impedance and load losses
- Measurement of no load current and no load losses
- Dielectric routine test
  - Applied voltage test
  - Induced voltage test
- Measurement of partial discharge (routine test for dry type transformers)

Type Tests

- Temperature rise test
- Lightning impulse test
- Determination of sound levels
- Short-circuit withstand test (performed at international accredited laboratories KEMA, CESI, ICMET)

Special Tests

- Determination capacitances windings-to-earth and between windings
- Measurement of zero-sequence impedance on three phase transformers
- Measurement of the harmonic of the no load current
- Measurement of insulation resistance to earth of windings and/or measurement of dissipation factor of the insulation system capacitances.

ULUSOY OIL IMMERSED TYPE DISTRIBUTION TRANSFORMER

Eaton manufactures oil immersed type distribution transformers with a power range between 25kVA–10MVA 36kV maximum voltage, in accordance with international standards and customer requirements. Transformers are manufactured according to IEC 60076 standards and tests are performed in our laboratory.

Eaton designs and manufactures special transformers according to customer requirements with high technology machinery in global standards.

STANDARDS

Ulusoy Oil Immersed Type Distribution Transformer is manufactured in accordance with the national and international standards given below:

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

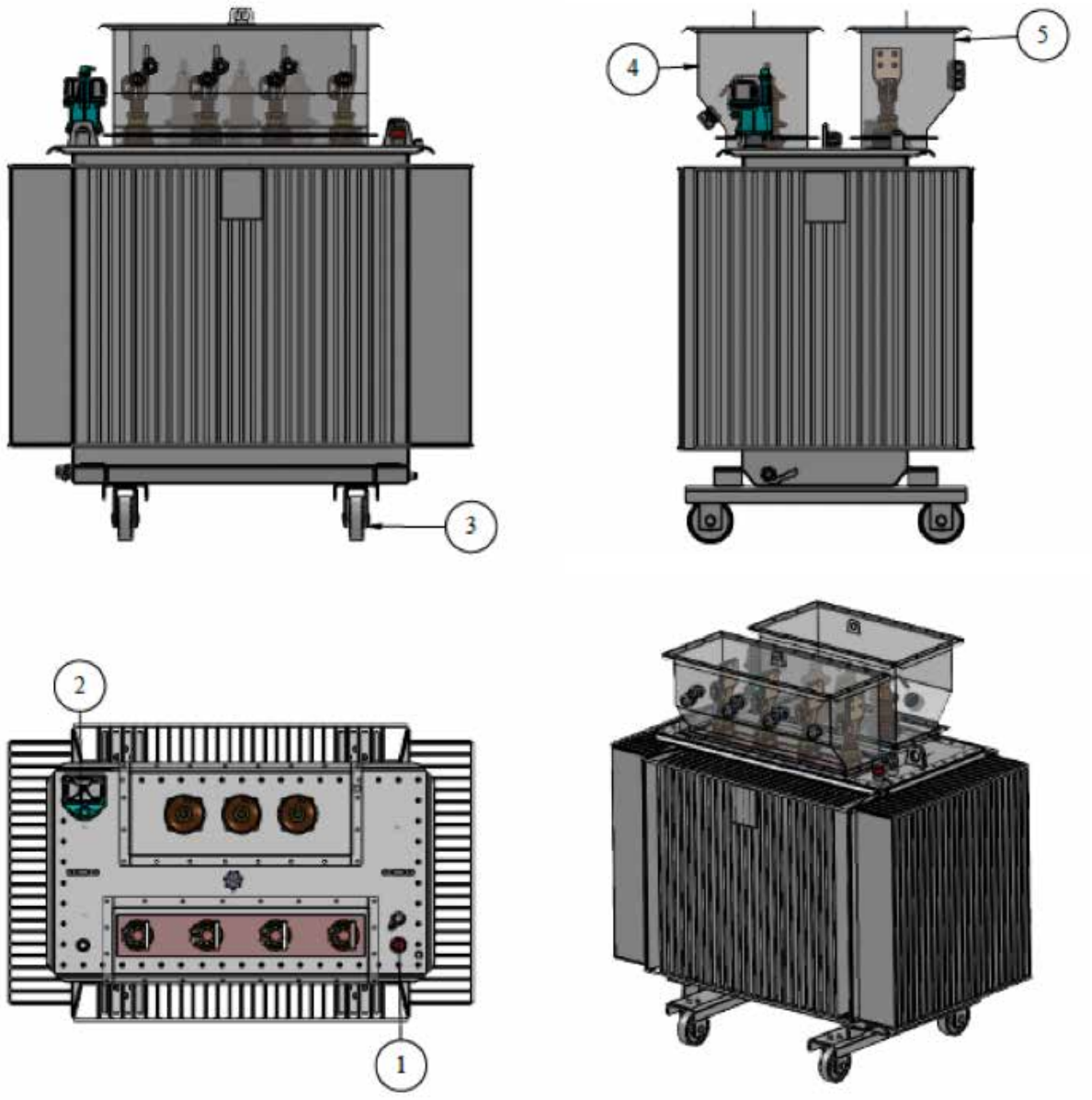
PRODUCT TYPES

- Distribution Transformer
- Solar Transformer
- Wind Turbine Transformer
- Earthing Transformer
- Dual Voltage Transformer
- Rectifier Transformer
- Start-up Transformer
- Auto Transformer
- Shunt Reactor
- Serial Reactors limiting the short circuit current
- Multi Winding Transformer

Rated Frequency	Hz	Specified according to requirement
Rated Power	kVA	up to 10.000kVA
Rated Voltage		
MV Winding	kV	up to 36kV
LV Winding	V	Specified according to requirement

PARTS

- **Hermetically Sealed Transformer**



1. Pressure Relief Valve

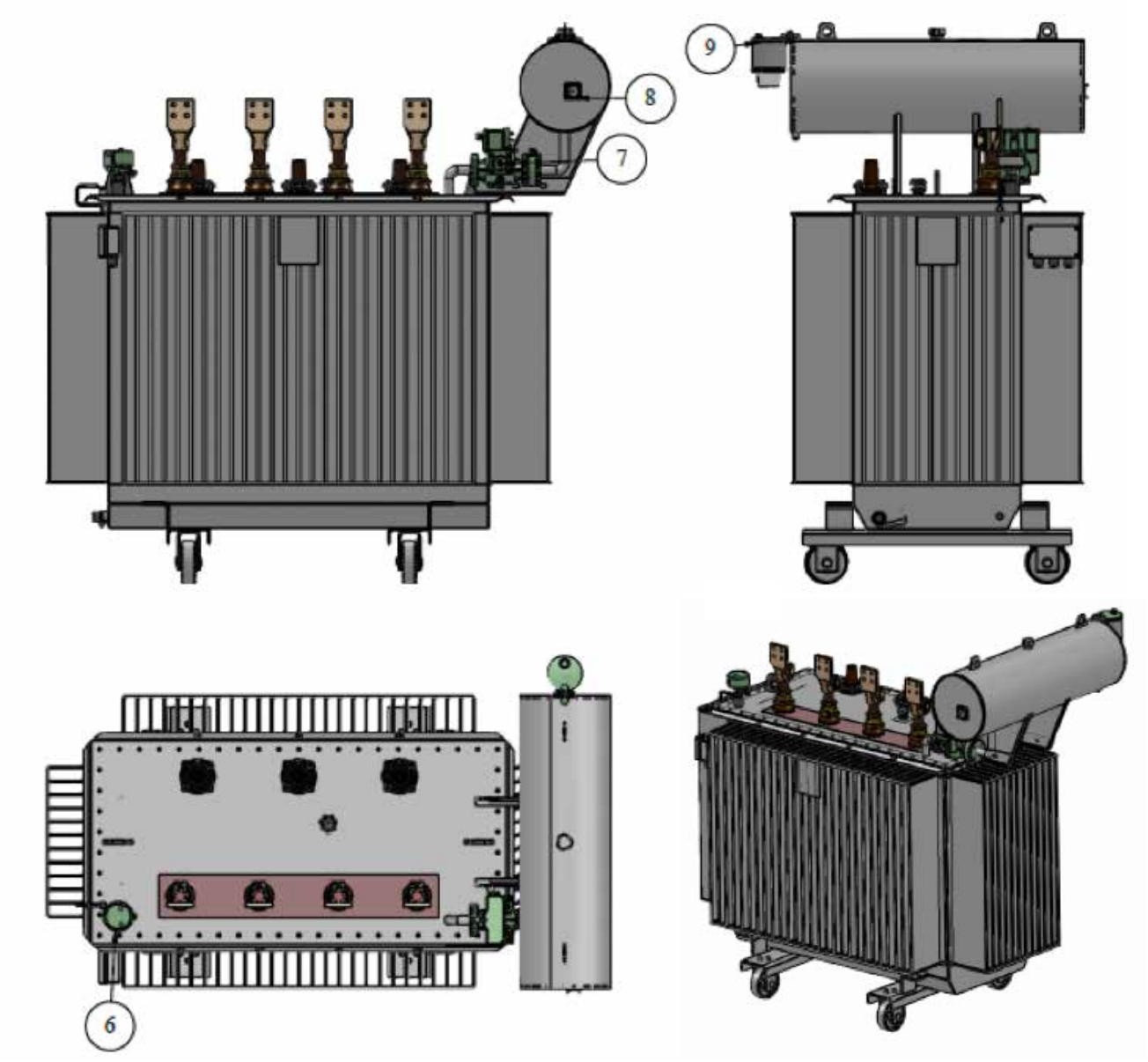
2. Hermetic Protection Relay

3. Wheels

4. HV Cable Box

5. LV Cable Box

• **Transformer with Conservator**



6. Oil Thermometer with Contact
7. Buchholz Relay
8. Magnetic Oil Level Indicator
9. Dehydrating Breather

ACCESSORIES

1. Pressure Relief Valve

It is preferred in hermetic design. It protects the transformer tank in case of sudden overpressure. It is mounted to the transformer cover and adjusted in such a way that it opens briefly in case of over pressure and compansates the pressure inside the tank. It is optional to use it with contact.

2. Hermetic Protection Relay

It is used in hermetic design. This relay monitors the discharge of gases, the temperature and the pressure in the tank. It is used for transformers bigger than 500 kVA power. It has 2 dry contacts for each of the discharge of gases, the tank pressure and the temperature. It gives alert according to the adjusted limits.

3. Wheel

The wheels are transported with the transformer. They are choosen according to the strength of it and sufficiency to carry the transformer.

4. HV Cable Box

It's a mechanical protection to protect HV bushing terminations against environmental impacts. It can be designed in several IP classes according to customer demands.

5. LV Cable Box

It's a mechanical protection to protect LV bushing terminations against environmental impacts. It can be designed in several IP classes according to customer demands.

6. Oil Thermometer with Contact

It has a maximum indicator in order to display maximum oil temperature, which can be reset by means of reset button located on the underside of the housing. It has smooth scale up to 120 oC, two micro switches rated at 5A, 250VAC or 0.2A, 250 VDC. Dial Type Thermometer can be used if the customer wants to see the oil rising temperature without contacts.

7. Buchholz Relay

It is fitted in the connection pipe between the transformer tank and conservator tank in order to monitor and protect transformers and other oil filled electrical equipment from faults arising internally. It gives alert in 3 conditions: faults that causes gas deposition, sudden oil surge and oil losses.

8. Magnetic Oil Level Indicator

It is used in order to display the level of the transformer oil in conservator tank. The transformation of the oil movement to display itself is effected by two permanent magnets which are matched to one another. If required, the level indicator with contacts can be used.

9. Dehydrating Breather

It is a uni-directional breather, where air circulation is controlled by the liquid seal located in the breather. The size of dehydrating breather is determined by the quantity of oil in the transformer.

OIL IMMERSED TYPE DISTRIBUTION TRANSFORMER PRODUCTION TECHNOLOGY

Windings

Windings are performed with high technology Tuboly-Switzerland full automatic machinery. For the low and high voltage coils, either copper or aluminum can be used as conductor material according to the standards or customer requirements. Winding are seperated as LV Windings and HV Windings.

Conductor types according to voltage level and load losses:
-On LV coil: Foil (sheet) or paper insulated rectangular sectioned
-On HV coil: Enamel insulated round or paper insulated rectangular sectioned conductors are used.

The windings are made of resin coated DDP (Diamond Dotted Presspaper) and special Kraft paper resistant to high shock and electrical withstand. 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 transformers are made of cold rolled grain oriented silicon steel (CRGO). The metal sheets used for production are choosen according to their no load loss value. Cores are cut fast and without burr by modern transformer lamination cut machine produced by Tuboly. The cores are aligned according to the project data with step-lap method to reduce losses and noise.

Active Part

Active part is formed by the placement of the coils to core legs and alignment of the upper core. Yoke clamps and wedges are placed to compress the coils. Cover, terminal and tap changer installations are done to make it ready for first pre-tests. The alignment of the insulations on the cover, accessories and other equipments are done according to the customer requirements.

Tank - Paint

Tanks are in 2 types: with radiator and corrugated walls. Tank base and top covers are made of mild steel. Corrugated walls of front and side surfaces of the tank also forms the cooling surfaces. Front and side surfaces are made of steel sheet in tank with radiator. Tanks are sealed with welding. Impermeality tests are also performed after the tank manufacturing process.

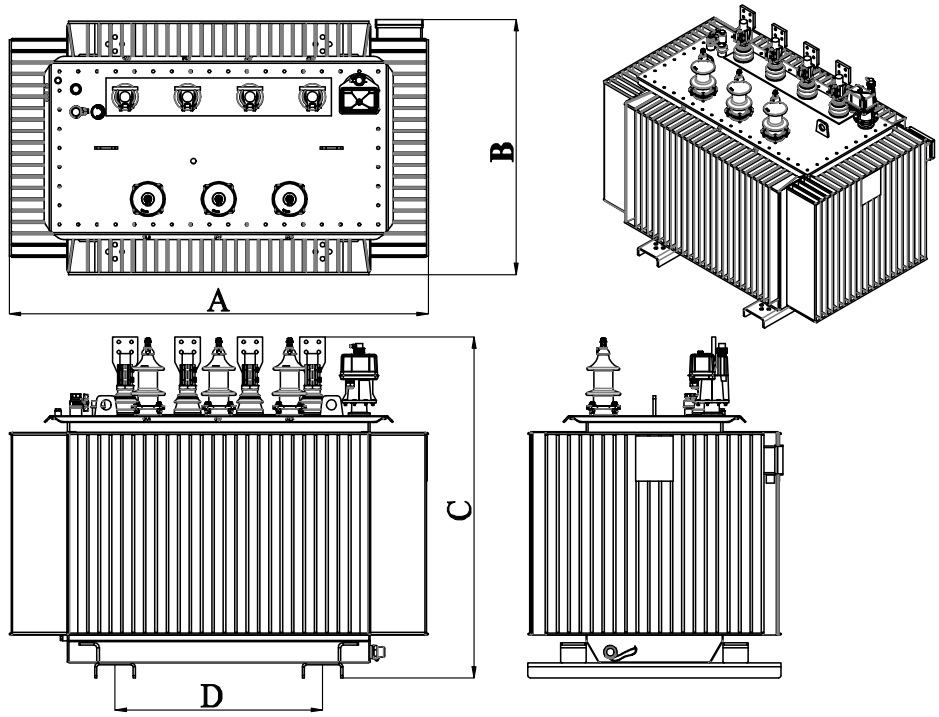
Tanks are cleaned with special chemicals and dryed before painting. RAL 7033 colour code is used as top coating paint (or with different colours as per customer requests). Inner surface of the tank is coated with special varnish. Corrosivity categories are shown in the table below. Different transformers can be produced in requested corrosion classes according to customer demands.

Corrosivity Category	Example of Typical Environments in a Temperate Climate (informative only)	
	Exterior	Interior
C1	-	Heated buildings with clean atmosphere, e.g offices shops, schools, hotels
C2	Atmosphere with low level of pollution. Mostly rural areas.	Unheated buildings where condensation may occur, e.g. depots, sport halls
C3	Urban and industrial atmospheres, moderate sulfur dioxide pollution, coastal areas with low salinity.	Production rooms with high humidity and some air pollution e.g. food-processing plants, laundries, breweries, dairies
C4	Industrial areas and coastal areas with moderate salinity.	Chemical plants, swimming pools, coastal ship and boatyards
C5-1	Industrial areas with high humidity and aggresive atmosphere.	Buildings or areas with almost permanent condensation and with high pollution
C5-M	Coastal and offshore areas with high salinity.	Buildings or areas with almost pemanent condensation and with high pollution

Drying and Filling

In oil immersed type distribution transformer, the insulation materials have to be dryed before oil filling. This drying process affects the quality of the transformer directly. Drying and filling process max. 0,1mbar vacuum with LFH (Low Frequency Heating) and vacuum drying technology / or / drying with classical hot air. Humidity is reduced to minimum in the oil part and in the active part of the tank by this process.

TECHNICAL SPECIFICATIONS



Ecodesign EU directive No. 548/2014 (Tier 1) AL-AL.

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	Distance between wheels D (mm)	Oil weight (kg)	Active part (kg)	Total Weight (kg)
7,2 - 12	25	70	900	4	37	830	610	1050	520	90	190	330
	50	90	1100	4	39	830	620	1090	520	110	280	440
	100	145	1750	4	41	910	650	1240	520	150	420	640
	160	210	2350	4	44	990	690	1240	520	180	530	790
	250	300	3250	4	47	1110	850	1240	520	240	740	1120
	315	360	3900	4	49	1130	870	1300	670	260	840	1260
	400	430	4600	4	50	1170	830	1490	670	290	950	1420
	500	510	5500	4	51	1210	870	1520	670	320	1070	1620
	630	600	6500	4	52	1270	890	1560	670	360	1260	1880
	800	650	8400	6	53	1390	930	1570	820	430	1410	2160
	1000	770	10500	6	55	1470	950	1680	820	520	1660	2550
	1250	950	1100	6	56	1570	970	1810	820	610	2150	3200
	1600	1200	14000	6	58	1590	990	1970	820	680	2310	3500
	2000	1450	18000	6	60	1650	1070	2010	1000	840	2660	4260
	2500	1750	22000	6	63	1930	1090	2090	1000	1040	3120	5120
	3150	2200	27500	6	64	2150	1070	2210	1070	1350	4100	6540

±10 tolerance on dimensions and weight.

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length *A* (mm)	Width B (mm)	Height C (mm)	Distance between wheels D (mm)	Oil weight (kg)	Active part (kg)	Total Weight (kg)
17,5 - 24	25	70	900	4	37	870	610	1140	520	100	200	350
	50	90	1100	4	39	850	620	1220	520	120	300	470
	100	145	1750	4	41	930	670	1290	520	160	440	660
	160	210	2350	4	44	1050	690	1290	520	200	600	890
	250	300	3250	4	47	1150	850	1350	520	250	770	1170
	315	360	3900	4	49	1170	830	1390	670	280	850	1280
	400	430	4600	4	50	1210	830	1590	670	310	980	1480
	500	510	5500	4	51	1230	890	1620	670	340	1150	1730
	630	600	6500	4	52	1290	910	1690	670	390	1350	1990
	800	650	8400	6	53	1410	950	1700	820	460	1500	2290
	1000	770	10500	6	55	1510	950	1780	820	530	1720	2640
	1250	950	1100	6	56	1610	990	1870	820	670	2200	3310
	1600	1200	14000	6	58	1730	1030	1940	820	720	2330	3580
	2000	1450	18000	6	60	1850	1090	2110	1000	900	2740	4450
	2500	1750	22000	6	63	1950	1110	2200	1000	1070	3180	5230
	3150	2200	27500	6	64	2150	1070	2320	1070	1370	4140	6610

±10 tolerance on dimensions and weight.

Ecodesign EU directive No. 548/2014 (Tier 1) AL-AL.

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	Distance between wheels D (mm)	Oil weight (kg)	Active part (kg)	Total Weight (kg)
36	25	80	990	4,5	46	910	610	1320	520	140	220	410
	50	103	1210	4,5	50	890	630	1360	520	150	290	490
	100	166	1925	4,5	54	950	670	1410	520	190	390	650
	160	241	2585	4,5	57	1050	730	1400	520	230	530	850
	250	345	3575	4,5	60	1130	870	1460	520	290	680	1110
	315	414	4290	4,5	61	1170	830	1530	670	320	790	1280
	400	494	5060	4,5	63	1230	890	1730	670	370	910	1470
	500	586	6050	4,5	64	1230	930	1740	670	390	1040	1670
	630	690	7150	4,5	65	1230	970	1820	670	430	1170	1890
	800	747	9240	6	66	1410	970	1830	820	510	1350	2210
	1000	885	11550	6	67	1550	970	1900	820	580	1570	2570
	1250	1092	12100	6	68	1630	1010	1940	820	680	1900	3040
	1600	1380	15400	6	69	1810	1130	2060	820	790	2180	3580
	2000	1667	19800	6	71	1810	1110	2150	1000	950	2390	4200
	2500	2012	24200	6	73	1950	1150	2290	1000	1130	2890	5090
	3150	2530	30250	6	75	2230	1170	2400	1070	1480	3800	6550

±10 tolerance on dimensions and weight.

BS-EN 464-1:2007 E0Dk Losses with IEC tolerances. AL-AL

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	Distance between wheels D (mm)	Oil weight (kg)	Active part (kg)	Total Weight (kg)
7,2 - 12	25	150	900	4	51	830	620	970	520	80	160	290
	40	180	1150	4	53	910	620	960	520	100	190	340
	50	190	1350	4	55	870	620	1100	520	110	210	380
	63	240	1650	4	57	790	620	1110	520	100	220	380
	100	320	2150	4	59	790	650	1220	520	120	270	480
	160	460	3100	4	62	890	750	1140	520	150	360	630
	250	650	4200	4	65	1190	810	1130	520	200	500	860
	400	930	6000	4	68	1330	930	1350	670	260	670	1190
	630	1300	8400	4	70	1350	910	1490	670	350	930	1630
	800	1400	10500	6	71	1550	1050	1500	820	420	1000	1900
	1000	1700	13000	6	73	1590	1070	1630	820	500	1210	2270
	1250	2100	16000	6	74	1610	1070	1700	820	550	1370	2550
	1600	2600	20000	6	76	1750	1170	1790	820	770	1630	3400
	2000	3250	23750	6	78	1850	1190	1900	1000	870	1990	3970
	2500	3500	32000	6	81	1870	1170	2030	1000	1000	2320	4450
	3150	3600	34000	6	84	2250	1190	2120	1070	1310	3170	5860

±10 tolerance on dimensions and weight.

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	Distance between wheels D (mm)	Oil weight (kg)	Active part (kg)	Total Weight (kg)
17,5 - 24	25	150	900	4	51	870	620	1080	520	90	170	310
	40	180	1150	4	53	930	620	1080	520	110	200	360
	50	190	1350	4	55	910	620	1210	520	120	220	410
	63	240	1650	4	57	810	620	1230	520	110	230	400
	100	320	2150	4	59	830	710	1280	520	130	290	510
	160	460	3100	4	62	930	770	1230	520	170	390	670
	250	650	4200	4	65	1110	810	1270	520	210	520	900
	400	930	6000	4	68	1310	910	1490	670	270	680	1210
	630	1300	8400	4	70	1370	870	1600	670	360	940	1630
	800	1400	10500	6	71	1550	1030	1600	820	440	1030	1920
	1000	1700	13000	6	73	1550	1050	1730	820	520	1230	2270
	1250	2100	16000	6	74	1590	1090	1800	820	570	1410	2580
	1600	2600	20000	6	76	1750	1150	1900	820	780	1670	3380
	2000	3250	23750	6	78	1870	1190	1990	1000	880	2010	3960
	2500	3500	32000	6	81	1870	1190	2130	1000	1010	2340	4480
	3150	3600	34000	6	84	2270	1190	2220	1070	1350	3220	5960

±10 tolerance on dimensions and weight.

BS-EN 464-1:2007 COCk Losses with IEC tolerances. AL-AL

Voltage (kV)	Power (kVA)	No Load Losses (W)	Load Losses 120 (W)	Short Circuit Impedance (%)	Sound Level (dB)	Length A (mm)	Width B (mm)	Height C (mm)	Distance between wheels D (mm)	Oil weight (kg)	Active part (kg)	Total Weight (kg)
36	25	165	990	4,5	48	970	620	1220	520	140	200	390
	40	207	1265	4,5	50	990	630	1240	520	150	220	430
	50	230	1450	4,5	52	950	620	1330	520	160	240	460
	63	269	1684	4,5	54	850	620	1420	520	150	250	460
	100	380	2350	4,5	56	890	750	1420	520	180	310	580
	160	520	3350	4,5	59	990	810	1390	520	210	410	740
	250	780	4250	4,5	62	1130	850	1410	520	270	550	990
	400	1120	6200	4,5	65	1250	890	1630	670	330	720	1290
	630	1450	8800	4,5	67	1250	910	1740	670	410	1000	1710
	800	1700	10500	6	68	1470	990	1760	820	490	1110	2030
	1000	2000	13000	6	68	1610	1070	1860	820	590	1330	2450
	1250	2400	16000	6	70	1590	1050	1930	820	640	1530	2720
	1600	2800	19200	6	71	1730	1130	2030	820	830	1780	3490
	2000	3400	24000	6	73	1890	1170	2120	1000	970	2190	4170
	2500	4100	29400	6	76	1930	1230	2220	1000	1140	2410	4720
	3150	4500	32000	6	80	2250	1230	2390	1070	1480	3330	6240

±10 tolerance on dimensions and weight.

TESTS

Routine Tests

- Measurement of winding resistance
- Measurement of voltage ratio and verification of phase displacement
- Measurement of short circuit impedance and load losses
- Measurement of no load current and no load losses
- Dielectric routine test
- Test of on-load tap changers
- Insulation resistance

Type Tests

- Temperature rise test
- Lightning impulse test
- Measurement of sound level

Special Tests

- Determination capacitances windings-to-earth and between windings
- Measurement of zero-sequence impedance on three phase transformers
- Short-circuit withstand test (performed at KEMA)
- Measurement of noise level
- Measurement of the harmonic of the no load current
- Measurement of insulation resistance to earth of windings and/or measurement of dissipation factor of the insulation system capacitances

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