

Distribution Transformers

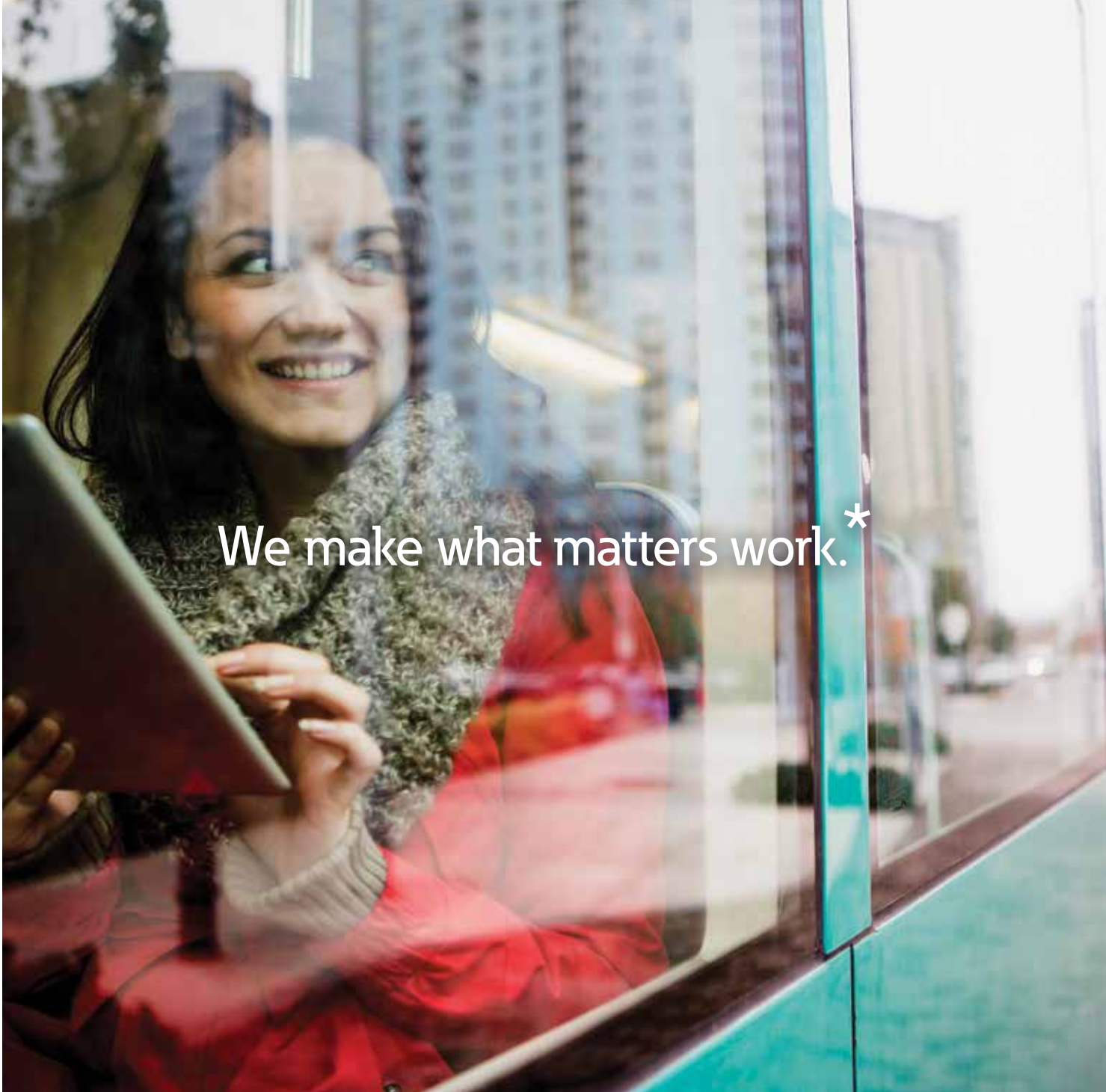


Ulusoy

Dry type transformer

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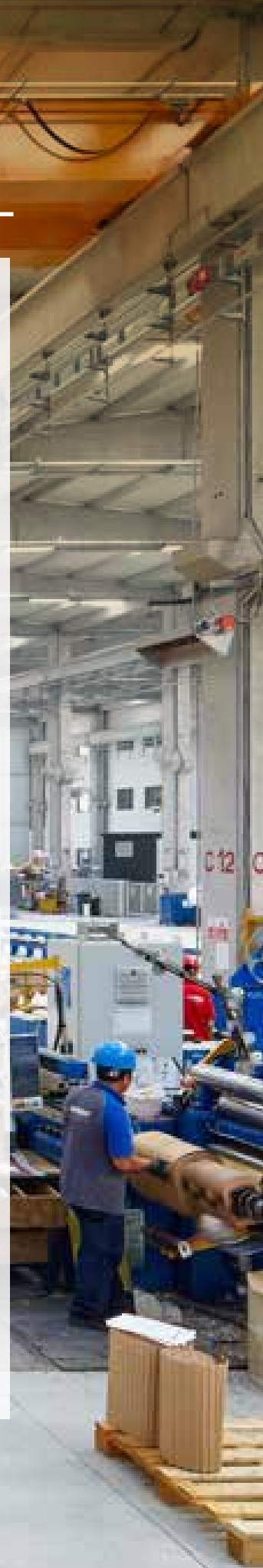
Introduction

Eaton manufactures dry type distribution transformers in accordance with various global and industrial standards and customer requirements with a power range from 250 kVA to 5000 kVA and a maximum voltage level of 36 kV. Requests between 3150 kVA and 5000 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.

Transformers are manufactured with high-quality, high-performance for various applications. They can also be used under harsh operating conditions. It provides general environmental safety with non-flammable, self-extinguishing material, non-toxic gas emissions, low noise levels and low electromagnetic emissions.

Dry type distribution transformers are moisture-proof, making them suitable for operation in humid environments or where pollution is high. These transformers work in environments with over 95% humidity as well as at temperatures down to -25°C .





Standards

Dry type transformers are manufactured according to the following national and international standards:

IEC

IEEE

CENELEC EN

TS EN

DIN EN 50588-1

Advantages

Health and safety

- Non-flammable and self-extinguishing
- Resistant to moisture
- Does not cause environmental pollution
- Environmentally friendly insulation materials without halogen or nitrogen

Functionality and cost

- Requires minimal maintenance
- No risk of environmental pollution
- Easier on-site maintenance and repair service
- Can be installed very close to highly populated areas
- Low operating and installation costs
- Special safety measures not required thanks to self-extinguishing materials

Life and durability

- Forced cooling can increase the nominal power of the transformer by 50%
- Longer service life due to low partial discharge
- High dielectric insulation level available to withstand transients and overvoltage
- Performs better than liquid immersed transformers in short-term overloads
- High mechanical resistance against short circuit

Areas of use

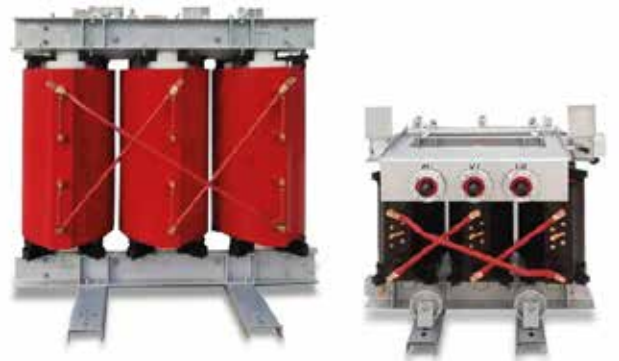
Dry type transformers can be used in a wide range of settings. They can be used in distribution systems, cogeneration systems, rectifier applications.

- Internal and external transformer centers
- Industry and oil refineries
- Subways
- Oil platforms
- Energy production facilities
- Schools
- Hospitals
- Airports
- Shopping centers
- Solar power plants
- Wind turbines
- Data centers

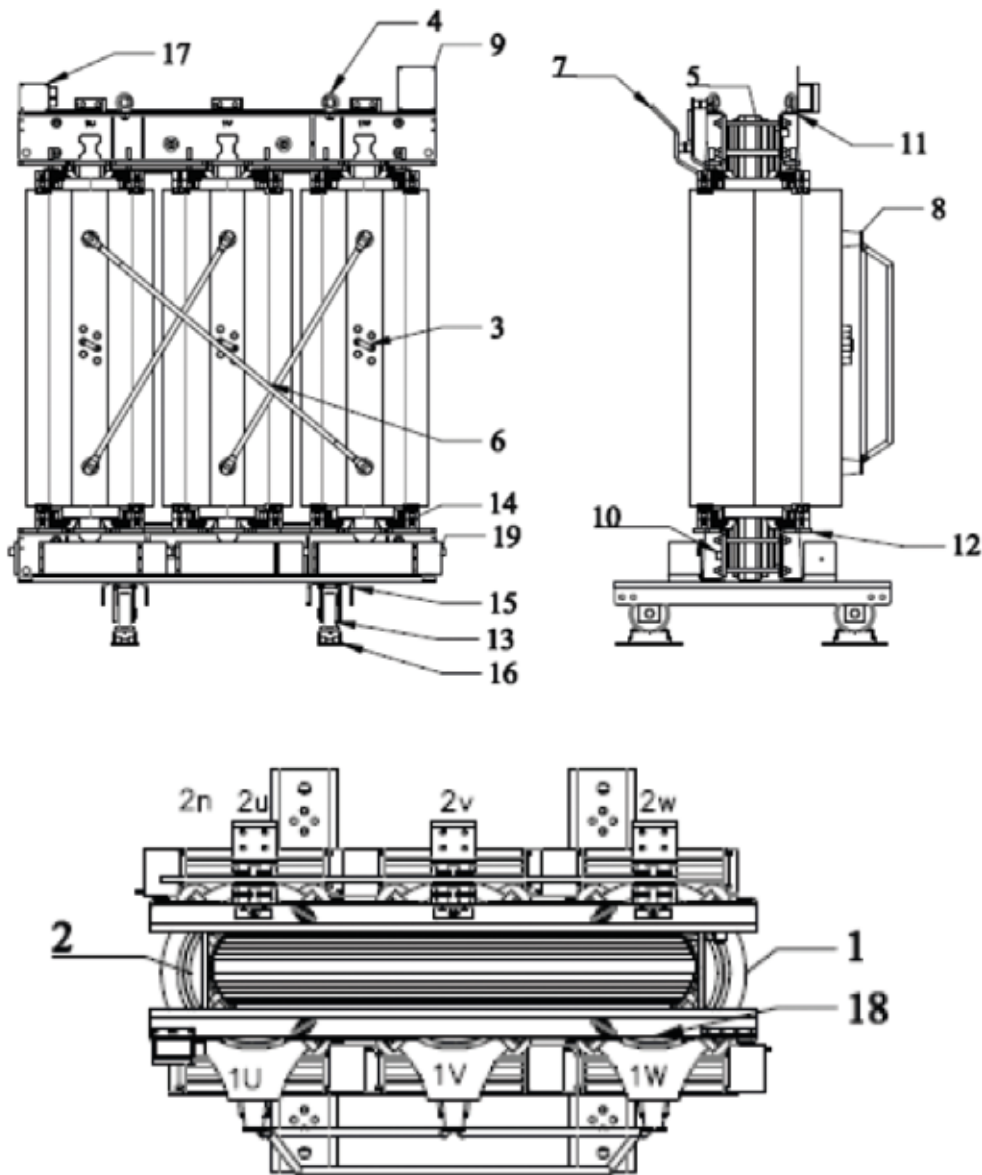
Portfolio

Eaton manufactures standard and customized transformers as required by the market.

Rated frequency	Hz	As per request. (50 Hz–60 Hz...)
Rated powers	kVA	250 kVA to 3150 kVA (Transformer requests between 3150 kVA and 5000 kVA are evaluated on a project basis.)
Max system voltage	kV	Up to 36 kV
Environmental class		E2 - Frequent condensation or light pollution or combination of both
Climatic class		C2 - The transformer is suitable for operation, transport and storage at ambient temperature
Fire behavior class		F1 - Transformer is at potential risk of fire and flammability must be reduced. Fire on the transformer should go out within a specified time frame.



Parts



- | | |
|-----|----------------------------|
| 1. | High voltage winding |
| 2. | Low voltage winding |
| 3. | Tap changing terminal |
| 4. | Lifting rings |
| 5. | Core |
| 6. | Delta connection conductor |
| 7. | LV terminal |
| 8. | HV terminal |
| 9. | Warning plate |
| 10. | Earthing terminal |
| 11. | Upper clamps |
| 12. | Lower clamps |
| 13. | Wheel |
| 14. | Clamping wedges |
| 15. | U-beams |
| 16. | Anti-vibration pad |
| 17. | Terminal box |
| 18. | PT100 |
| 19. | Fan |

Accessories

Standard accessories

- Two-way adjustable wheels
- Lifting rings
- Terminal for earthing connection
- Temperature control relay
- PT100 thermal sensor and relay

Optional accessories

- PTC thermistor (can be used instead of PT100)
- Cooling fans (can increase transformer power)
- Fan control relay (trip to keep temperature at the set level)
- Socket connection for high voltage connections
- High voltage surge arresters
- Anti-vibration pads
- Enclosure

Wheels

Wheels in various diameters, selected to bear the transformer weight, are shipped with the transformer as per customer request.



Anti-vibration pads

Placed on the base of the transformer wheels. These prevent vibration while the transformer is in operation. Anti-vibration pads reduce and isolate vibrations occurring in the transformer in applications relating to buildings, shopping malls - and have advantages in commercial use.



PT100 sensors

One is used in each phase for temperature control inside transformer LV windings. Can be used in the core upon customer request.



Cooling fans

Six cooling fans are placed under the coils to keep the coils cool and temporarily increase the transformer's power by 50%.



Temperature control relay

The temperature control system is designed to measure and control overheating, resulting from high ambient temperatures or transformer winding overload. For this purpose, PT100 or PTC temperature sensors are installed in low voltage windings with the highest temperature. In this system, alarm and trip signals are received according to the temperatures. The device connected to these sensors will sound an alarm and activate the breaker. In addition, if the transformer has a fan cooling system, this device also enables the fans to be turned on and off automatically.



Enclosure

Dry type transformers are manufactured as standard without a protective enclosure (IP00). As per customer request and depending where the transformer will be placed, to protect against solid objects, water and dust, enclosures are used according to IEC 60529. Transformer protective enclosures in superior protection classes can also be custom designed (air-conditioned and heated).



Dry type transformer manufacturing technology

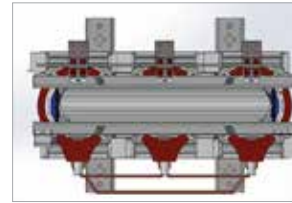
Primary winding

High voltage coils are manufactured using copper and aluminum flat, round or foil conductors covered with F class (H class optional) glass fiber, as per customer request. In order to produce a homogeneous structure, high voltage windings are casted under vacuum using resin. They are hardened in special drying ovens to high production standards to prevent cracking. As a result, dry type transformers have a long operational life with a very low partial discharge value.



Assembly

The clamping structure is used at the top and bottom to compress the coils. These hold the cores and coils together. Coils are mounted with glass fiber reinforced supports to protect against short circuit forces and vibration. The wheels are designed to allow the transformer to move all round. All steel parts used in transformer assembly are painted to prevent corrosion. The painting method is selected in accordance with the atmospheric conditions under which the transformer will operate.



Secondary winding

Copper or aluminum foils are used in the windings, as per customer request. Axial short circuit forces are reduced with the foil winding technology. The foil conductor and F class (H class optional) insulation material are wound together by heating and formed a rigid unit to withstand radial short circuit forces.



Casting

High quality epoxy resin components are used under the vacuum casting of HV coils in dry type transformers. Quartz sand is used as filling material. F or H thermal class epoxy resin and insulation materials are used in coils as per customer request.



Core

The core is built with laminations of high-grade cold rolled grain oriented magnetic steel. The special cutting and stacking methods result in low no-load losses and noise level. The core is painted to provide resistance against high temperature and rust.



Technical information

Dry type transformers produced according to Ecodesign EU No. 548/2014 (Tier 2)

Rated Voltage (kV)	Rated power (kVA)	No-load Loss, P ₀ (W)	Load Loss P _k (W)	Short circuit impedance, U _k %	Noise level (dB)	Width (mm)	Length (mm)	Height (mm)
Up to and including 24 kV	250	468	3400	6%	56	750	1350	1310
	315	557	3876	6%	57	750	1440	1370
	400	675	4500	6%	59	950	1470	1450
	500	811	5630	6%	59	950	1510	1530
	630	990	7100	6%	61	950	1510	1550
	800	1170	8000	6%	63	950	1580	1650
	1000	1395	9000	6%	64	1100	1660	1690
	1250	1620	11000	6%	66	1100	1710	1780
	1600	1980	13000	6%	68	1100	1790	2000
	2000	2340	16000	6%	69	1350	1910	2140
	2500	2790	19000	6%	70	1350	2030	2240
	3150	3420	22000	6%	73	1350	2160	2380

Rated Voltage (kV)	Rated power (kVA)	No-load Loss, P ₀ (W)	Load Loss P _k (W)	Short circuit impedance, U _k %	Noise level (dB)	Width (mm)	Length (mm)	Height (mm)
36 kV	250	538	3740	6%	56	750	1640	1790
	315	641	4264	6%	57	750	1640	1900
	400	776	4950	6%	59	950	1690	1980
	500	933	6193	6%	59	950	1700	2010
	630	1138	7810	6%	61	950	1700	2040
	800	1345	8800	6%	63	950	1780	2070
	1000	1604	9900	6%	64	1100	1850	2150
	1250	1863	12100	6%	66	1100	1960	2240
	1600	2277	14300	6%	68	1100	2030	2270
	2000	2691	17600	6%	69	1350	2080	2470
	2500	3208	20900	6%	70	1350	2140	2610
	3150	3933	24200	6%	73	1350	2350	2610

Rated Voltage (kV)	Rated power (kVA)	No-load Loss, P ₀ (W)	Load Loss P _k (W)	Short circuit impedance, U _k %	Noise level [dB (A)]	Width (mm)	Length (mm)	Height (mm)	Total Weight [kg]
Up to and including 12 kV	250	468	3400	6.00	56	750	1350	1310	1260
	315	557	3876	6.00	57	750	1440	1370	1520
	400	675	4500	6.00	59	950	1470	1450	1730
	500	811	5630	6.00	59	950	1510	1530	1890
	630	990	7100	6.00	61	950	1510	1550	1980
	800	1170	8000	6.00	63	950	1580	1650	2370
	1000	1395	9000	6.00	64	1100	1660	1690	2780
	1250	1620	11000	6.00	66	1100	1710	1780	3190
	1600	1980	13000	6.00	68	1100	1790	2000	3950
	2000	2340	16000	6.00	69	1350	1910	2140	4620
	2500	2790	19000	6.00	70	1350	2030	2240	5620
	3150	3420	22000	6.00	73	1350	2160	2380	6740

* Weight and dimensions are approximate.

Rated Voltage (kV)	Rated power (kVA)	No-load Loss, PO (W)	Load Loss Pk (W)	Short circuit impedance, Uk %	Noise level [dB (A)]	Width (mm)	Length (mm)	Height (mm)	Total Weight [kg]
Up to and including 24 kV	250	468	3400	6.00	56	750	1540	1520	1860
	315	557	3876	6.00	57	750	1590	1590	2060
	400	675	4500	6.00	59	950	1590	1630	2160
	500	811	5630	6.00	59	950	1610	1650	2280
	630	990	7100	6.00	61	950	1590	1710	2340
	800	1170	8000	6.00	63	950	1660	1810	2810
	1000	1395	9000	6.00	64	1100	1770	1890	3290
	1250	1620	11000	6.00	66	1100	1820	1970	3710
	1600	1980	13000	6.00	68	1100	1860	2160	4300
	2000	2340	16000	6.00	69	1350	1940	2260	4890
	2500	2790	19000	6.00	70	1350	2120	2380	6230
	3150	3420	22000	6.00	73	1350	2220	2520	7310

Rated Voltage (kV)	Rated power (kVA)	No-load Loss, PO (W)	Load Loss Pk (W)	Short circuit impedance, Uk %	Noise level [dB (A)]	Width (mm)	Length (mm)	Height (mm)	Total Weight [kg]
Up to and including 36 kV	250	538	3740	6.00	56	750	1640	1790	2290
	315	641	4264	6.00	57	750	1640	1900	2380
	400	776	4950	6.00	59	950	1690	1980	2740
	500	933	6193	6.00	59	950	1700	2010	2900
	630	1138	7810	6.00	61	950	1700	2040	2980
	800	1345	8800	6.00	63	950	1780	2070	3420
	1000	1604	9900	6.00	64	1100	1850	2150	3920
	1250	1863	12100	6.00	66	1100	1960	2240	4600
	1600	2277	14300	6.00	68	1100	2030	2270	5160
	2000	2691	17600	6.00	69	1350	2080	2470	5830
	2500	3208	20900	6.00	70	1350	2140	2610	6640
	3150	3933	24200	6.00	73	1350	2350	2610	8190

* Weight and dimensions are approximate.

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
- Partial discharge

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)

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