

OIL IMMERSED TRANSFORMERS

POWER TRANSMISSION & DISTRIBUTION



GREEN INITIATIVE

A new generation of Eco-Design Oil Immersed Transformers that help keep our planet green.



a Bulox Corporation company

OIL IMMERSED TRANSFORMERS FOR POWER GENERATION, TRANSMISSION & DISTRIBUTION INDUSTRY

Bulox Power Pte Ltd – a subsidiary of **Bulox Corporation**, is one of the leading and most established electrical solution providers with more than 25 years of experiences in electrical power transmission and distribution industry. The company collaborates with many leading-edge OEM partners to design, manufacture and distribute a wide range of quality products with the strictest standard for the local and overseas market. Bulox Power earned a strong reputation in the electrical industry for its design innovation, quality products and excellent services as the company always keep to its commitment.

The **BULOX range of Oil Immersed Transformers** are designed and manufactured by **Bulox Power Pte Ltd** – in collaboration with its OEM partners using high quality materials with strict quality control and latest type of technology for transformers manufacturing. Depending on its capacity, the **Oil Immersed Transformers** are designed either hermetically-seal or come with conservator tank with simplicity and flexibility design to meet customer's requirement.

All **Bulox Oil Immersed Transformers** are designed and manufactured in accordance to **IEC 60076 Standards** and compliances – with strict Quality Control under modern production process. Each Transformer is fully tested in the factory before they are allowed to leave for shipment. The advantage and benefits of manufacturing our range of transformers under our OEM qualified factories are as follows:

- Standard design and documentation
- Better efficiency & faster respond
- More flexibilities to meet production volume and targeted delivery schedule
- More cost-effective and no licensing constraints, etc
- Standard warranty & better aftersales service



TYPE OF OIL-IMMERSED TRANSFORMERS

The following are the three most common type of Oil Immersed Transformers:

- Mineral Oil Transformer – Power & Distribution Type
- Silicon Oil Transformer – Distribution Type
- FR-3 / Ester Oil Transformer – Environmental Friendly Type

Our standards production capacity & highest voltage level:

- Power Transformer : 10Mva ~ 250Mva @ 245kV
- Distribution Transformer : 100Kva ~ 20,000Kva @ 36Kv

International Standard Complied:

IEC 60076 / BS 171 / VDE 0532 / DIN 4290 / ANSI 57 / NEMA / IEEE



COMPARISON OF INSULATION LIQUIDS

The following are the main features / comparison among different type of Oil Immersed Transformers:

S/N	Main Specifications	FR3 / Ester Oil	Silicon Oil	Mineral Oil
1	Dielectric Strength (kV)	56	40	45
2	Viscosity (cSt) 40°C - ASTM D445	33	39	9.2
	Viscosity (cSt) 100°C - ASTM D445	8.0	17	2.3
3	Flash point (oc) ASTM D92	>240	>300	>191
4	Fire point (oc) ASTM D92	360	343	280
5	Specific Heat (cal/gm.°C) ASTM D2766	0.50	0.36	0.39
6	Specific Gravity ASTM D1298	0.92	0.96	0.88
7	Bio-chemical oxigen demand (ppm), 5 days SM5210B	>200	0	<6
8	Recycling back to nature (%) 21 days CEC-L-33	>99	0	25.2
9	Coefficient of Expansion (°C)	7.4x10-4 @25°C	10x10-4 @20°C ±100°	7.5x10-4
10	Appearance	Clear light-green	Clear colorless	Clear colorless
11	pH	Neutral	Not available	Not available
12	Vapor Pressure (mm Hg)	<0.01 @ 20°C	<1 @ 20°C	<0.0001 @ 20°C
13	Stability	Stable	Stable	Stable

S/N	Main Attributes/Benefits	FR3 / Ester Oil	Silicon Oil	Mineral Oil
1	Transformer Fire Safety Level	High	High	Low
2	Transformer Oil Toxicity when combusted	Normal	Poor	Normal
3	Oil Circulation Efficiency	High	Low	High
4	Transformer Physical Dimension	Compact	Larger	Compact
5	Transformer Weight	Lighter	Heavier	Lighter
6	Environment Friendly	Yes	No	Yes

TYPICAL USES

BULOX range of Oil Immersed Transformers can be used for the following industries:



STANDARD COMPLIANCES

The **Oil Immersed Transformers** are designed and manufactured in our selected OEM partners factories with high quality materials and with modern manufacturing processes. The equipment generally complies with the main **IEC Standards: IEC 60076** as proven in comprehensive testing.

In addition, **Oil Immersed Transformers** can be filled with Mineral Oil, Silicon Oil and FR-3 / Ester Oil according to IEC standards:

- **Mineral Oil** - which complies with the specifications of the international standards for insulating oils, IEC Publication 60296 – for distribution transformers without special requirement.
- **Silicon Oil** - which is self-extinguishing in case of fire. Due to its high fire point above 300°C it has been classified as a K-liquid according to IEC 61100.
- **FR-3 / Ester Oil** - which is non-hazardous to water and has a very good biodegradability for use in distribution and power class transformers where its unique fire safety, environmental, electrical, and chemical properties are advantageous. It offers high fire safety due to its high fire point above 300°C, and has also been qualified as a “high-fire-point”, classified as a K-liquid according to IEC 61100.



Eco Design - In recent years, climate change and the consequence of it has been a major topic and concerns for mankind and our Earth. Hence, it is very important and imperative that society should conserve our natural resources and reduce our carbon footprint. Bulox Transformers can be designed to meet the latest requirement in term of low losses and high efficiencies as per Eco-Design directives.

TYPE TEST CERTIFICATE

All **Bulox range of Oil Immersed Transformers** designed and manufactured by our OEM partners have also been type tested by independent institution and / or internationally recognized testing laboratory such as **KEMA/CESI** etc. Individual and / or customized transformers can also be type tested by 3rd party, testing institution - if needed.



CLASS APPROVAL

The **Oil Immersed Transformers** can also be tested and complied to meet the Classes. If needed, we can also comply or meet the other classes or Society requirement – **DNV, ABS, BV, Lloyd or GL**



QUALITY ASSURANCES

Bulox Power strives to provide the **highest guarantee on Quality & Safety** by adopting and implementing all the relevant international quality standards, compliances, approvals and best practices in the industry.



ADVANTAGES OF OIL IMMERSED TRANSFORMERS

The following are some of the main advantages of using Oil Immersed Transformers:

SIMPLE, SAFE & RELIABLE

The windings as the center-piece of the transformer are especially protected – both against high electrical stress due to external over-voltages and against mechanical overloads by short circuits. The layer insulation is adapted to the occurring alternating voltage strain in daily operation. Large-scale oil channels are provided in order to secure sufficient cooling of the windings and to avoid “hot spots”

LOW LOSSES & LOW NOISE

The silicon-alloyed electric sheet steel used is grain-oriented, cold-rolled and insulated on both sides, guaranteeing low losses and noise. Standard use of step-lap cutting additionally minimizes losses and noise.

FLEXIBILITY IN WINDINGS

Transformers are normally designed for the highest daily temperature, average daily temperature and the average annual temperature. The Oil Immersed Transformers caters for a wide range of different ambient temperatures and permissible winding and oil temperature rises are available on request.

ABILITY TO WITHSTAND SHORT CIRCUIT

All transformers are designed and manufactured in such a way are capable of withstanding short-circuit forces, which is proved by testing according to IEC 76 or a national standard (DIN, BS or the like).

OVERLOAD ABILITY

The Oil Immersed Transformers have a better rating performance radiating through air and have a better overload ability when it is natural cooling.

WITH CONSERVATOR TANK

The tank is made of steel sheets and is capable of withstanding a certain vacuum without permanent deformations.



MAINTENANCE FREE

Generally, all Oil Immersed Transformers can be installed outdoor without any shelter and does not require much maintenance.

CORROSIVE PROTECTION

Finished tanks, covers and other metal parts are sand blasted and then protected by two primary and two finishing coats of paint. In such a way good adherence and the necessary thickness of protective coat of paint is achieved.



RECONNECTING

The Oil Immersed Transformers are re-connectable at HV and LV side or if the transformers are three-winding-one at intermediate voltage side.



MORE FLEXIBILITY & CHOICES

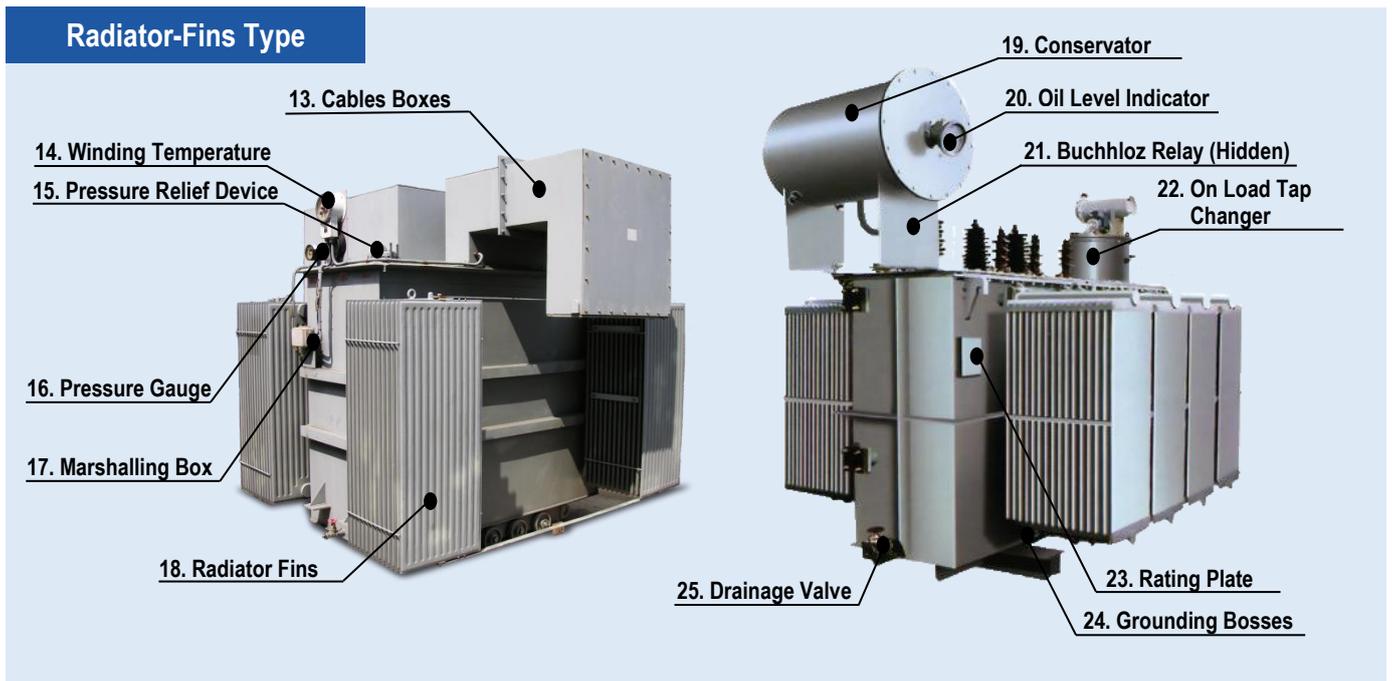
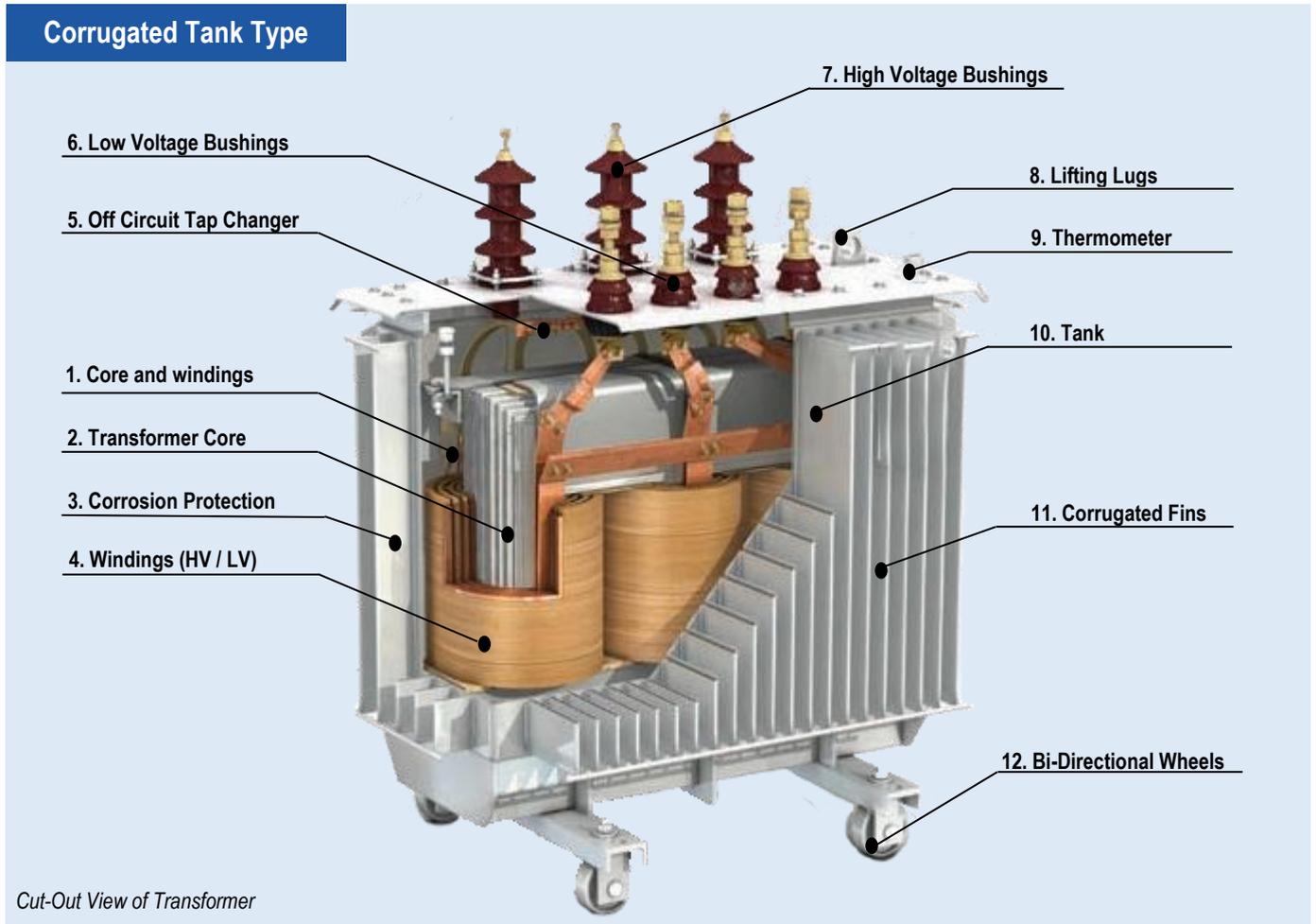
The Oil Immersed Transformer can be filled with Mineral Oil, Silicon Oil, FR-3 / Ester Oil, according to IEC standards. Bulox Power uses the adequate fluid for each customer requirement and application as different countries have different requirement

ENVIRONMENTAL FREE

The FR-3 / Ester Oil used in this liquid type Transformers does not use or produce any toxic by-products which are harmful to the environment.

MAIN COMPONENTS & FEATURES OF OIL IMMERSED TRANSFORMER

The following illustrates the key features / components of both corrugated tank and radiator fins Transformer:



Note: Pictures above are for illustration only

The following are the brief description of the main components typically found in an Oil Immersed Transformers:



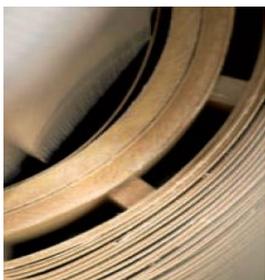
CORE AND WINDING

Both cores and windings are held together by a pressed structure and bolted together with the tank lid. The complete unit can be lifted out of the tank.



LAMINATION CORES

High quality electric sheet steel, most modern core design and optimized lamination provide low loss and noise optimized operation



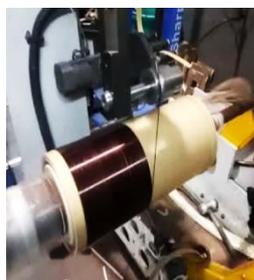
WINDING ASSEMBLY

The windings are made of high quality electrolytic copper or aluminium materials, insulated with pure cellulose paper particularly suitable to withstand direct atmospheric over tension. Before assembling, the low voltage and high voltage windings are submitted to vacuum drying and impregnation process under very strict process control



LV WINDINGS

Copper foils are typically used for the conductor of LV winding. Layer insulation uses double layers diamond dotted paper



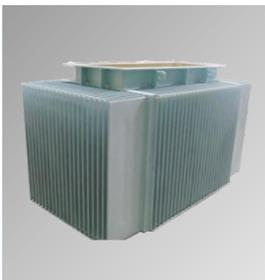
HV WINDINGS

HV winding is wound directly on the finished LV winding. HV winding machine adjust the tension automatically according to dimension of copper wire and control the turns which results in the winding with high accuracy, compact & reliable.



HIGH VOLTAGE & LOW VOLTAGE BUSHINGS

The bushing insulators are made of quality porcelain. The placement can be carried out without taking the active part out from the tank. High voltage bushing insulators conform to DIN 42531 and low voltage to DIN 42530. The Transformers can also be supplied with cable boxes c/w with different types of cable connector or busduct system.



TANK

The tank is made of welded corrugated steel sheet with thickness of 1.2mm to 3.0mm, internally and externally painted with special epossidica enamel, corrosion proof. The cooling is obtained by means of radiators and corrugated steel sheet.



CONSERVATOR (Option)

The conservator is equipped with an oil level indicator and a filling socket. It provides adequate space to its expanded Transformer oil and act as reservoir of Transformer insulating oil.



CORROSION PROTECTION

The surface of the Transformer gets a multi-coating in the standard colour cement grey (RAL 7033). All metallic surfaces are protected with two primary coats which are hardened at the high temperature. To the primary coat the two protective layers are applied. The protective layer of minimum 80µm is obtained which ensures high mechanical and anti-corrosion properties. Special colours or galvanization are possible.

Note: Pictures above are for illustration only



OFF CIRCUIT TAP CHANGER

Off Circuit Tap Changer is typically used to adjust the ratio to the local voltage conditions. It can be adjusted from outside in de-energized condition.



ON LOAD TAP CHANGER

On Load Tap Changer is typically used on large transformer to automatically regulate the incoming voltage fluctuation.



OIL LEVEL INDICATOR

The Oil Level Indicator is typically used to monitor the oil level in the transformer tank and/or the conservator tank.



THERMOMETER

An important accessory to monitor the temperature of the Transformers and/or of the windings



DEHYDRATING BREATHER

The air enters the conservator through dehydrating breather. In a transparent enclosure is placed silicagel which absorbs the moisture. The silicagel should be replaced by the new one when its one third changes the colour (turns red).



BUCHHLOZ RELAY

It is built in the oil pipe between the tank and conservator. It serves as a protection against defects occurring in the tank. The relay has two floats connected to the contacts: one for alarm and the other one for tripping.



PRESSURE RELIEF DEVICE

The Pressure Relief Device is an important safety device for all Oil-Immersed Transformers as it helps to relief any internal pressure safety in case of any internal fault.



CABLES BOXES

The Cables Boxes provide and protect for the termination of vertically ascending high voltage and low voltage cables.



HERMATICALLY SEALED TANK

The Transformers with hermetically sealed tank avoid sludging and oxidation of dielectric fluid. The dielectric fluid in hermetically sealed tank is completed sealed and is zero contact to atmosphere.



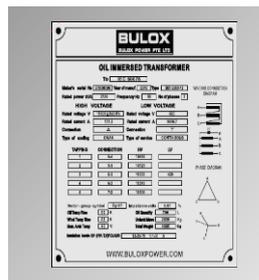
RADIATOR FINS

Radiator Fins are installed on the Transformer and helps to accelerate the cooling rate of transformer oil and reduce the winding temperature under loading condition.



BI-DIRECTIONAL ROLLER

Bi-Directional Rollers are temporary installed on the transformer based skid to it move around easily during installation period.



RATING PLATE

A stainless steel plate helps to identify the Transformer's manufacturer, comprehensive technical specification, serial number and other required data.

Note: Pictures above are for illustration only

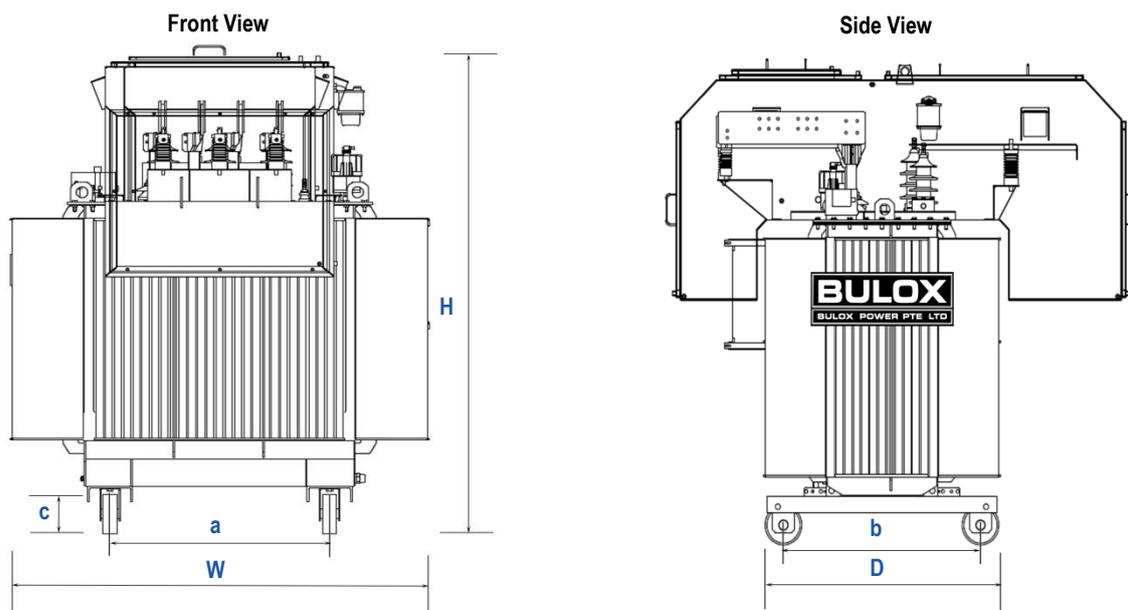
TECHNICAL SPECIFICATION – OIL IMMERSED TRANSFORMERS



NORMAL LOSS TYPE

Standard : IEC 60076 - 11
Rated Power : 50 - 2500 kVA (Others on request)
Rated Frequency : 50Hz / 60Hz
HV Rating : up to 36kV
LV Rating : up to 780V (special design for up to 12kV)
Tapping on HV Side : $\pm 2 \times 2.5 \%$

Standard Connection : HV- Delta; LV – Star (Dyn11)
Impedance Voltage : 4.0 – 10.0%
Insulation Class : Class A
HV/LV Material : Copper / Aluminium
Type of Cooling : ONAN (ONAF also available)
Colour of Metal Parts : RAL 5009 (Other colours are available)



kVA	P ₀ (W)	P _{CC} (75°C) (W)	η 4/4 Cos ϕ 1 (%)	η 4/4 Cos ϕ 0.9 (%)	η 3/4 Cos ϕ 1 (%)	η 3/4 Cos ϕ 0.9 (%)	ZI (%)	W (mm)	D (mm)	H (mm)	a (mm)	b (mm)	c (mm)	oil (kg)	kg
50	190	1100	97.48	97.21	97.88	97.65	4.0	1120	470	1100	520	520	100	100	440
100	320	1750	97.97	97.75	98.29	98.10	4.0	1170	590	1150	520	520	100	150	650
160	460	2350	98.27	98.08	98.53	98.37	4.0	1200	640	1200	520	520	100	170	810
200	550	2800	98.35	98.17	98.60	98.45	4.0	1250	680	1250	520	520	100	200	950
250	650	3250	98.46	98.29	98.69	98.55	4.0	1250	700	1350	520	520	100	230	1100
315	790	4000	98.50	98.33	98.72	98.59	4.0	1300	750	1420	520	520	100	260	1280
400	930	4600	98.63	98.48	98.84	98.71	4.0	1350	780	1500	670	670	150	300	1500
500	1100	5500	98.69	98.55	98.89	98.77	4.0	1480	820	1600	670	670	150	350	1800
630	1300	6500	98.77	98.64	98.96	98.84	6.0	1610	870	1650	670	670	150	410	2000
800	1500	8500	98.76	98.63	98.96	98.85	6.0	1700	950	1750	670	670	150	520	2400
1000	1700	10500	98.79	98.66	98.99	98.88	6.0	1800	1030	1850	820	820	150	570	2800
1250	2100	13500	98.76	98.63	98.97	98.86	6.0	1950	1150	1900	820	820	150	650	3200
1600	2600	17000	98.78	98.65	98.99	98.88	6.0	2130	1315	2060	820	820	150	770	3850
2000	3200	22000	98.75	98.61	98.97	98.85	6.0	2300	1450	2150	1070	1070	200	900	4500
2500	3800	26500	98.80	98.67	99.01	98.90	6.0	2350	1450	2270	1070	1070	200	980	5000

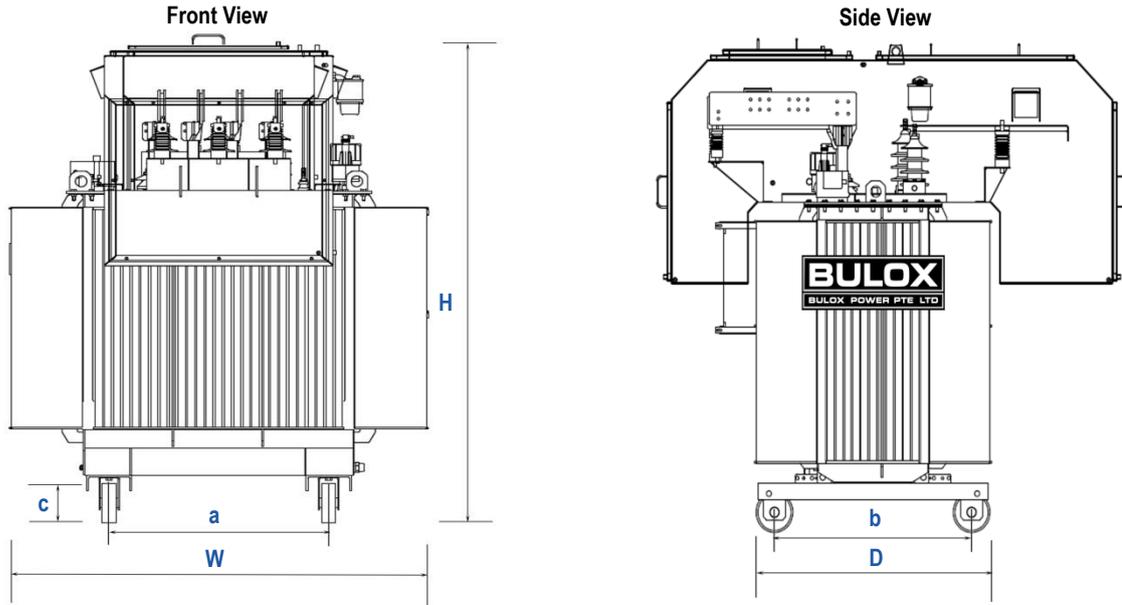
*Other larger transformer capacities are available on request.

Note: The technical specifications provided above are based on Bulox's standard Oil Immersed Transformers and are used for guidance only. Manufacturer reserved the rights to change technical specifications without giving prior notice. All other customized or non-standard design technical specifications can be provided separately upon request before manufacture.



Standard : IEC 60076 - 11
Rated Power : 50 - 2500 kVA (Others on request)
Rated Frequency : 50Hz / 60Hz
HV Rating : up to 36kV
LV Rating : up to 780V (special design for up to 12kV)
Tapping on HV Side : $\pm 2.5\%$ or $\pm 2 \times 2.5\%$

Connection : HV- Delta; LV - Star
Impedance Voltage : 4.0 – 7.0% (Others on request)
Insulation Class : Class A
HV/LV Material : Copper / Aluminium
Type of Cooling : ONAN (ONAF also available)
Colour of Metal Parts : RAL 5009 (Other colours are available)



kVA	P ₀ (W)	P _{CC} (75°C) (W)	η 4/4 Cos ϕ 1 (%)	η 4/4 Cos ϕ 0.9 (%)	η 3/4 Cos ϕ 1 (%)	η 3/4 Cos ϕ 0.9 (%)	ZI (%)	W (mm)	D (mm)	H (mm)	a (mm)	b (mm)	c (mm)	oil (kg)	kg
50	150	850	98.03	97.82	98.35	98.17	4.0	1120	450	1100	520	520	100	110	4802
100	250	1400	98.37	98.19	98.63	98.48	4.0	1170	560	1180	520	520	100	150	680
160	360	1850	98.63	98.48	98.84	98.71	4.0	1210	590	1200	520	520	100	180	850
200	430	2170	98.71	98.57	98.91	98.79	4.0	1250	620	1350	520	520	100	200	1000
250	520	2600	98.76	98.63	98.95	98.83	4.0	1285	670	1450	520	520	100	250	1160
315	610	3050	98.85	98.72	99.02	98.91	4.0	1300	700	1500	520	520	100	290	1350
400	740	3650	98.91	98.79	99.07	98.97	4.0	1350	750	1550	670	670	150	330	1600
500	800	4500	98.95	98.83	99.11	99.02	4.0	1420	850	1620	670	670	150	360	1900
630	900	5600	98.97	98.86	99.15	99.05	6.0	1470	920	1680	670	670	150	450	2200
800	1100	7200	98.97	98.86	99.14	99.05	6.0	1500	980	1750	670	670	150	550	2600
1000	1300	9000	98.98	98.86	99.15	99.06	6.0	1510	1050	1850	820	820	150	600	2900
1250	1600	10600	99.03	98.92	99.19	99.11	6.0	1800	1150	1900	820	820	150	690	3400
1600	2000	13000	99.07	98.96	99.22	99.14	6.0	2150	1250	1950	820	820	150	780	4000
2000	2400	16000	99.08	98.98	99.24	99.16	6.0	2250	1350	2150	1070	1070	200	900	4700
2500	2900	21000	99.05	98.94	99.22	99.13	6.0	2450	1460	2200	1070	1070	200	1050	5500

*Other larger transformer capacities are available on request.

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TESTING SCHEDULE – FACTORY ROUTINE TEST/SITE TEST

All Transformers are individually checked and fully tested in the factory according to **IEC 60076 standard**. Upon request, other special or type test can also be carried out as well at optional cost.

The following tests are performed according to **IEC standard**:

Standard Factory Routine Test / FAT

- Measurement of winding resistance
- Measurement of voltage ratio and check of phase Displacement (Polarity Test)
- Measurement of short circuit impedance & load loss
- Measurement of no load loss and current
- Measurement of insulation resistance
- Separate source AC withstand voltage test
- Induced AC Voltage tests

Special / Type Test (Optional Cost)

- Temperature rise test
- Full wave impulse test
- Impulse test
- Sound Level measurement

Site Acceptance Test (SAT)

- Turn Ratio Test
- Winding Resistance Test
- Vector Group Test
- AC Hi-Pot Test
- Insulation Resistance Test
- Polarization Index test
- Functionality Test
- Partial Discharge Measurement (Option)
- Thermal Imaging (Option)



BULOX ADVANCED REMOTE MONITORING (ARM) SYSTEM

The **Bulox ARM System** is the latest state of art innovation from **Bulox Corporation**. It is a universally accepted condition monitoring system which helps to monitor your critical Equipment assets such as HV Switchgears, Transformers and Main switchboard 24/7 using latest IoT technologies through clouds system. It is very safe and reliable and will help owner's peace of mind and security on their equipment before any failure and/ or mishap can occur. The **Bulox ARM system** uses different type of sensors with different technologies for different equipment. The system also allows the owner as well as the service agent to keep a proper record of all the equipment automatically - as well as allow remote troubleshoot and schedule all the maintenance regularly – all through digital platform. It is an extension of the conventional BMS System – in line with latest **Industry 4.0** requirements.

Please contact with our sales for more information about the Bulox ARM System.





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