Transforming energy into growth

TRANSFORMING ENERGY INTO GROWTH

Since the 1960s our planet has been undergoing a series of major transformations, characterized ainly by unexpected changes occurring at unprecedented and often dazzling speeds.

Our organization is part of a world that, due to these changes, has become increasingly globalized, with the result, among many other factors, of a growing flow of trade among the various countries, resulting in an indiscriminate level of competition. In order to survive in this highly competitive environment, our organization had to adapt to these new circumstances, going to great lengths to create innovation in our products, processes and customer service, in an effort to match our level of competitiveness with that of world-class companies participating in our market.

To respond to these pressing needs, our Organization has focused its efforts on the implementation of a management process with three components:

· Improved efficiency in all our productive processes.
· An integrated management system under the models of the NTC-ISO 9001 Quality Management, NTC-ISO 14001 Environmental Management and OHSAS 18001 Industrial Safety and Occupational Health Management Systems.

· A Product Safety Management and Administration system covering our products, as well as all areas and activities of our Organization, in accordance with the standards of the World Basc Organization (WBO) and its Business Alliance for Secure Commerce (BASC) program.

Under these circumstances, and with the support and effort of our entire team of employees, we have adopted these guiding principles as part of the fundamental philosophy of our Organization, in order to keep the certification of our products current and up to date and to maintain our highly competitive capacity both in domestic and international markets.

BASC
BUSINESS ALLIANCE FOR SECURE COMMERCE
COLPE000045-1-10

ISO 9001:2008
ISO 14001:2004
OHSAS 18001:2007
BUREAU VERITAS
Certification

Conventional Transformers

Application:

Conventional distribution transformers are used outdoors or indoors on medium-voltage distribution systems. They are designed to convert medium voltage to low voltage or vice versa.

They are typically used for residential service loads and occasionally for light commercial or industrial loads. These transformers are usually designed for pole mounting, although in some cases they are built for installation on certain types of substations.

These transformers do not include any protection accessories; therefore, any surge arresters or other overvoltage or overload protection must be provided by the buyer.

Scope of the offer:

Manufactured in compliance with applicable NTC, IEC and ANSI standards and/or individual customer specifications.

Single-phase transformers may be manufactured with one or two high-voltage bushings to be connected in E1GrdY/E or E/E1GrdY configurations, where E is the phase-to-neutral voltage and E1 is the phase-to-phase voltage. Low voltage configurations are typically 2E/E or E/2E; the latter are usually used to form three-phase banks. Switchable single-phase transformers are specially designed to operate at two different input voltages.

Three-phase transformer configuration is made in accordance with the connection required by the standard or by the customer; the most common types are Dy, Yd, Dd, Yy, Dz, Yz.

Ratings (kVA):
Single Phase: 5 kVA to 167 kVA.
Three-phase: 15 kVA to 500 kVA.

Basic Insulation Level:
Single phase: Up to BIL 150 kV
Three-phase: Up to BIL 200 kV*

* At transformer voltages below 75 kVA BIL 200 kV, failure in the surge arrester, the cable or in the transformer itself may occur as a result of ferroresonance. Ferroresonance is a phenomenon usually characterized by overvoltages and irregular wave shapes and associated with the excitation of one or more saturable inductors through a capacitance in series with the inductor [ANSI/IEEE Std. 100-1984].

Typical construction mode:

Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, which is determined in accordance with the type of transformer, placed in a tank that provides the equipment with specific features, depending on its intended application.

Conventional Transformers

Coils:
- Rectangular cross section and concentric copper or aluminum windings.
- Insulation: High-quality epoxy resin coated paper.

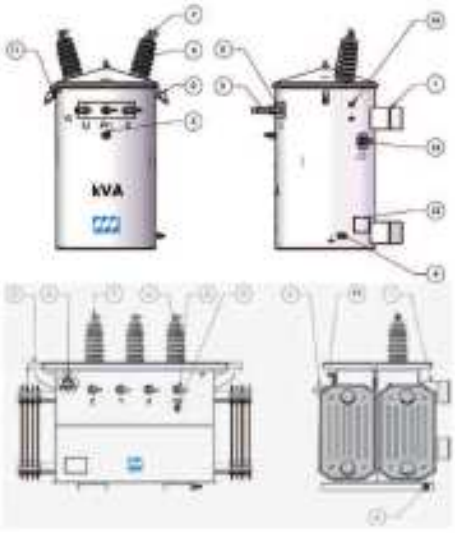
Cores:
- Shell Type or Core Type, wound with a back-to-back interleaving arrangement, step-lapped for easy assembly and disassembly without losing dimensional characteristics, thus ensuring very low levels of losses and excitation currents.
- Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

Yoke clamps:
- Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps that can be easily removed and disassembled for maintenance purposes.
- They ensure high resistance to short circuit mechanical stresses, with low noise levels and low excitation currents.

Tanks:
- Single-phase transformers: Cylindrical, made from Cold Rolled and Hot Rolled Steel.
- Three-phase transformers: Rectangular in shape, made of Cold Rolled or Hot Rolled steel, with reinforcements capable of withstanding internal pressures resulting from temperature rise and mechanical stresses due to equipment installation and handling.
- Cold Rolled steel radiators are attached to the tank.

Accessories and protection devices:

MAGNETRON S.A.S. offers a variety of high voltage and low voltage protection accessories, as well as control and alarm devices to control the basic functions of the transformers, such as pressure relief valves, temperature, oil level indicators, internal gas generation and moisture control devices, in accordance with the customer's requirements.



	DESCRIPTION
1	Support for hanging on the utility pole
2	Lifting lug
3	Refrigerant liquid level indicator
4	Tank grounding
5	Low voltage neutral grounding
6	High-voltage bushings
7	High-voltage terminals
8	Low-voltage bushings
9	Low-voltage terminals
10	Pressure relief device
11	Nameplate
12	Vacuum tap changer

Optional accessories

- External SPD
- Control and measurement accessories
  - Vacuum Pressure Gauge
  - Thermometer
  - Oil level indicator with and without contacts
- Bi-directional wheels (Applies to transformers with power rating >=300kVA

Power Transformers

Application:

IEEE Standard C57.12.80 © defines a power transformer as a transformer that transfers electrical energy in any part of the circuit between the generator and the primary distribution circuits, and a distribution transformer as a transformer for transferring electrical energy from a primary distribution circuit to a secondary distribution circuit or consumer's service circuit.

Small power transformers manufactured by Magnetron are used mainly in industrial service loads, shopping malls, schools and educational institutions, and in utility substations.

Scope of the offer

Manufactured in compliance with NTC, IEC, ANSI and other applicable standards.

Three-phase transformer configuration is made in accordance with the connection required by the standard or the customer; the most common types are Dy, Yd, Dd, Yy, Dz, Yz.

Ratings (kVA):
Single Phase: 250 kVA to 500 kVA.
Three-phase: 630 kVA to 10,000 kVA.

Basic Insulation Level:
Single phase: Up to BIL 150 kV
Three-phase: Up to BIL 200 kV

Leveraging the expertise of our engineering team and the production capacity of its manufacturing plant, Magnetron can manufacture transformers with specific requirements determined by our customers within the ranges indicated herein.

Typical construction mode:

Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, which is determined in accordance with the type of transformer, placed in a tank that provides the equipment with specific features, depending on its intended application.

Coils:
- Rectangular section (single-phase from 250 kVA to 500 kVA, three-phase from 630 kVA to 1,250 kVA, circular section (three-phase from 1,500 kVA to 10,000 kVA), concentric with copper or aluminum windings.
- Insulation: High-quality paper with epoxy resin coatings.

Cores:
- Shell Type, wound (single-phase from 250 kVA to 500 kVA and three-phase from 630 kVA to 1,250 kVA); or Core Type, stacked (three-phase from 1,500 kVA to 10,000 kVA), step-lapped for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents.
- Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

Yoke clamps:

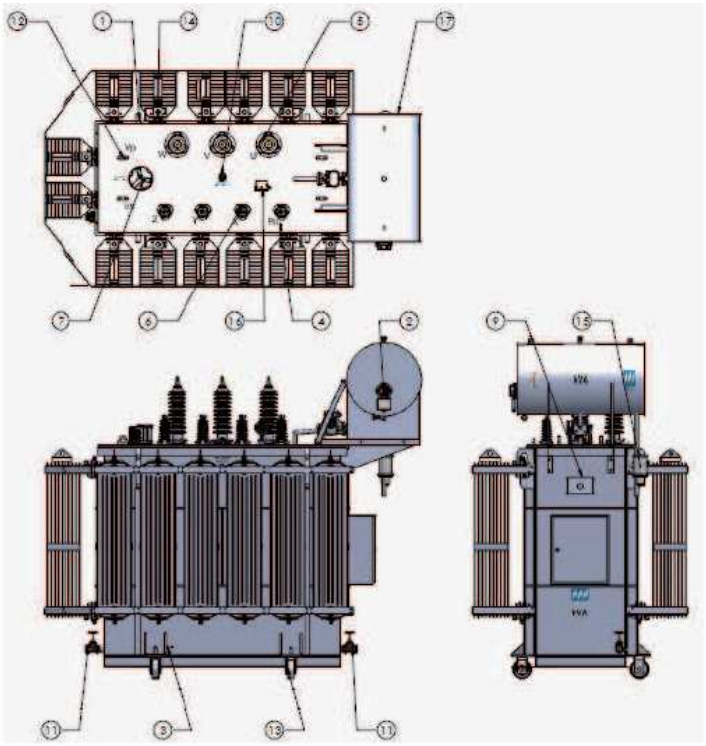
- Made of cold-rolled and hot-rolled steel (single-phase from 250 kVA to 500 kVA, three-phase from 600 kVA to 1,250 kVA and profiles from 1,500 kVA), they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
- They guarantee high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Tanks:

- Single-phase transformers: Cylindrical made from Cold Rolled and Hot Rolled Steel.
- Three-phase transformers: Rectangular in shape, made of Cold Rolled or Hot Rolled steel with reinforcements capable of withstanding internal pressures resulting from temperature rise and mechanical stresses due to equipment installation and handling.
- Radiators attached to the tank or detachable from 2,500 kVA onward, in Cold Rolled steel.

Accessories and protection devices:

MAGNETRON S.A.S. offers a variety of high voltage and low voltage protection systems, as well as control and alarm devices to control the basic functions of the transformers, such as pressure relief valves, temperature, oil level indicators, internal gas generation and moisture control devices, in accordance with the customer's requirements.



	DESCRIPTION
1	Lifting lug
2	External refrigerant liquid level indicator without contacts
3	Tank grounding device
4	Low voltage neutral grounding
5	High voltage bushings and terminal
6	Low voltage bushings and terminal
7	Pressure relief device without contacts
8	High- and low voltage bushings, rated power and grounding marking
9	Nameplate
10	Tap changer for no load operation
11	Refrigerant liquid recirculation and drainage device
12	Device to lift the cover of the main tank
13	Flat 90° rotating wheels
14	Butterfly valves for detachable radiators (for 2500 kVA and above)
15	Silica gel breather (for 2500 kVA and above)
16	Oil temperature thermometer without contacts
17	Expansion tank

Optional accessories

- Oil temperature thermometer with 2 contacts
- Pressure relief valve with 2 contacts
- Floating ball oil level indicator with 2 contacts
- Buchholz relay with two contacts
- Winding temperature thermometer
- Sudden pressure relay
- Vacuum pressure gauge without contacts
- Fans

Self-Protected Transformers

Application:

Used mainly in residential service loads and where the power utilities require a load control.

Starting at the design stage, self-protected transformers include protection elements against overvoltages, overloads, and elements to isolate it from the network in the event of internal or external failures.

The following elements provide the self-protection:

- Surge Protection Device SPD (lighting arrestor)
- Protection fuse: Expulsion fuse or isolation link
- Circuit breakers: Breaker or Magnex interruptor

Protection schemes:

SELF PROTECTED SP (Surge Protecting): Includes SPD and expulsion fuses. Does not include low-voltage or high-voltage circuit breakers

SELF PROTECTED CP (Current Protecting): Built with internal high voltage fuses and an internal breaker that can be installed on the high-voltage (Magnex) or low-voltage (Breaker) end, depending on the customer's requirement. Does not include mounting of SPDs.

COMPLETELY SELF PROTECTED (CSP): These transformers can be supplied with two types of configuration: Breaker or Magnex.

Scope of the offer:

Manufactured in compliance with applicable NTC standards and/or individual customer specifications.

Three-phase transformer configuration is made in accordance with the connection required by the standard or the customer; the most common types are Dy, Yd, Dd, Yy, Dz, Yz.

Ratings (kVA):
Single Phase: 10 kVA to 75 kVA.
Three-phase: 30 kVA to 225 kVA.

Basic Insulation Level:
Single phase up to BIL 150 kV
Three phase up to BIL 150 kV

Typical construction mode:

Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, which is determined in accordance with the type of transformer, placed in a tank that provides the equipment with specific features, depending on its intended application.

Self-Protected Transformers

Coils:
- Rectangular sections and concentric copper or aluminum windings.
- Insulation: High-quality paper with epoxy resin coatings.

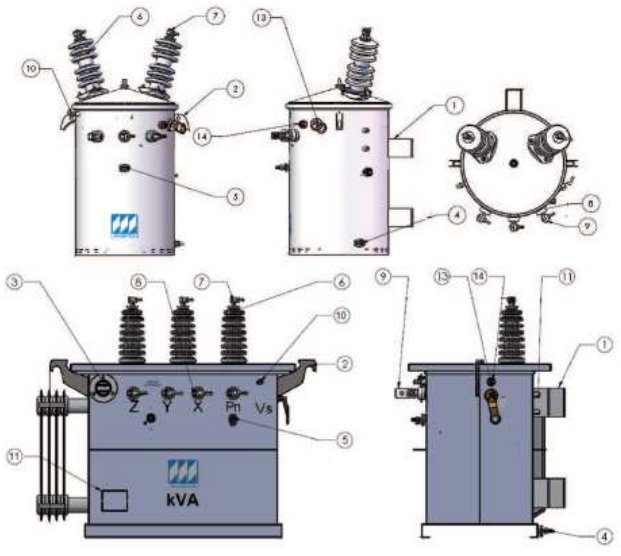
Cores:
- Shell Type or Core Type, wound, step-lapped for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents.
- Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

Yoke clamps:
- Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
- They guarantee high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Tanks:
- Single-phase transformers Cylindrical made from Cold Rolled and Hot Rolled Steel.
- Three-phase transformers: Rectangular in shape, made of Cold rolled or Hot rolled steel with reinforcements capable of withstanding internal pressures resulting from temperature rise and mechanical stresses due to equipment installation and handling.
- Radiators: Attached to the tank, made from Cold Rolled steel.

Accessories and protection devices:

MAGNETRON S.A.S. offers a variety of high voltage and low voltage protection systems, as well as control and alarm devices to control the basic functions of the transformers, such as pressure relief valves, temperature, oil level indicators, internal gas generation, and moisture control devices, in accordance with the customer's requirements.



	DESCRIPTION
1	Support for hanging on the utility pole
2	Lifting device
3	Internal refrigerant liquid level indicator
4	Tank grounding
5	Low voltage neutral grounding
6	High voltage bushings
7	High voltage terminals
8	Low voltage bushings
9	Low-voltage terminals
10	Pressure relief device
11	Nameplate
12	Tap changer
13	Breaker or Magnex interruptor
14	Pilot light

Optional accessories:

- Current limiting fuses
- Surge arrester mounting device
- Expulsion fuse

Pad-Mounted Transformers

Application:

Pad-mounted transformers are used in underground distribution systems. Their sealed high-voltage and low-voltage safety compartments ensure their safe operation and reduce the risk of accidents, making them ideally suited for use in residential applications, tourist sites, hotels and other buildings. Pad mounted transformers are placed inside a cabinet with doors and locks, usually located outdoors, with dead-front medium-voltage terminals. Single-phase transformers are designed to operate from the primary under a line-ground system, in order to avoid magnetic ferroresonance effects.

These transformers come in two basic configurations: radial and loop feed, which are selected based on the type of circuit on which the transformers will be installed.

Radial configuration: the transformer is connected to the primary feeding line and does not allow continuation of the line through the equipment.

Loop configuration: The transformer is connected to the primary feeding line and allows other loads to be fed through it.

Scope of the offer:

Manufactured in compliance with applicable NTC, IEC and ANSI standards and/or individual customer specifications.

Ratings (kVA):
Single Phase: 15 kVA to 500 kVA.
Three-phase: 30 kVA to 2500 kVA.

Basic Insulation Level:
Up to BIL 150 kV

Typical construction mode:

Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, which is determined in accordance with the type of transformer, placed in a tank that provides the equipment with specific features, depending on its intended application.

Coils:

- Rectangular sections and concentric copper or aluminum windings.
- Insulation: High-quality paper with epoxy resin coatings.

Cores:

- Shell Type or Core Type, wound, step-lapped for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents.
- Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

Yoke clamps:

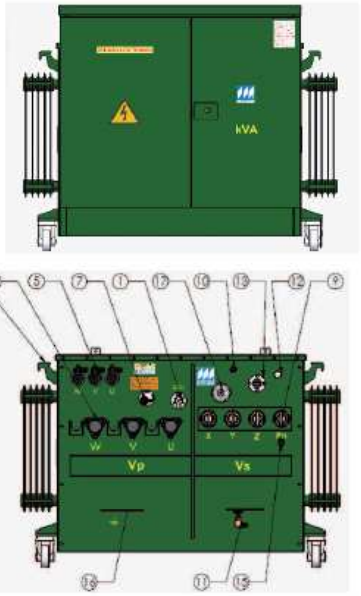
- Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
- They guarantee high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Tanks:

- Rectangular in shape, made of cold rolled or hot rolled steel sheet with reinforcements capable of withstanding internal pressures due to temperature rise and mechanical stresses due to equipment installation and handling.
- Three-phase TANKS include a separate cabinet that is studded to the transformer and serves as protection for the Low and Medium Voltage circuits, with a mechanical locking system which, for safety reasons, prevents opening of the medium-voltage compartments until the same has been done with the low-voltage one.
- Single-phase TANKS have a single cabinet with hinges at the top, enabling easy access to the terminals and the transformer's protection system.
  Radiators: Attached to the tank, made from Cold Rolled steel.

Accessories and protection devices:

Medium voltage accessories used in pad mounted transformers are of the premolded elastomeric type, for operation under load (with the exception of 600A) and dead-front, ensuring safe operation. They are fed through an internal on-load operating switch with bayonet or canister fuse systems enabling a complete protection system.



	DESCRIPTION
1	5-position tap changer
2	Insert-type bushings
3	Well-type bushings
4	Loadbreak elbows
5	Bayonet current sensing fuse assemblies
7	On-Off switch
8	Isolation link or LCP fuses
9	Low-voltage terminals
10	Pressure relief valve
11	Globe valve for filtering, draining and oil sampling
12	Nipple and fill stopper
13	Sight glass oil level indicator
14	Lifting lugs
15	Neutral terminal grounding
16	Tank grounding
17	Thermometer

Class F Dry Type Transformers

Application:

Oil-filled transformers have traditionally been the most commonly used option in electrical grids, but a number of issues in relation to the environment, fire hazards, control of leaks and general maintenance, have led to the evolution and increased use of dry-type transformers in areas such as shopping malls, public buildings, hospitals, tunnels, banks, ships, mining, subways (metro), oil platforms and, in general, sites that are generally open to the public.

Dry-type transformers are encapsulated in an epoxy resin and can be used even at high humidity and pollution levels, eliminating the risk of fire and emission of harmful and toxic substances. They are fully manufactured with flame-retardant and self-extinguishing insulating materials.

Scope of the offer:

Manufactured in compliance with applicable NTC and IEC standards and/or individual customer specifications.

Ratings (kVA):
Three-phase: 15 kVA to 30,000 kVA.

Basic Insulation Level:
Three-phase: Up to BIL 145 kV

Dry-type resin-encapsulated transformers are confined in cells that protect them from weather-related phenomena, with the type of IP[1] protection requested by the customer.

This transformer is designed to operate under adverse conditions. The reliability of the equipment is shown below:

- E2, environmental class: the transformer will be subjected to considerable condensation or to intense pollution or a combination of both.
- C2, climate class: Outdoors installation. The transformer is designed to operate, be transported and stored at temperatures as low as -25°C
- F1, behavior in case of fire: Transformers subject to fire hazards require reduced flammability. The fire must self-extinguish within a given period, to be agreed between the manufacturer and the customer. Emissions of toxic substances and opaque smoke must be minimized. The combustion materials and products must be free from halogen compounds and contribute only minimal amounts of thermal energy to an external fire.

Typical construction mode:

Coils:

- Dry-type transformers are built with circular windings
- The insulation system of epoxy-resin encapsulated transformers is designed using 155° Class materials, guaranteeing optimal resistance to load variations and ambient temperature changes.

Class F Dry Type Transformers

Cores:

- Materials: Grain-oriented silicon electrical steel sheet with insulating coating on both sides and with high magnetic permeability.
- The cut and composition is of the 45 degree type, with step-lapped joints, keeping losses and audible noises low.

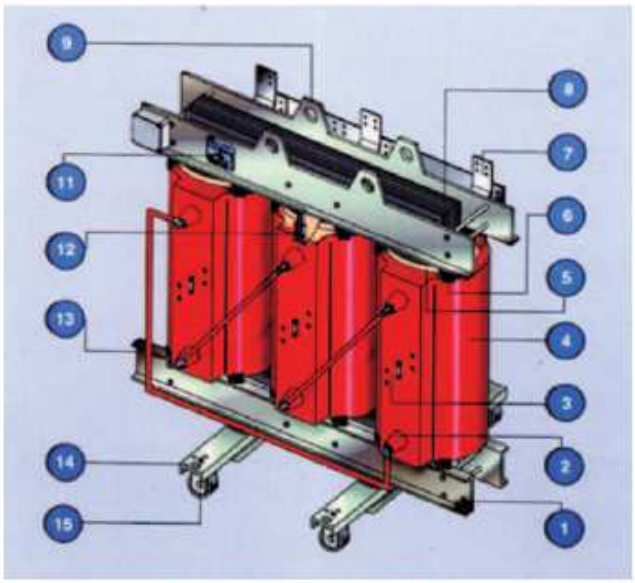
Yoke clamps:

- They guarantee high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Cells:

- Designed to be included within the cabinets or cells of high-voltage substations, to be provided in accordance with the customer's requirements.

Accessories and protection devices:



	DESCRIPTION
1	Grounding terminals
2	Medium-voltage insulator
3	Medium-voltage regulation
4	Medium-voltage winding
5	Low-voltage winding
7	Confinements
8	Low voltage busbars
9	Magnetic core
11	Nameplate
12	Thermal temperature control sensors
13	Yoke clamp
14	Moving lugs
15	Omni-directional orthogonal wheels

Optional accessories

- Centralized sensor box
- Installation for connection to socket outlets
- Connection for socket
- Protection cabinet
- Axial forced ventilation
- Shock absorber set
- Thermometer with contacts

Occasionally Submersible Transformers

Application:

Submersible and occasionally submersible transformers are used mainly in underground distribution circuits that are susceptible to corrosive environments and temporary or extended flooding conditions.

Occasionally submersible transformers are built to operate in an underground chamber or vault subject to potential flooding under a set of predetermined pressure and time conditions (24 hours under a 40 cm water column measured from the upper part of the transformer).

Scope of the offer:

Designed and manufactured as radial or loop types, depending on the customer's requirements.

Manufactured in compliance with NTC standards (occasionally submersible transformers), ANSI and EDC standards (submersible transformers) and/or individual customer specifications.

Ratings (kVA):
Single Phase: 15 kVA to 500 kVA.
Three-phase: 30 kVA to 2500 kVA.

Basic Insulation Level:
From BIL 95 kV to BIL 150 kV

Typical construction mode:

Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, which is determined in accordance with the type of transformer, placed in a tank that provides the equipment with specific features, depending on its intended application.

Coils:
- Rectangular section with copper or aluminum windings.
- Insulation: High-quality paper with epoxy resin coatings.

Cores:
- Shell Type or Core Type, wound, set up in groups for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents.
- Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

Yoke clamps:

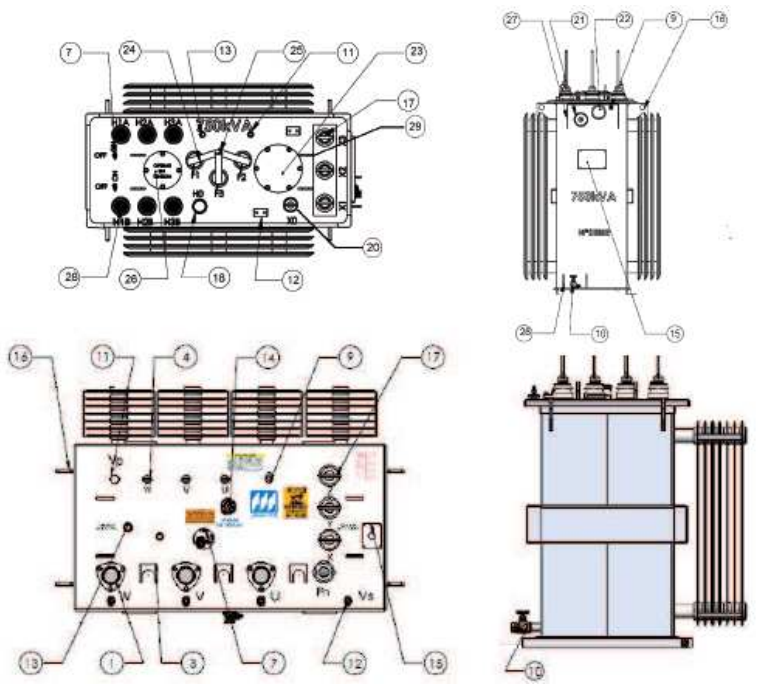
- Made of cold-rolled and hot-rolled steel, the clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
- They guarantee high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Tanks:

- Single-phase transformers: Cylindrical made from Cold Rolled and Hot Rolled Steel.
- The TANKS are made of corrosion-resistant material. They are made of stainless steel and include with a single coating of finishing paint for appearance.
- Radiators: Depending on the voltage, a radiation system with vertical blades may be used, enabling a more compact construction of the tank, in radiation panels with radiating elements.

Accessories and protection devices:

In order to ensure superior operational safety and reliability for underground applications, the connection at the high voltage end includes elastomeric components, such as vertical bayonet sets, canister fuses, long-shank bushing wells that can be immersed in oil, ON-OFF vertical loadbreak switches, oil level gauges, and any additional accessories requested by the customer.



DESCRIPTION	
1	Well-type bushing
3	Parking bushing stand
4	Bayonet-type fuse holder set
5	Bayonet fuse
7	Switch
9	Pressure relief valve
10	NTP drain valve with sampling device
11	Nipple and fill stopper
12	Grounding points
13	Oil level indicator
14	Tap Changer
15	Nameplates
16	Lifting lugs
17	Low-voltage terminals

OTHER ACCESSORIES

DESCRIPTION	SINGLE-PHASE	THREE-PHASE
Insert bushing	X	X
Backup bushing		X
Elbow	X	X

Class H Dry Type Transformers

Application:

Oil-filled transformers have traditionally been the most commonly used option in electrical grids, but a number of issues in relation to the environment, fire hazards, control of leaks and general maintenance, have resulted in the evolution and increased use of dry-type transformers in areas such as shopping malls, public buildings, hospitals, tunnels, banks and other sites.

Two classes of open coil Class H dry-type transformers are available:

Low-Low Typically used to convert low voltages such as 440V/220V or 220V/440V in commercial or industrial buildings with equipment operating at different voltage levels.

Medium-Low: Typically used in shopping malls, buildings and industries where fire hazards must be minimized.

Efficient: They are designed at very low no-load loss levels in order to ensure maximum efficiency performance, which translates into energy savings, and thus to the protection of the environment and a reduction of operating costs.

Scope of the offer

Manufactured in compliance with applicable NTC, IEC and ANSI standards and/or individual customer specifications.

Class H.

Type
Low-Low, Class 1.2 kV
Medium-Low, Class 15 kV

Ratings
Single-phase: 10 kVA to 100 kVA
Three-phase 15 kVA to 1500 kVA

Basic Insulation Level:
Up to BIL 10 kV
Up to BIL 60 kV

Class H dry-type transformers are confined in cells that protect them from weather-related phenomena, with the type of IP protection requested by the customer.

Typical construction mode:

<u>Coils</u>:

- Dry-type transformers are built with circular and rectangular section windings
- The Class H insulation system is designed with Class 180°C materials, enabling it to withstand the temperature rise and overload conditions stipulated by the standard.

Class H Dry Type Transformers

Cores:

- Step lap stacked and wound
- Materials: Grain-oriented cold rolled silicon electrical steel sheet with insulating coating on both sides low core loss and high permeability.

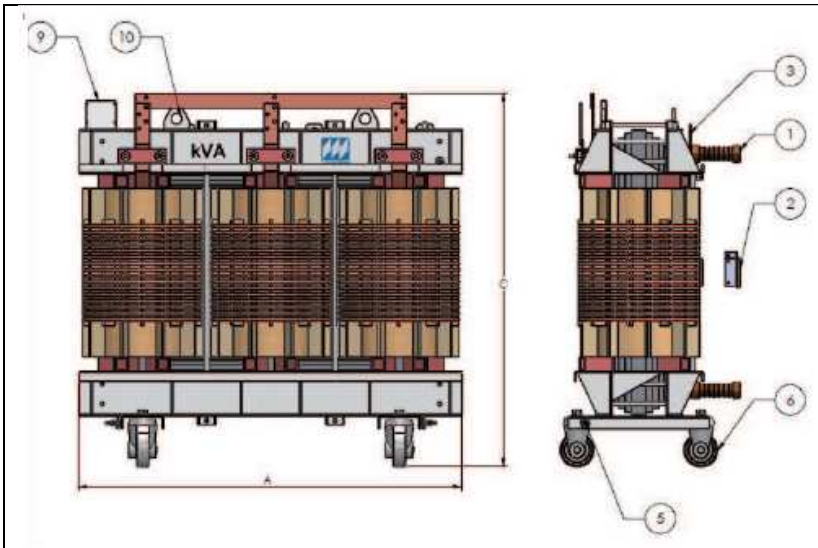
Yoke clamps:

- Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
- They ensure high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Cells:

- Designed to be included within the cabinets or cells of high-voltage substations, to be provided in accordance with the customer's requirements.

Accessories and protection devices:



	DESCRIPTION
1	HIGH VOLTAGE INSULATORS
2	TAP CHANGER
3	SURGE ARRESTER STAND
4	SURGE ARRESTER (OPTIONAL)
5	TRANSFORMER GROUNDING
6	BIDIRECTIONAL WHEELS (OPTIONAL)
7	THERMOMETER (OPTIONAL)
8	JUNCTION BOX
9	NAMEPLATES
10	TRANSFORMER LIFTING LUGS

12-Pulse Phase Shift Transformer

General Information:

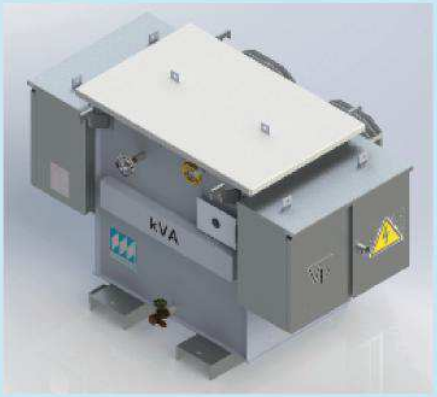
The many benefits of variable speed drives (VSD) in electric-submersible pumping systems (ESP) have led to exponential growth in the use of these devices in production fields handling high fluid output levels. The use of VSDs causes some difficulties when connected to the electrical power system, due to the fact that static power converters produce non-linear loads, affecting the natural sine shape of alternating current, introducing harmonic currents into the electric power network that could cause interference in the communication circuits and damage the equipment installed on the network.

Specially designed transformers called phase shift transformers can help to mitigate the effect of speed drives when connected to the network, by helping to reduce the harmonics reaching the electrical network, depending on the number of pulses of the VSD. This harmonic distortion may be mitigated by increasing the number of rectifying sections used in the VSD; for instance, a 12 pulse converter has 2 rectifiers sections that are 30° out of phase, an 18 pulse converter has 3 rectifiers with a phase shift of 20° and a 24 pulse converter has 4 rectifiers that are 15° out of phase. Therefore, the larger the number of pulses, the smaller the trigger distance between waves, resulting in a shorter distance between wave crests and thus in lower harmonic distortion.

It is important to take into account that, the higher the number of pulses, the more complex the system becomes and the cost of the required equipment may be considerably higher.

AUTOTRANSFORMER:

TRANSFORMER:



Scope of the offer:
Manufactured in accordance with applicable ANSI, IEC and NTC standards and/or specific customer specifications.

Voltages
Three-phase: 85 kVA to 1500 kVA.

Primary voltage (V)
- Autotransformer : 480
- Transformer: 480, 4160, 13200, 13800, 34500

Secondary voltage (V)
- Autotransformer : 497*2
- Transformer: 480*2

Frequency (Hz)
50,60

K Factor
2, 4, 6, 9, 12, 20.

Taps:
- 5 voltage positions
- Vacuum operation
- In the primary windings
- Only in step-down transformers

Connection type:
- Autotransformer: Delta/polygon
- Transformer: Dd0-Dy1

12-Pulses Phase Shift Transformer

Transformers

Product Description:
The Magnetron PST has been specifically designed for the connection of variable speed drives used in ESP to the electric power distribution grid, based on Magnetron's extensive knowledge of transformer design and manufacture and on the technological developments of the main manufacturers of variable speed drives, resulting in a device that is a perfect fit to meet the technical and economic needs of the oil industry.

Magnetron has developed two basic types of transformers for this purpose:

- PST:

- Phase-Shift Autotransformer: This equipment has an input voltage at 480V and two outputs at 497V, which are 30° out of phase with each other (+15° -15° with respect to the input) for connection to 12-pulse variable speed drives.
- Phase-Shift Transformer: This equipment has an input voltage at 480V and two outputs at 480V, which are 30° out of phase with each other (+15° -15° with respect to the input) for connection to 12-pulse variable speed drives.

- SDPST: Step-Down Phase-Shift Transformer. With a primary winding designed for connection to power sources with voltages of 34.5kV, 13.8kV, 13.2kV, 4.1kV (Bear in mind that the transformer is designed only for one type of power source voltage.) Not switchable from 13.8kV to 13.2kV or any of the other options. There are two secondary windings, each at 480V, 30° out of phase with each other, for connection to 12-pulse variable speed drives.

Special cases:

- Transformers with different primary or secondary winding voltages from those indicated here can be manufactured upon review of the requirements by our engineering group.

Typical construction mode:
Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, determined in accordance with the type of transformer, and placed in a tank that provides the equipment with specific features, depending on its intended application.

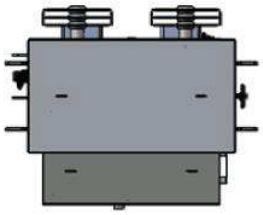
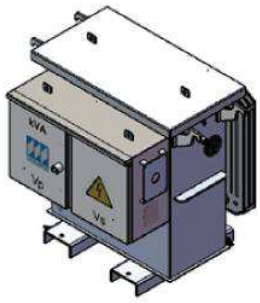
Coils:
Concentric circular or rectangular sections with copper or aluminum windings.
Insulation: High-quality paper coated with epoxy resin.

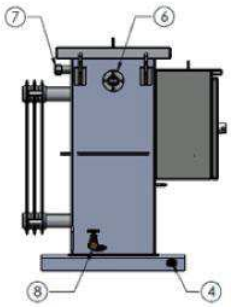
Cores:
Shell Type or Core Type, wound or stacked, set up in groups for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents
Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

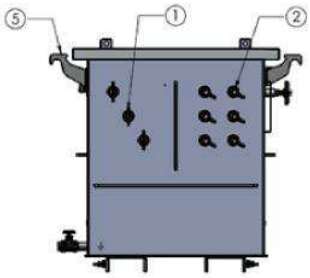
Yoke clamps:
Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
Ensure high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

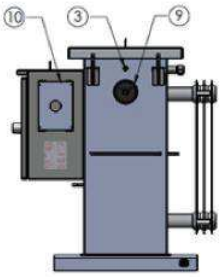
Tanks:
Rectangular in shape, made of cold rolled or hot rolled steel plates with reinforcements capable of withstanding internal pressures due to temperature rise and mechanical stresses due to equipment installation and handling. Three-phase TANKS include a cabinet that is studded or welded to the transformer and serves as protection for the Low Voltage and Medium Voltage circuits, with a mechanical locking system which, for safety reasons, prevents opening of the compartments without the appropriate key.

ITEM	DESCRIPTION	QUA
1	Primary insulator	3
2	Secondary insulator	6
3	Pressure relief valve	1
4	Tank anchoring	2
5	Lifting lugs	4
6	Oil level	1
7	Fill plug	1
8	Drain valve	1
9	Oil Thermometer	1
10	Nameplate	1

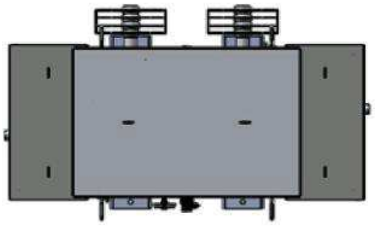
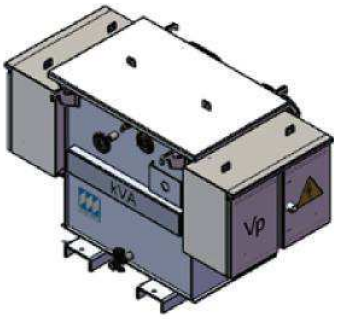



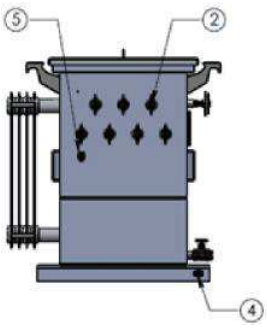


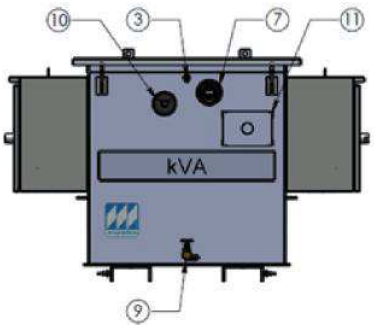


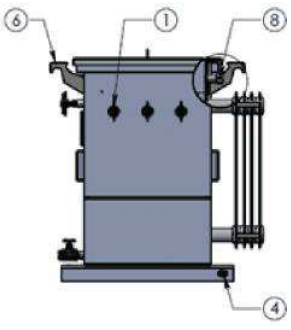


ITEM	DESCRIPTION	QUA
1	Primary insulator	3
2	Secondary insulator	7
3	Pressure relief valve	1
4	Tank grounding	2
5	Neutral grounding	1
6	Lifting lugs	4
7	Oil level	1
8	Fill plug	1
9	Drain valve	1
10	Oil Thermometer	1
11	Nameplate	1







24 Pulses Phase Shift Transformer

General Information:

The many benefits of variable speed drives (VSD) in electric-submersible pumping systems (ESP) have led to exponential growth in the use of these devices in production fields handling high fluid output levels. The use of VSDs causes some difficulties when connected to the electrical power system, due to the fact that static power converters produce non-linear loads, affecting the natural sine shape of alternating current, introducing harmonic currents into the electric power network that could cause interference in the communication circuits and damage the equipment installed on the network.

Specially designed transformers called phase shift transformers can help to mitigate the effect of speed drives when connected to the network, by helping to reduce the harmonics reaching the electrical network, depending on the number of pulses of the VSD. This harmonic distortion may be mitigated by increasing the number of rectifying sections used in the VSD; for instance, a 12 pulse converter has 2 rectifiers sections that are 30° out of phase, an 18 pulse converter has 3 rectifiers with a phase shift of 20° and a 24 pulse converter has 4 rectifiers that are 15° out of phase. Therefore, the larger the number of pulses, the smaller the trigger distance between waves, resulting in a shorter distance between wave crests and thus in lower harmonic distortion.

It is important to take into account that, the higher the number of pulses, the more complex the system becomes and therefore the cost of the required equipment will be considerably higher.

Scope of the offer
Manufactured in accordance with applicable ANSI, IEC and NTC standards and/or specific customer specifications.

Voltages
Three-phase: 260 kVA to 1500 kVA.

Connection type:
Delta - ZigZag

Product Description

The Magnetron 24-pulse PST has been specifically designed for the connection of variable speed drives used in ESP to the electric power distribution grid, based on Magnetron's extensive knowledge of transformer design and manufacture and on the technological developments of the main manufacturers of variable speed drives, resulting in a device that is a perfect fit to meet the technical and economic needs of the oil industry.

The 24-pulse step-down phase-shift transformer has a primary winding designed for connection to power sources with voltages of 34.5kV, 13.8kV, 13.2kV, 4.1kV, 0.48kV. (Bear in mind that the transformer is designed only for one type of power source voltage.) Not switchable from 13.8kV to 13.2kV or any of the other options. There are four secondary windings, each at 480V, 15° out of phase with each other, for connection to 24-pulse variable speed drives.

Special cases:

o Transformers with different primary or secondary winding voltages from those indicated here can be manufactured upon review of the requirements by our engineering group.

Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, determined in accordance with the type of transformer, and placed in a tank that provides the equipment with specific features, depending on its intended application.

Coils:

Concentric circular or rectangular sections with copper or aluminum windings.
Insulation: High-quality paper coated with epoxy resin.

Cores:

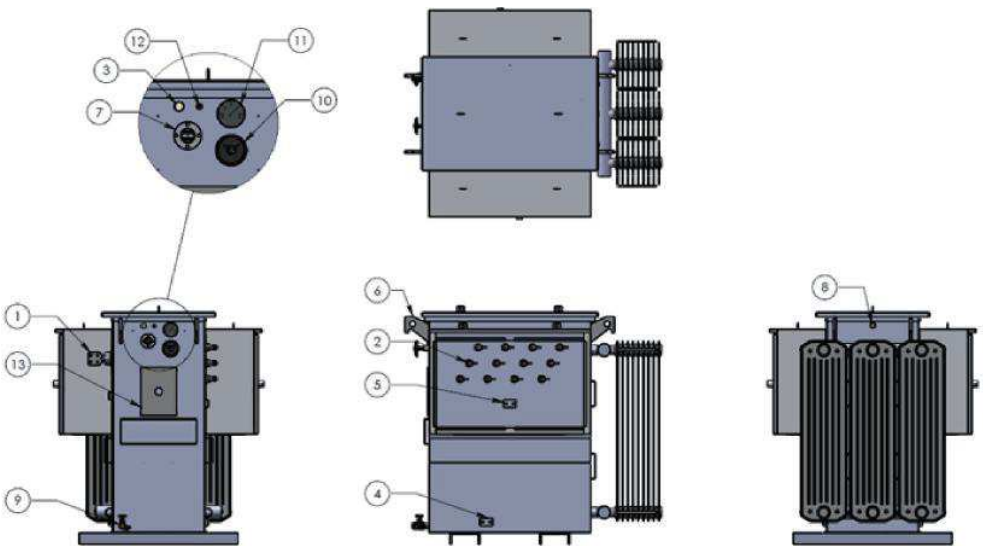
Shell Type or Core Type, wound or stacked, set up in groups for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents.
Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

Yoke clamps:

Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
Ensure high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

Tanks:

Rectangular in shape, made of cold rolled or hot rolled steel plates with reinforcements capable of withstanding internal pressures due to temperature rise and mechanical stresses due to equipment installation and handling. Three-phase TANKS include a cabinet that is studded or welded to the transformer and serves as protection for the Low Voltage and Medium Voltage circuits, with a mechanical locking system which, for safety reasons, prevents opening of the compartments without the appropriate key.



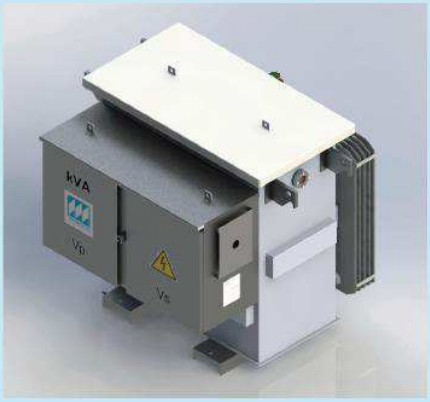
ITEM	DESCRIPTION	QUA
1	Primary insulator	3
2	Secondary insulator	12
3	Pressure relief valve	1
4	Tank grounding	2
5	PV/SV grounding	2
6	Lifting lugs	4
7	Oil level	1
8	Fill plug	1
9	Drain valve	1
10	Oil Thermometer	1
11	Vacuum Pressure Gauge	1
12	Nitrogen filling	1
13	Nameplate	1

Application:

The electrical submersible pump (ESP) system is intended to lift large volumes of fluids in an efficient and cost-effective manner. Several variables in the lifting process affect the production level. The variable speed drive (VSD) enables the operator to control performance of the ESP system, changing the speed of the motor installed at the bottom of the well, by making changes in the frequency.

Fluid production at the surface is affected to a large extent by the motor operation. Motors installed at the bottom may generate a maximum torque depending on the voltage applied to their terminals at a given frequency. Due to the differences in fluid properties, it is necessary to vary the motor speed in order to obtain the maximum torque; this is achieved by modifying the voltage applied at the motor terminals. This is one of the reasons for using VSD in ESP systems.

Typically, VSD output voltages are lower than those required by the ESP system motor for optimal operation. In addition, since the VSD operating frequency varies depending on the well characteristics and, given that the VSD wave contains harmonics, use of a conventional transformer is not possible in these cases. For these reasons, a special step-up transformer must be used.



Scope of the offer:
Manufactured in accordance with applicable ANSI, IEC and NTC standards and/or specific customer specifications.

Volt/Hz Ratio (V-boost)
10.67

K factor
2, 4, 6, 9, 12, 20.

Product Description
The Magnetron ESP-SUT has been specifically designed for electric-submersible pumping of oil, combining Magnetron's extensive expertise in transformer design and manufacture, with the advanced technology of the main ESP Service Providers, resulting in a perfectly matched team to address and meet the technical and economic needs of the oil industry.

Typical construction mode:
Transformers typically consist of an active part made up of the core (magnetic circuit), the coil (electric circuit) and the yoke clamp, which is determined in accordance with the type of transformer, and placed in a tank that provides the equipment with specific features, depending on its intended application.

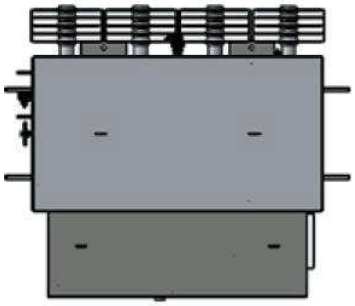
Coils:
Concentric circular or rectangular sections with copper or aluminum windings.
Insulation: High-quality paper with epoxy resin coatings.

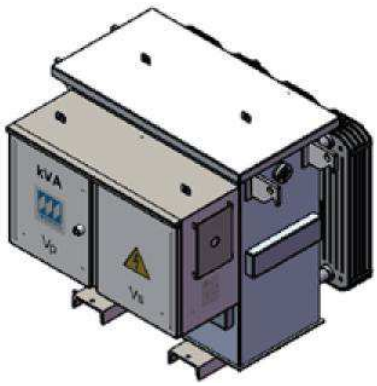
Cores:
Shell Type or Core Type, wound or stacked, set up in groups for easy assembly and disassembly without loss of dimensional characteristics, guaranteeing low losses and excitation currents.
Materials: Cold-rolled grain-oriented silicon electrical steel sheet with insulating coating on both sides, low core loss and high permeability.

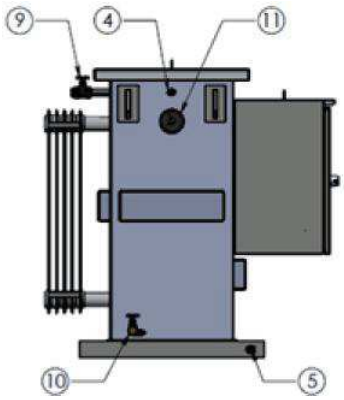
Yoke clamps:
Made of cold-rolled and hot-rolled steel, they clamp the core, with individual bolted caps enabling easy disassembly for maintenance purposes.
They ensure high resistance to short circuit mechanical stresses, low noise levels and low excitation currents.

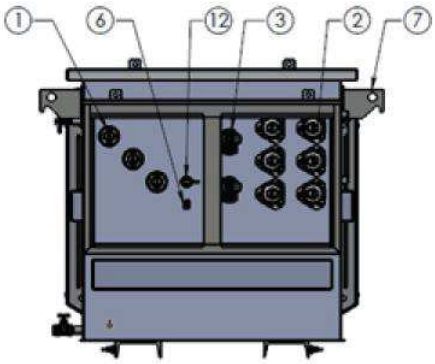
Tanks:
Rectangular in shape, made of cold-rolled or hot-rolled steel plates with reinforcements capable of withstanding internal pressures due to temperature rise and mechanical stresses due to equipment installation and handling. Three-phase TANKS include a cabinet that is studded or welded to the transformer and serves as protection for the Low Voltage and Medium Voltage circuits, with a mechanical locking system which, for safety reasons, prevents opening of the compartments without the appropriate key.

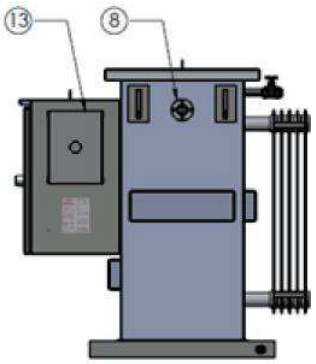
ITEM	DESCRIPTION	QUANT
1	Primary insulator	3
2	Secondary insulator	6
3	Tap Changer	2
4	Pressure relief valve	1
5	Tank grounding	2
6	Electrostatic screen grounding	1
7	Lifting lugs	4
8	Oil level	1
9	Fill valve	1
10	Drain valve	1
11	Oil Thermometer	1
12	Electrostatic shield insulator	1
13	Nameplate	1











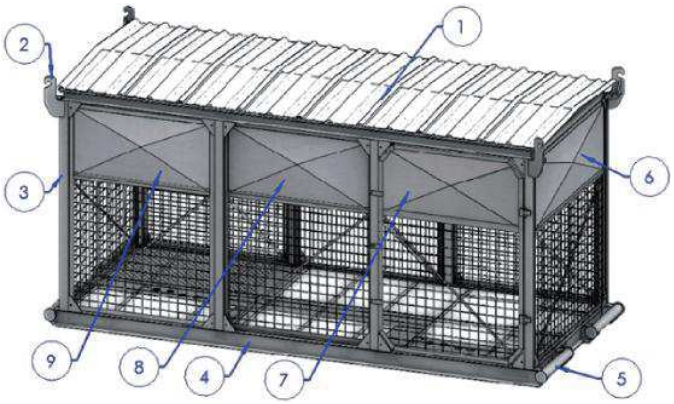
SKID

General:

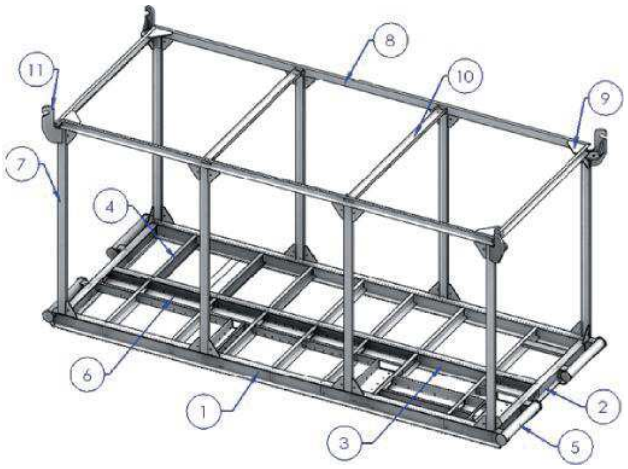
The electrical submersible pump (ESP) system is intended to lift large volumes of fluids in an efficient and cost-effective manner. The system can be divided into two main equipment groups, located downhole and at the surface, and connected to each other by a power cable.

The need to protect people and the environment, while maximizing operational functionality of the surface equipment led to the development of Skids for this specific application.

Main Components



No.	DESCRIPTION	MATERIAL
1	COVER	ZINC PLATE, SQUARE PIPE FRAME
2	LIFTING LUGS	HR SHEET
3	STRUCTURAL COLUMNS	C-PROFILE
4	SIDE BEAMS	IPE PROFILE
5	DRAGGING PIPES	ROUND PIPE
6	SIDE PANEL	ANGLE, MESH, SHEET
7	HINGED DOOR	STEEL ANGLE, MESH, SHEET, HINGES
8	SLIDING DOOR	ANGLE, MESH, C-14 SHEET, RAIL AND ROLLERS
9	FRONT PANEL	ANGLE, MESH, SHEET



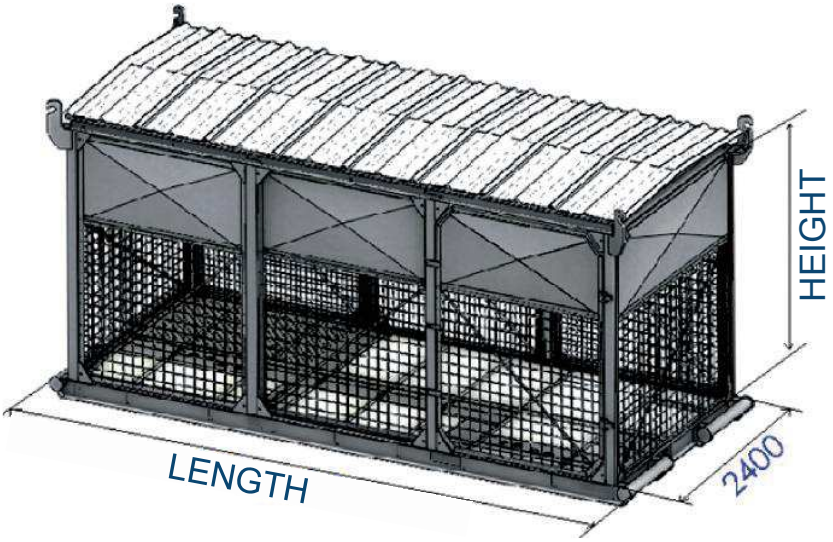
No.	DESCRIPTION	MATERIAL
1	SIDE BEAMS	IPE PROFILE
2	BASE ENCLOSURE	IPE PROFILE
3	MAIN BEAM	IPE PROFILE
4	BASE SUPPORT	C-PROFILE
5	DRAGGING PIPES	SCH 40 ROUND PIPE
6	SUMPS	HR SHEET
7	STRUCTURAL COLUMNS	C-PROFILE
8	UPPER FRAME	C-PROFILE
9	PERIMETER REINFORCEMENTS	HR SHEET
10	FRAME REINFORCEMENTS	C-PROFILE
11	LIFTING LUGS	HR SHEET

SKID

Magnetron Skid:
The Magnetron Skid has been specifically designed for surface equipment used in electrical submersible pumping of oil, resulting in a perfectly matched system to address and meet the technical and economic needs of the oil industry.

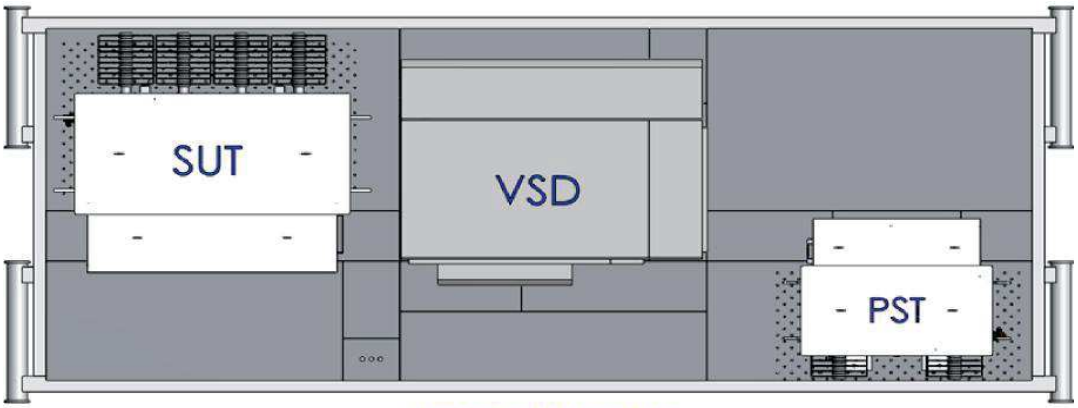
Skid dimensions / Voltages (kVA):

LENGTH	WIDTH	HEIGHT	kVA	ROOF OPTIONS	LIFTING OPTIONS	ACCESS OPTIONS
6 and 7 m	2.4m	2.3 - 2.5m	130-260-400-520-750.	Fixed or sliding	Top lifting lugs	Front and back



*The dimensions indicated here are estimates and are not to be used for the design of civil works.

Typical skid distribution for 3 devices



VISTA SUPERIOR
TOP VIEW

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