

Transformer Solutions from Schneider Electric

Schneider
Electric™

Table of Contents

Title	Page
Minera MP	
● Minera MP oil immersed medium power transformer	4
● The right tune for your network	4
● High quality level for more reliability	5
● Customer benefits	5
● Technical characteristics	6
Minera	
● Minera Oil-Immersed Transformers Up to 5 MVA - 36 kV	8
● The right tune for your network	8
● High quality level for more reliability	9
● Customer benefits	9
● Technical characteristics	10
Trihal	
● The new worldwide quality reference	12
● Climatic test C3*	12
● Environmental test E3	13
● Fire withstand F1	13
● Partial discharges ≤ 5 pC	14
● Customer benefits	14

Minera MP

Oil Immersed
Medium Power Transformers



Electrical
Energy



Wind
Farm



Refinery



Mining,
Minerals
& Metals



> Minera MP oil immersed medium power transformer

Minera MP oil-immersed medium voltage power transformer is dedicated to all applications up to 100 MVA and is designed to meet your needs. Our broad range for Minera MP transformers includes:

- > Three phase units (single phase available on request)
- > Ratings up to 80 MVA, 50 or 60 Hz
- > Voltage insulation level up to 170 kV
- > Breathing or sealed type
- > A wide range of accessories
- > High capacity cooling options such as ONAN, ONAF, OFAF, OFWF or others upon request
- > Standard or low noise levels
- > Off-circuit tap changer (OCTC) or on load tap changer (OLTC)

Minera MP oil-immersed transformers are also available upon request for special applications including rectifier, hazardous area transformers, reactors (shunt and series), auto-transformers, step-up transformers, Solar power plant , Wind Mill Application etc.

Minera MP oil-immersed transformers meet the requirements of international standards such as ANSI, IEEE, IEC as well as other international/national standards.



> The right tune for your network

Depending on your application and the different environmental influences you meet, we are able to deliver you a large variety of Minera MP transformers. Schneider Electric's R&D team has created special designs for all your particular needs:

- > Breathing type and sealed type,
- > For indoor application in buildings or industrial plants and in compact distribution substations,
- > For outdoor applications,
- > Normal noise level for urban or residential areas
- > Normal, low or very low level of losses

As customer satisfaction is our main concern, we constantly improve our manufacturing process, thus we are able to speed up delivery time while ensuring that all ISO 9001, ISO 14001 and/or ISO 18001 requirements are met at each production step. To ensure this high level of quality, our Minera MP transformers undergo routine tests in accordance with international standards such as IEC, ANSI standards. We can also provide type tests or special tests on request.



ISO 9001, ISO 14001 and ISO 18001
Transformers units certifications

> High quality level for more reliability

Our company follows a policy of continuous improvement taking into account the latest worldwide developments. This ensures that our transformers are state-of-the-art and fully compliant with the modern world's highest requirements: fast delivery time, improved quality and recycling capacities, reduced size and, on request, very low noise and losses values.

Magnetic core

The transformer's magnetic core is manufactured from a high grade, cold-rolled, grain-oriented silicon steel. The lamination stacking is step lap type. The magnetic core is generally a multi-layer circular cross section and the slitting and cutting of the magnetic core is made by automated machines. In order to reduce transformer sound level to a minimum, the magnetic core and its framework are carefully sized to minimize the vibrations and, in particular, magnetostriction effects, which constitute the main sources of sound in medium power transformers. Moreover, in order to reduce the no-load losses and / or the no-load transformer current, the quality of the magnetic steel and the induction, together with the design of the magnetic core, are carefully chosen to meet the requirements.

Tank construction

The main tank construction type is panel radiator type. The corrugated wall tank is also available in some ranges. Radiators are welded or removable. Tank welding is done by qualified welders. To validate the oil-tightness after complete assembly, the tank is leak tested under gas or liquid overpressure.

Low voltage windings

The low voltage winding material is copper or Aluminium according to the rated power. The shape of the conductor is rectangular or

foil type. To obtain a controlled temperature gradient, cooling ducts are added in the coil. The low voltage winding is built around the magnetic core. An insulating barrier is wound or installed around the low voltage coil in order to provide an electrical separation between LV and HV coils.

Surface protection

One of our major quality commitment is to provide high-quality surface protection. The coating (painting) type is chosen in accordance with the environmental conditions considering the degree of pollution, humidity, etc. Zinc Spray / Hot dip galvanized Tank, HV/LV covers and conservator can also be provided.

High voltage winding

The high voltage winding material is copper or Aluminium according to the rated power. To obtain a controlled temperature gradient, the cooling ducts are added in the coil. High voltage coils are in long layers or disc type. Due to recent developments in the winding process, interlayer insulation and wire insulation have allowed the automation of the winding process.

Tappings

The tap changers allow voltage adjustment for a variation of the supply network voltages on the primary side of the transformer or for increasing or decreasing the secondary voltage. Tappings are provided on the primary winding connected to an off-circuit or on-load tap changer. The operating handle for hand operated tap changer is mounted outside. In general, tapping range for off-load tap changer is 3, 5 or 7 position and for on-load tap changer it is from 7 to 27 positions. We provide tap position & range as per customer requirements.

> Customer benefits

- > Extremely versatile
- > Robust construction
- > High quality and reliability
- > Continuous improvement
- > Tailor made
- > Highly economical thanks to reduced operating and maintenance costs
- > Strong after sales support



> Technical characteristics



Oil-immersed medium power transformers	With oil conservator or sealed
Manufacturing standards	IEC, ANSI, BS, AS, GOST, IEEE, IS, BS, etc.
Rated power	4 MVA - 100 MVA
Voltage level	Up to 170 kV
Phases	One or three phase unit
Voltage regulation	With off-circuit tap changer or on-load tap changer
Short circuit impedance	On request as per customer requirement
Rated frequency	50 Hz or 60 Hz
Vector groups	Dy, Yy, Yd as standard, others on request
Material thermal class insulation	According to IEC 60085 class A, and as per customer requirement
Temperature rise	<p>Mean winding temperature rise: 65 K Top oil temperature rise: 60 K With ambient temperature in accordance with IEC 60076-1 The temperature of the oil cooling air should not exceed:</p> <ul style="list-style-type: none"> • 20 C yearly average • 30 C monthly average during the hottest month • 40 C at any time <p>For others ambient temperatures, winding and oil temperature rise can be adapted</p>
Type of cooling	ONAN (Oil Natural Air Natural) (ONAF, OFAF, ODAF, OFWF or ODWF on request)
Dielectric liquid	Mineral oil according to IEC or ANSI standard (silicon, synthetic ester or vegetal oil on request).
Short circuit withstand ability	The transformers are designed to withstand the thermal and dynamic effects resulting of a secondary short-circuit in accordance with IEC 60076-5.
Sound level	The measurement (A-weighted sound pressure LpA) and the calculation of sound level (A-weighted sound pressure LwA) are done in accordance with IEC 60076-10. The sound level requirements are in accordance with national standards.
Installations	Indoor or outdoor
HV & LV terminals	HV terminals: plug-in or porcelain bushings LV terminals: busbars or porcelain bushings On request: cable boxes according to client / manufacturer standard or norm (i.e BS) requirements
Accessories	<ul style="list-style-type: none"> • Standard: lifting lugs, earthing terminal, name and rating plate, oil filling plug, tap changer, bidirectional rollers if applicable. • Standard for sealed transformers: filling pipe or gas filling valve, oil drain valve, oil thermometer, oil level indicator. • Standard for transformers with conservator: oil level indicator, Buchholz relay, oil thermometer, dehydrating breather, terminal box, oil filling & draining valves, filtering valves. <p>On request: pad lock / locking device for HV plug-in bushings, pressure relief device, pressure relay with contact, explosion vent, winding thermometer, sudden pressure relay, pressure monitor, rubber bag (only for conservator type), Gas analyzing purpose systems (such as Hydran), Seal-in Relay, Current Transformers for protection and measuring, Automatic Voltage Regulator Panel for OLTC, etc.</p>

Minera

Oil-Immersed
Distribution Transformers



Electrical
Energy



Wind Farm



Oil and Gas



> Minera Oil-Immersed Transformers Up to 5 MVA - 36 kV

Depending on the methods and the standards applied in your country, a transformer should be best adapted to the structure of your distribution network while offering the most cost-effective solution. With a large industrial world-wide platform, we offer versatility and flexibility and are able to deliver you the oil-immersed distribution transformer to meet your needs. Whatever the transformer type you require, you will find your solution in Minera.

Quality based upon years of experience

With more than 80 years of experience and over two million oil-immersed transformers installed worldwide, you can be sure of investing in a proven technology, constantly enhanced in our competence centers.

Your solution in Minera

Our standard range of Minera transformers is available as:

- > Three phase units (single phase available on request)
- > With ratings up to 4 000 kVA, 36 kV, 50/60 Hz
- > With conservator or hermetically sealed type
- > Ground, pad or pole-mounted
- > Naturally cooled (ONAN), air forced (ONAF) or other type of cooling upon request
- > With normal or low noise or loss levels

We also offer (upon request) higher ratings up to 100 MVA, 170 kV and transformers for special applications (rectifier, hazardous area, earthing, welding, transformers with OLTC, reactors, solar power plant, wind mill application etc.).



> The right tune for your network

Our company follows a policy of continuous improvement taking into account the latest worldwide developments. This ensures that our transformers are state-of-the-art and fully compliant with the modern world's highest requirements: fast delivery time, improved quality and recycling capacities, reduced size and, on request, very low noise and losses values.

Depending on applications and environmental influences, you will require a different type of oil-immersed transformer. We can deliver every type of Minera:

- > Hermetically sealed or breathing type
- > For indoor applications in buildings or industrial plants and in compact distribution substations
- > For outdoor applications: ground mounted but also pad or pole mounted
- > Low noise level for urban or residential areas
- > Normal, low, or very low level of losses

As customer satisfaction is our main concern, we constantly improve our manufacturing processes, thus we are able to speed up delivery times whilst ensuring a high level of quality.

All our production sites of Minera oil-immersed transformers are ISO 9001, ISO 14001 and ISO 18001 certified. To ensure this high level of quality, our Minera transformers undergo routine tests in accordance with IEC standards. We can also proceed to type tests or special tests on request.



ISO 9001, ISO 14001 and ISO 18001
Transformers units certifications

> High quality level for more reliability

Magnetic core

The magnetic core of the transformers is manufactured from a high grade, cold rolled grain oriented silicon steel. The stacking of the laminations is either butt lap or step lap type. The magnetic core is generally of a multi-layer, circular cross section type, where the slitting and cutting of the magnetic core is done by automatic machines. In order to reduce the sound level of the transformer to a minimum, the magnetic core and its framework are carefully sized to minimize the vibrations and in particular, the magnetostriction effects which constitute the main sources of sound in distribution transformers. In addition, in order to reduce the no load losses and / or the no load current of the transformer, the quality of the magnetic steel and the induction together with the design of the magnetic core are carefully chosen to meet the requirements.

Surface protection

One of our major quality commitment is to provide high-quality surface protection. The coating (painting) type is chosen in accordance with the environmental conditions, considering the degree of pollution, humidity, etc. Zinc Spray / Hot dip galvanized tank, HV/LV cover and conservator may also be provided.

Tappings

Tap changers allow voltage adjustment for a variation of the supply network voltages on the primary side of the transformer, or for increasing or decreasing the secondary voltage. Tappings are provided on the primary winding and connected to an off-circuit tap changer. The operating handle for the hand-operated, off-circuit tap changer is mounted outside. The standard tapping range is $\pm 2 \times 2.5\%$. However we can provide tapping range as per customer requirement. For adjustment operations, the transformer needs to be de-energized. However, on

request for special applications, an on load tap changer can be provided.

High voltage winding

The high voltage winding material is either copper or aluminum: the choice depends on the load losses and on the rated power. The shape of the conductor is either of a round or rectangular type. To obtain a controlled temperature gradient, cooling ducts are added in the coil. High voltage coils are in long layers or of disc type. Due to recent developments in the winding process, interlayer insulation and wire insulation have allowed the automation of the winding process.

Low voltage windings

The low voltage winding material is either of copper or aluminum: the choice depends on the load losses, and on the rated power. The shape of the conductor is either round, rectangular or foil type. To obtain a controlled temperature gradient, cooling ducts are added in the coil. The low voltage winding is built around the magnetic core, and an insulating barrier is wound or installed around the low voltage coil in order to provide an electrical separation between the LV/HV coil.

Tank construction

The corrugated tank (cooling fins) is the most common type used for distribution transformers. The corrugated panels are welded onto the tank sides. Cooling radiators can also be provided on request. To validate the oil-tightness after complete assembly, the tank is leak tested under gas or liquid over-pressure. For hermetically sealed transformers, the cooling fins are designed to compensate for excessive over pressure and to limit the effects of cooling liquid dilatation. Hanging pole transformers are provided with a hanging device welded on the rear side according to national standards.

> Customer benefits

- ✓ Extreme versatility of the range
- ✓ High quality and reliability
- ✓ Economically optimized
- ✓ Capitalization of the losses
- ✓ Easy recycling
- ✓ Proven and permanently
- ✓ Optimized technology
- ✓ Reduced dimensions
- ✓ Solid construction
- ✓ Long life-cycle with low maintenance



> Technical characteristics



Oil-immersed distribution transformers	Hermetically sealed (without conservator) or with conservator
Manufacturing Standards	ANSI, IEC, BS, AS, GOST, IS, IEEE etc.
Rated power	Up to 4 MVA (others rated powers on request)
Insulation level	According to IEC $U_M=1.1, 3.6, 7.2, 12, 17.5, 24, 36$ kV According to ANSI up to 36.5 kV
Phases	3-phase (single phase is applicable on request)
Tappings	$\pm 2 \times 2.5$ % (or different range on request)
Voltage regulations	With off-circuit tap changer (regulation with on-load tap changer is available on request)
Short circuit impedance	$U_k=4$ % for $P \leq 630$ kVA and $U_M \leq 24$ kV $U_k=4$ or 4.5 % for $P \leq 630$ kVA and $U_M=36$ kV $U_k=6$ % for $P > 630$ kVA
Rated frequency	50 Hz (60 Hz on request)
Vector groups	Yzn recommended up to 50kVA with $U_M \leq 24$ kV Yzn recommended up to 100kVA with $U_M=36$ kV Dyn11 for all other rated power (any vector group according to IEC Standards)
Material thermal class insulation	According to IEC 60085 class A
Temperature rise	Mean winding temperature rise: 65K Top oil temperature rise: 60 K with ambient temperature in accordance with IEC 60076-1. The temperature of the cooling air should not exceed: <ul style="list-style-type: none"> • 20 C yearly average • 30 C monthly average of the hottest month • 40 C at any time For other ambient temperatures, winding and oil temperature shall be adapted.
Type of cooling	ONAN (Oil Natural Air Natural) or other type of cooling like ONAF, KNAN, KNAF, ODAF, OFWF, etc.
Dielectric liquid	Mineral oil according to IEC/ANSI Standard on request: silicon, synthetic ester, vegetable oil.
Short circuit withstandability	The transformers are designed to withstand the thermal and the dynamic effects resulting from a secondary short-circuit in accordance with IEC 60076-5.
Sound level	The measurement (A-weighted sound pressure L_pA) and the calculation of sound level (A-weighted sound level L_wA) are done in accordance with IEC 60076-10 or NEMA - TR1. The sound level requirements are in accordance with national standards.
Installations	Indoor and/or outdoor
HV & LV terminals	HV terminals: plug-in or porcelain bushings LV terminals: busbars or porcelain bushings On request: cable boxes according to client/manufacturer standard or norm (i.e BS) requirements
Accessories	- Standard: lifting lugs, earthing terminal, name and rating plate, oil filling plug, off circuit tap changer, bi-directional rollers if applicable (out of scope hanging pole transformer) - On request: pad lock/locking device for HV plug-in bushings and/ or tap changer, protective relay (DMCR®, DGPT2®, RIS®,...), oil level indicator, oil thermometer, pressure relief device, filling valve, drain valve, explosion vent, winding temperature indicator, etc. Accessories for conservator: dehydrating breather, buchholz relay, drain plug, oil level indicator, etc.

Trihal

Dry Type Cast Resin
Transformer



> The new worldwide quality reference

Faithful to the vocation of feeling firsts, our full range Trihal dry type cast resin transformer is now gratified with the highest tests performances level:

- > C3* E3 F1
- > Partial discharges $\leq 5\text{pC}$

Prove of its high grade design and manufacture quality, it will perfectly answer to a critical need for power companies to improve personnel safety and decrease the potential for loss of service to improve personnel safety.



> Climatic test C3*

Climate +++

C1

Lowest ambient temperatures:
> Operation -5°C
> Storage / Transport -25°C

C2

Lowest ambient temperatures:
> Operation -25°C
> Storage / Transport -25°C

C3

Lowest ambient temperatures:
> Operation -50°C
> Storage / Transport -50°C

Thermal shock test proceeded under C2 Climatic test conditions but conducted at -50°C :

- > Temperature lowered to -50°C in 8 hours.
- > Holding at -50°C for 12 hours.
- > Thermal shock test at -50°C .
- > Dielectric tests and partial discharge measurements.
- > Visual inspection



* C2 Thermal shock test carried out at -50°C

> Environmental test E3

Environment +++

E0	<ul style="list-style-type: none"> Normal indoor installation > No condensation, > No considerable pollution
E1	<ul style="list-style-type: none"> > Occasional condensation > Limited pollution
E2	<ul style="list-style-type: none"> > Frequent condensation > Heavy pollution or combination of both > Relative humidity up to 93 %
E3	<ul style="list-style-type: none"> Nearly total condensation or heavy pollution or combination of both > Abnormal level of humidity up to 95% > According to new IEC 60076-16 Standard



Test conducted in two parts according to IEC 60076-11 and IEC 60076-16 standards:

Condensation test

- > 6 hours with 95% humidity (by indirect spraying of water of a conductivity of between 3.6 and 4 S/m)
- > Induced voltage test

Humidity penetration test

- > 6 days at 50 C with 90%(+/-5%) humidity
- > Dielectric tests
- > Visual inspection

> Fire withstand F1

Fire +++

F0	<ul style="list-style-type: none"> > No special fire risk to consider > Except for the characteristics inherent in the design of the transformer, no special measures are taken to limit flammability
F1	<p>Transformers subject to a fire hazard:</p> <ul style="list-style-type: none"> > Self-extinguishing transformer fire > Restricted flammability required > Limited formation of fumes > Limited contribution with calorific energy to the source of fire



The fire behaviour test is conducted in a specific test chamber according to procedure described in IEC60076-11 Standard:

- > 1 ethylic alcohol tank (sufficient quantity for 20 min combustion) burns under the tested coil
- > 1 panel heater in front of the tested coil
- > 1 reflector, concentric to the coil, is fitted opposite the panel heater

The 2 fire-proof effects of the resin used in Trihal made it possible to observe:

- > Immediate self-extinguishing of Trihal as soon as the flames from the alcohol tank and heating of panel cease
- > Absence of halogen products, toxic emissions and opaque smoke



> Partial discharges ≤ 5 pC

Partial discharges +++

≤ 10
pC at 1.3 Un

> Maximum level of partial discharges measured during Routine Test

≤ 10
pC at 1.3 Un

> Maximum level of partial discharges measured during Special Test according to IEC 60076-11 Standard

A partial discharge is the dissipation of energy caused by the build-up of localized electric field intensity.

These phenomena, defined by IEC 60270, cause the insulation to deteriorate progressively and can lead to electrical breakdown.

Integrity of the insulation of a transformer is confirmed during Partial Discharge Analysis and used as a tool to judge the state of the device and the quality of its manufacture.

Prove of our quality advance, acceptance criteria applicable to all new Trihal are now 10 pC during Routine Test or 5 pC in case of Special Test ordered by the customer according to IEC 60076-11 Standard.



> Customer benefits

✓ C3*

- > Resistance to thermal shock
- > Highest performance under severe ambient conditions
- > Superior behaviour on load changes
- > Extended service life

✓ E3

- > Insensitive to total condensation or/and heavy pollution
- > Suitable to installation in harsh environment (e.g Wind turbine)

✓ F1

- > Full safety for all type of buildings
- > Suitable to fire hazard area
- > Guarantee your safety

✓ ≤ 5 pC

- > Improve transformers aging
- > Extended service life





Make the most of your energySM

Schneider Electric India Pvt. Ltd.

Corporate office

9th Floor, DLF Building No.10, Tower C, DLF Cyber
City, Phase II, Gurgaon - 122002, Haryana
Tel: 0124 3940400, Fax: 0124 4222036
www.schneider-electric.co.in

Customer Care Centre :

Toll-free numbers: 1800 180 1707, 1800 103 0011,
General number: 0124 4222040,
Email: customercare.in@schneider-electric.com

