



Minera

Oil-Immersed
Distribution
Transformers



Electrical
Energy



Wind Farm



Oil and Gas

Make the most of your energySM

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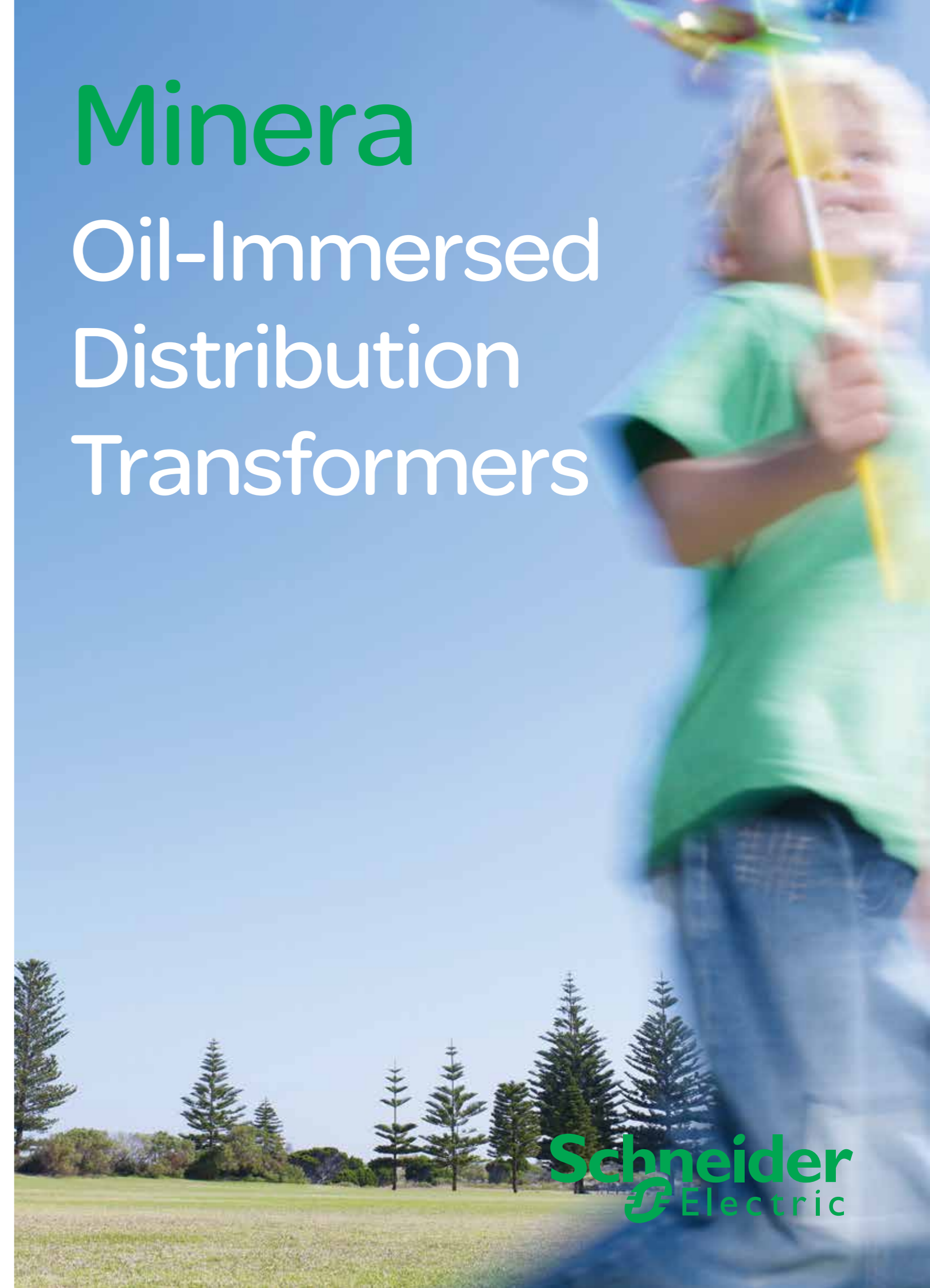
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As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

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Oil-Immersed
Distribution
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> 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.



> 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.



**ISO 9001, ISO 14001 and 18001
Transformers units certifications**

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.).

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.

> 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 $U_n=1.1, 3.6, 7.2, 12, 17.5, 24, 36$ 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 LpA) and the calculation of sound level (A-weighted sound level LwA) 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.