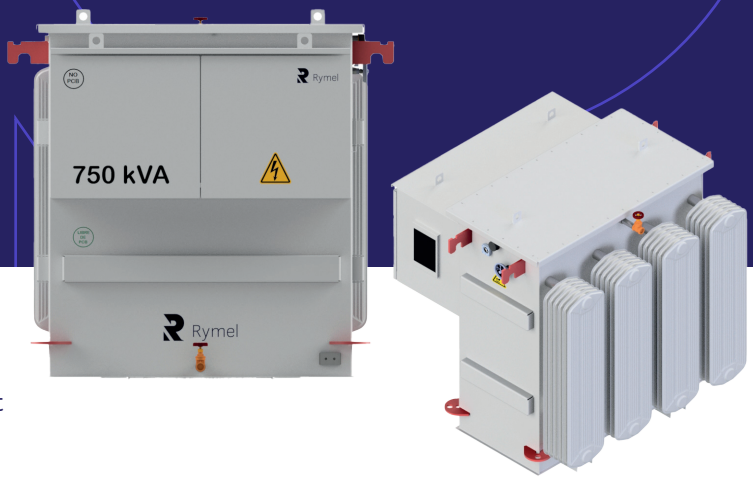
Rymel

SUT & PST TRANSFORMERS



In the oil industry, every second of production counts.

Electric Submersible Pumping (ESP) systems have become the most effective solution for extracting large volumes of crude oil from deep wells, maintaining stable performance even under the most demanding conditions. The reliability and efficiency of an ESP system are key factors in sustaining high production levels. These systems, composed of high-power submersible motors controlled by Variable Speed Drives (VSD), allow precise adjustment of frequency and operating speed, optimizing extraction flow and adapting to the specific characteristics of each well.

However, incorporating a VSD alone is not enough for an ESP system to achieve maximum performance. The power supply must be managed by specialized equipment that ensures the proper voltage, frequency stability, and harmonic control.

At this point, two components become essential:

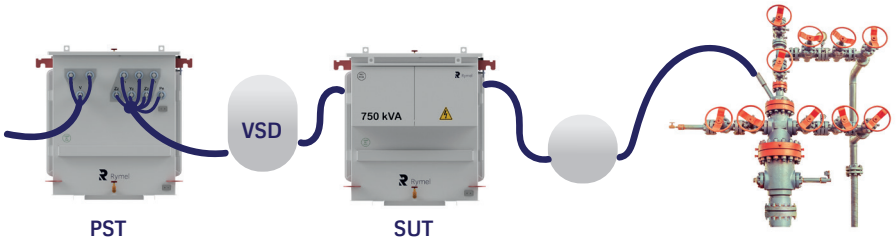
SUT Variable Frequency Transformers (Step-Up Transformer):

- Step-up of VSD output voltage to motor requirements.
- Designed for variable frequency operation.
- Protection against harmonics.
- Filtering of electrical noise.

PST Transformers (Phase Shifting Transformer)

- Minimize harmonic distortion returned by VSDs to the grid.
- Improve power quality and system stability.
- Optimize power factor.
- Increase overall system efficiency.
- Protect associated electrical equipment.

SUT and PST Transformers:
Clean and stable power for enhanced ESP system performance and extended equipment lifespan.



For further information, please contact a Rymel representative

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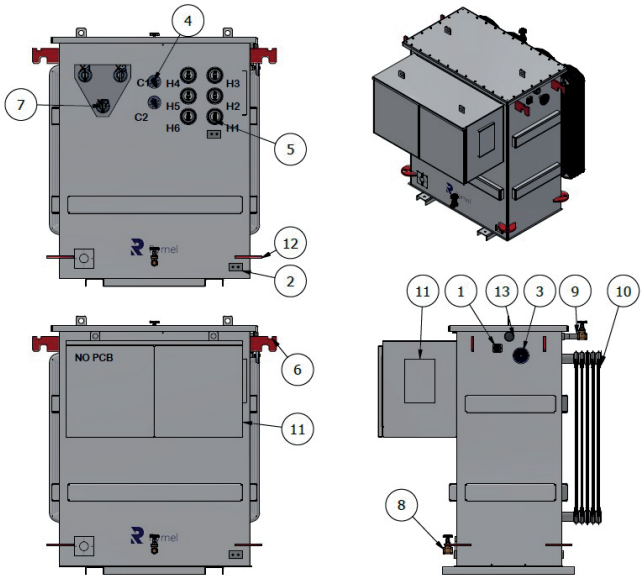
SUT VARIABLE FREQUENCY TRANSFORMERS

For an Electro-Submersible Pumping (ESP) motor to operate with continuous power and reliability, a conventional power supply is not enough. A transformer specifically designed to withstand the extreme conditions of this application is required.

Rymel introduces its SUT (Step-Up Transformer), engineered to:

- Work in perfect harmony with Variable Speed Drives (VSD).
- Step up the VSD output voltage to the optimal levels required by the submersible motor.
- Operate with variable frequency voltages.
- Withstand harmonic distortion without compromising pumping system performance.



1. Oil Level Indicator
2. Tank Grounding Terminal
3. Thermometer
4. *Fine Tap Changer
   *Coarse Tap Changer
5. High Voltage Bushings and Terminals
6. Lifting Device
7. Low Voltage Bushings and Terminals
8. Drain Valve
9. Oil Filling Valve
10. Radiators
11. Cabinet
12. Supports
13. Pressure Relief Valve

SUT VARIABLE FREQUENCY TRANSFORMERS	
Power Ratings [kVA]:	150 to 1250
Series voltage [kV]:	8.7 / 1.2
Voltage HV [V]	1000 - 5000
Voltage LV [V]:	480
Number of Phases:	3
Operating Frequency Range [Hz]:	10 - 90
Vector Group:	Dd0 / Ynd1
Mounting Type:	Outdoor
Standards:	NTC, IEEE
Winding Temperature Rise:	65 C
BIL [kV]	75 / 30
K Factor	1 to 20
Insulation Class	Ao
Insulating Fluid	Mineral Oil or Natural Ester Fluid
Cooling	ONAN KNAN
Tap Changer	25 positions

Note: For voltage ranges different from those listed, please consult the factory.
For higher or lower power ratings, please consult the factory.

Special Features:

- Incorporates 2 Tap Changers for fine and coarse adjustment
- Capability to operate with multiple frequencies
- Includes an electrostatic shield
- Harmonic support capability
- Electrostatic paint coating

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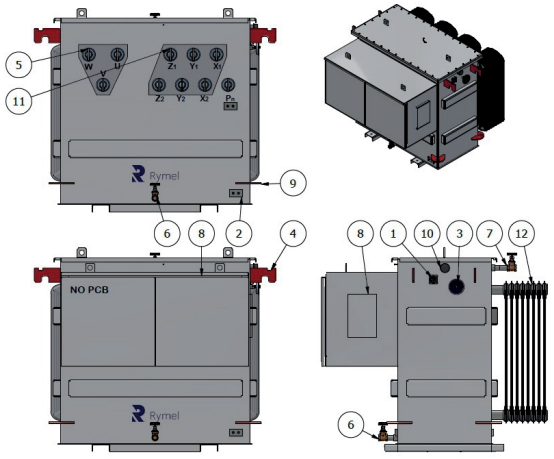
PHASE SHIFTING TRANSFORMERS (PST)

Variable Speed Drives (VSD) provide precise control of electric submersible pumps (ESP). However, by generating harmonics in the electrical network, they can reduce efficiency, cause interference, overheating, and even premature failures in other connected equipment.

To improve system performance and mitigate harmonic distortion in the power grid, Rymel has developed specialized Phase Shifting Transformers (PST). These transformers feed VSDs through multiple three-phase output groups, each phase-shifted with respect to the input voltage, without altering its frequency or magnitude.

By minimizing harmonic distortion returned to the grid, the PST improves power quality, optimizes the power factor, and enhances overall system efficiency, while also protecting associated electrical equipment.

This effect is achieved through specific winding configurations that generate a controlled angular displacement of 30° between two three-phase output groups.



1. Oil Level
2. Tank Ground
3. Thermometer
4. Lifting Device
5. Primary Bushings and Terminals
6. Drain Valve
7. Oil Fill Valve
8. Cabinet
9. Support
10. Pressure Relief Valve
11. Secondary Bushings and Terminals
12. Radiators

PHASE SHIFTING TRANSFORMERS (PST)	
Power Ratings [kVA]:	150 to 1250
Series voltage [kV]:	15 / 1.2
Voltage HV [kV]	13.2, 13.8, 0.48
Voltage LV [V]:	480
No of Input phases:	3
No of Output phases:	6
Pulse number:	6 -12 - 18 - 24
Mounting Type:	Outdoor
Standards:	NTC, IEEE
Winding Temperature Rise:	65 C
BIL [kV]	95 / 30
K Factor	1 to 20
Insulation Class	Ao
Insulating Fluid	Mineral Oil or Natural Ester Fluid
Cooling	ONAN KNAN
Connection group	Dd0yn1 Transformers

Note: For customized power ratings, please contact the factory.

Special Features:

- Includes an electrostatic shield
- Provides two sets of three-phase outputs, phase-shifted by 30°, ideal for 12-pulse VSDs
- Harmonic support capability
- Electrostatic paint coating

For more information, please contact a Rymel Consultant

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COMPARATIVE BENEFITS – SUT AND PST TRANSFORMERS

SUT VARIABLE FREQUENCY TRANSFORMERS

- **Precise Voltage Adjustment**
  Raises and regulates the voltage supplied by the VSD to the optimal level required by the submersible motor, ensuring maximum performance.
- **Variable Frequency Operation**
  Designed to operate seamlessly with the variable-frequency power supplied by VSDs.
- **Harmonic Support**
  Withstands harmonic content without efficiency loss, preventing damage or premature wear.
- **Advanced ESP System Protection**
  Filters electrical noise and voltage spikes, protecting the submersible pump and extending the overall system lifespan.
- **Higher Efficiency and Production**
  Optimizes ESP system performance, maximizing oil and gas extraction.
- **Control and Cost Reduction**
  Enables precise control of pump speed, reducing mechanical wear and energy consumption.
- **High Operational Versatility**
  Equipped with coarse and fine tap changers, allowing adaptation to the specific conditions of each well.

PHASE SHIFTING TRANSFORMERS (PST)

- **Precise Voltage Adaptation**
  Adjusts the voltage to the exact levels required by the VSD, ensuring a stable and efficient power supply.
- **Harmonic Distortion Reduction**
  Decreases harmonics generated by VSDs, preventing interference and overheating in connected equipment.
- **Improved Power Factor**
  Helps optimize the power factor and enhance overall power quality.
- **Comprehensive Harmonic Support**
  Operates without performance loss or reduced lifespan, even under high harmonic conditions.
- **Greater Operational Efficiency**
  A better power factor and lower harmonic content allow the VSD to operate at maximum efficiency, reducing energy losses.
- **Reduced Electromagnetic Interference**
  Minimizes failures in control, instrumentation, and communication systems connected to the same network.
- **Protection for the VSD and ESP System**
  Filters electrical noise and high-frequency voltage spikes, extending the lifespan of the equipment.

Accessories and Design Conditions

- Additional accessories—such as thermometer with contacts, pressure relief valve with contacts, magnetic oil level indicator, winding thermometer, and cooling fans, are quoted upon customer request at an additional cost.
- Equipment design and layout subject to change without notice.