

# POWER TRANSFORMERS

DRY AND OIL-INSULATED

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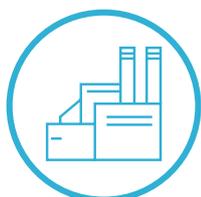
# SCORE OF APPLICATION OF EQUIPMENT



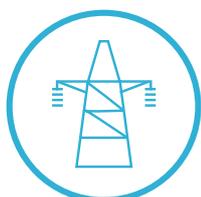
Oil and gas production and processing



Generation



Industrial enterprises



Grid companies, urban networks



Russian Railways



Renewable energy



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# INTRODUCTION

## Electroshield Samara manufactures the following versions of three-phase oil power transformers:

### **TMG-SESH**

- sealed transformer without conservator. No-load voltage adjustment (NLTC). TMGF-SESH - sealed transformer without conservator with flanges on the cover for side busbars connection. No-load voltage adjustment (NLTC).

### **TM-SESH**

-transformer with no-load voltage adjustment (NLTC).

### **TMN-SESH**

- transformer with the expansion tank. On load tap changing.

### **TMF-SESH**

- transformer with flanges on the cover side busbar connection. No-load voltage adjustment (NLTC).

### **TMPNG-SESH**

- sealed transformer for power supply of submersible pumps, without expansion tank. No-load voltage adjustment (NLTC).

### **TMPG-SESH**

- transformers for power supply of 24 pulse variable - frequency asynchronous valve electric drive with low-harmonics current option.

### **TNG-SESH, TNGF-SESH**

- power transformers for distribution network 10 kV (with flanges on the cover for side busbars connection or without them) filled with fire retardant dielectric liquid. OL-SESH, OLS-SESH low -power transformers.

### **TLSZ-SESH**

- distribution dry-insulated cast resin transformers (power 25 - 100 kVA). May be completed with protective cover.

## Oil-insulated transformers are manufactured on advanced equipment using cutting-edge technologies:

- magnetic core stacking using the five-stage STEP-LAP technology;
- oil filling in vacuum chamber;
- corrugated tank with powder coating;
- automated quality control system.

## 11 series transformers

Due to higher quality design transformers of this series are lighter and lighter and more compact in comparison with transformers of previous series, while maintaining all basic advantages of previous series transformers.

## 12 series energy - efficient transformers

In line with the worldwide trend of increase in cost of energy resources the issue of losses reduction in distribution transformers which make up major part of all power transformers fleet gains prime importance. Energy -efficient transformers have the lowest level of no-load and short circuit losses of all power transformers commercially available in the CIS.

Technical specifications of these transformers are presented in ORT.135.020 TI.

The low level of losses is achieved through the use of more efficient materials resulting in increased price of the transformer, however this price increase is paid back in short time.

### **Example on energy saving at daily average load of 0,7:**

- for transformer with power of 400 kVA annual energy savings will amount to 7 500 kW/hour;
- for transformer with power of 630 kVA annual energy savings will amount to 5 800 kW/hour;
- for transformer with power of 1000 kVA annual energy savings will amount to 5 200 kW/hour;
- these figures become even more attractive at high medium transformer load.

## 14 series transformers

For technological processes with increased fire hazard, a very important role is played by the choice of electrical equipment with the use of fireproof materials. When choosing a transformer, preference can be given to transformers with dry insulation and transformers filled with flame retardant dielectrics.

## 15 series transformers

Transformers for reconciliation scheme and voltage.

# GENERAL INFORMATION

## Transformers are composed of the following main components:

- Case;
- Active part (carcass, windings, insulation, taps, switching device);
- HV and LV bushing terminals;
- Control-measurement and protection apparatus.

## The transformer case

is a metal welded rectangular structure consisting of the tank and the cover. The external design surface is painted with a powder painting of light color. The joint is sealed with the oil and petrol resistant rubber gasket.

The distribution transformer tank consists of the upper frame, corrugated walls and the bottom. Support beam channels are welded to the bottom. Corrugated tanks of transformers are entirely safe and highly reliable. The oil-drain valve is provided on the tank bottom side wall along with two grounding contacts.



## The active part consists of the following units:

- Carcass;
- HV and LV windings;
- Insulation;
- HV and LV taps;
- Switching device;
- Assembly units.

## The transformer carcass

Magnetic system is the main part of the carcass and this system consists of vertical rods overlapped by horizontal yokes from the top and bottom in order to form the closed magnetic circuit. The magnetic core is stacked from sheets of cold-roller electric steel using the STEP-LAP technique (5 stages). At present the step stacking with chamfered joints is the most advanced technique of all known techniques which ensures minimum no-load losses. Yokes are tightened by means of yoke beams, beam channels and tension studs.



## HV and LV windings

The basic factor governing geometrical dimensions of the transformer is the active wire space factor of the cross section of the magnetic conductor aperture. Use of aluminum tape in the LV transformers windings instead of rectangular winding wires provides for increase of the winding space factor.

Tape windings significantly increase transformer electrodynamic withstand.

The windings of the transformer are layered, have cylindrical form and are installed on the rod of the carcass in the following order, starting from the rod: LV (low voltage) winding, HV (high voltage) winding.

The LV winding is made of aluminum or copper tape with interlayer insulation.

The HV winding is made of round or rectangular aluminum or copper wire with interlayer insulation.

Interlayer insulation is provided using KREMPEL insulation with sections of hot-melt adhesive which glues together adjacent layers of the windings when drying in thermal chamber. Seamless design is obtained as a result which significantly enhances resistance of the winding to compressive radial electrodynamic forces of short-circuit. Pressing of windings is performed by tightening yoke beams with of vertical pins.



## Windings cooling ducts

In order to enhance heat dissipation between layers of the windings vertical cooling ducts are provided for free oil circulation.

## Taps

Taps are intermediate current-carrying elements providing winding connections with bushing terminals and with switching device in order to form the required electrical circuit.

## Switching device

Is designer for voltage regulation with no excitation at deenergized transformer (NLTC) via connection of respective winding taps.

Components (LV and HV insulator bushings, switching devices, pressure relief valves, gas relays and oil indicators) are presented by high quality instruments of world leading manufactures, which provide reliable operation of transformers through their entire service life.

## Preparation and filling of transformer oil

Besides the corrugated tank other essential conditions for sealed transformers good workmanship are deep degassing prior to oil filling and oil filling under deep vacuum.

Sealed transformers are manufactured completely filled with oil without conservators and without air or gas cushions.

Sealed transformers are manufactured completely filled with oil without conservators and without air or gas cushions. There is no contact of oil with ambient environment which eliminates the risk of transformer oil humidification, oxidation and studge formation. Oil is degassed prior to filling. Oil filling into the tank is performed in special vacuum filling chamber thus significantly enhancing electrical insulation strength of the transformer.

Properties of oil in sealed transformers practically do not change through out the entire service life of the transformer. Transformers are filled with GK grade oil (TU 38.101.1025-85).

## Physical and chemical properties of transformer oil

Specifications	Measuring unit	Transformers 10 kV		Transformers 35 kV
		Value		
		Oil (type G)	Oil (type VG)	Oil (type G)
Breakdown voltage, not less than	kv	50	50	70
Tangent delta at 90°C, no more than	%	0,5	0,5	0,5
Kinematic viscosity: at +50°C, no more than/at -30°C, no more than	mm <sup>2</sup> /C	9/1200	9/1200	9/1200
Acid number, no more than	mg KON per 1g of oil	0,01	0,01	0,01
Anti-oxidative stability:				
-volatile acidity	mg KON per 1g of oil	0,01	0,01	0,01
-sediment, no more than	%	NA	NA	NA
-oxidized oil acid number, no more than	mg KON per 1g of oil	0,1	0,1	0,1
Content of water-soluble acids and alkalis		NA	NA	NA
Content of mechanical impurities		NA	NA	NA
Flash point, not less than	°C	135	125	135
Freezing point, not higher than	°C	minus 45	minus 45	minus 45
Color on the colorimeter, no more than	color units	1,0	1,0	1,0
Oil density at 20°C	kg/m <sup>3</sup>	895	895	895



Transformer selective solvent-refined oil contains not less than 0,2% of antioxidant additive of 2,6 di-tert-butyl paracresol.

## Tests

The whole scope of acceptance tests of transformers is performed at the complex automated test station. All tests data are computer registered, are processed and presented in the form of the finished test report and passport.

Multipurpose wattmeter NORMA 6000 is used as the instrument for measurements of transformers specifications - current, no-load losses, voltage and short-circuits losses, network qualitative characteristics, etc., and all measured data are input into computer by means of this instrument.

## Packaging and transportation

Transformers are delivered to customers completely assembled and filled with transformer oil.

LV and HV bushing terminals are protected with metal casing during transportation.

Transformers may be transported by road, railway or water in conformity with conditions specified in the supply contract.

# POWER TRANSFORMERS

## 10; 15; 20; 35 kV

### FOR DISTRIBUTION NETWORKS

#### Features of distribution transformers:

Three-phase two-winding distribution transformers of the following types:

- TMG-SESH, TMGF-SESH, TM-SESH, TMF-SESH with tap-changing without excitation with 25-25000 kVA power capacity are designed for operation in electrical networks with voltages of 6 and 10 kV;
- TMG-SESH, TM-SESH with 15, 20 kV voltages and 100 - 1000 kVA power capacity;
- TMG-SESH, TM-SESH with 35 kV voltage and 100 - 2500 kVA power capacity with alternating current frequency 50 Hz.

Climatic category of the transformer is specified in the product passport.

Transformers can be operated both with indoor and outdoor installation in regions with moderate and tropical climate, at that:

- Altitude above sea level - no more than 1000 m;
- Operation mode - continuous;
- Ambient temperature:
  - from - 45 °C to +40 °C - for transformer design "U";
  - from - 10 °C to +50 °C - for transformer design "T";
  - from - 60 °C to +45 °C - for transformer design "UHL".
- Relative air humidity
  - no more than 100% at 25 °C - for transformer design "U";
  - no more than 98% at 35 °C - for transformer design "T";
  - no more than 80% at 25 °C - for transformer design "UHL".
- Transformer are not designed for operation in condition of shaking, vibration and shocks, in explosive and aggressive environment.



**TMG-SESH type transformer**



**TM-SESH type transformer**

Transformers are manufactured and tested in accordance with requirement of GOST R 52719-2007 and IEC 60076.

- UHL - moderate cold climate;
- U - moderate climate;
- T - tropical climate.

The following components are mounted on the covers of TM-SESH, TMF-SESH transformers:  
LV and HV bushing terminals, switch actuator, pressure relief valve, transformer lifting lugs and expansion tank housing the following: oil indicator, dryer and filling valve.

TM-SESH, TMF-SESH transformers with power capacity over 1000 kVA are complete with the gas protection relay. Transformers with power capacity of 630 kVA and higher are provided with the thermometer for oil temperature control. Transformer bushing terminals are removable which allows to replace HV insulator without disconnection of the taps. Drawing of bushing terminals are presented in Annex 1.

Transformer bushing are located on its short side and are provided with removable rectangular flanges for connection of joint units.



**TMG-SESH type transformer 35 kV**



**TMGF-SESH type transformer**

## Technical data of 10; 15; 20; 35 kV power transformers

### Specifications of TMG-SESH, TM-SESH, TMGF-SESH, TMF-SESH transformers of voltage class 10 kV of 11 series

Designation	Rated power, kVA	Voltage combination, kV		Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage %	No-load current %
		HV	LV					
TM(G)-SESH-25/10-11	25			Y/YH-0 Δ/YH-11	190	630	4,5	5,0
				Y/ZH-11		750	5,0	
TM(G)-SESH-40/10-11	40			Y/YH-0 Δ/YH-11	260	980	4,5	5,0
				Y/ZH-11		1200	5,0	
TM(G)-SESH-63/10-11	63			Y/YH-0 Δ/YH-11	340	1480	5,5	4,0
				Y/ZH-11		1600	5,2	
TM(G)-SESH-100/10-11	100	6,00/0,40		Y/YH-0 Δ/YH-11	400	2400	4,5	4,0
				Y/ZH-11		2500	5,2	
TM(G)-SESH-160/10-11	160	6,30/0,40		Y/YH-0 Δ/YH-11	560	3300	5,5	4,0
				Y/ZH-11				
TM(G)-SESH-250/10-11	250	6,60/0,40		Y/YH-0 Δ/YH-11	580	3700	4,5	1,9
				Y/ZH-11		4600		
TM(G)-SESH-400/10-11	400	10,00/0,40		Y/YH-0 Δ/YH-11	830	5900	4,5	1,8
				Y/ZH-11		880		
TM(G)(F)-SESH-630/10-11	630	10,50/0,40		Y/YH-0 Δ/YH-11	1050	7900	5,5	1,8
TM(G)(F)-SESH-1000/10-11	1000			Y/YH-0 Δ/YH-11	1550	10800	5,5	1,2
TM(G)(F)-SESH-1250/10-11	1250	11,00/0,40		Y/YH-0 Δ/YH-11	1800	17000	6,0	1,2
TM(G)(F)-SESH-1600/10-11	1600			Y/YH-0 Δ/YH-11	2100	16500	6,0	1,0
TM(G)(F)-SESH-2500/10-11	2500			Y/YH-0 Δ/YH-11	3350	26300	6,0	0,8



Voltage regulation is performed using the no-excitation switch (NLTC) on the high voltage side in the range of 2 x 2,5% of the rated voltage.

**Specifications of TMG-SESH, TM-SESH, TMGF-SESH, TMF-SESH transformers of voltage class 10 kV of 12 series (with reduced no-load losses and short-circuit losses)**

Designation	Rated power, kVA	Voltage combination, kV		Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage %	No-load current %
		HV	LV					
TM(G)-SESH-25/10-12	25			Y/YH-0 Δ/YH-11	110	600	4,5	2,7
				Y/ZH-11		650	5,0	
TM(G)-SESH-40/10-12	40			Y/YH-0 Δ/YH-11	150	880	4,5	2,6
				Y/ZH-11		880	4,5	
TM(G)-SESH-63/10-12	63			Y/YH-0 Δ/YH-11	220	1280	4,5	2,4
				Y/ZH-11		1400	4,7	
TM(G)-SESH-100/10-12	100	6,00/0,40		Y/YH-0 Δ/YH-11	270	1970	4,5	2,2
				Y/ZH-11				
TM(G)-SESH-160/10-12	160	6,30/0,40	10,00/0,40	Y/YH-0 Δ/YH-11	370	2800	4,5	2,0
				Y/ZH-11		3100	4,5	
TMG-SESH-250/10-12	250	10,50/0,40		Y/YH-0 Δ/YH-11	425	3250	4,5	1,9
				Y/ZH-11				
TMG-SESH-400/10-12	400			Y/YH-0 Δ/YH-11	610	4600	4,5	1,8
				Y/ZH-11			5,5	
TMG-SESH-630/10-12	630			Y/YH-0 Δ/YH-11	800	6750	5,5	1,6
TMG-SESH-1000/10-12	1000			Y/YH-0 Δ/YH-11	1100	10500	5,5	1,2
TMG-SESH-1250/10-12	1250			Y/YH-0 Δ/YH-11	1350	13250	6,0	1,2
TMG-SESH-1600/10-12	1600			Y/YH-0 Δ/YH-11	1750	15000	6,0	1,0
TMG-SESH-2500/10-12	2500			Y/YH-0 Δ/YH-11	2400	24000	6,5	0,8

**Specifications of TMG-SESH transformers of voltage class 10 kV of 12 series, improved energy efficient series**

Designation	Rated power, kVA	Voltage combination, kV		Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage %	No-load current %	
		HV	LV						
TM(G)-SESH-25/10-12	25	6,00/0,40		Y/YH-0 Δ/YH-11	86	545	4,5	2,7	
TM(G)-SESH-40/10-12	40			Y/YH-0 Δ/YH-11	130	772	4,5	2,6	
TM(G)-SESH-63/10-12	63			Y/YH-0 Δ/YH-11	178	1154	4,5	2,6	
TM(G)-SESH-100/10-12	100			Y/YH-0 Δ/YH-11 Y/ZH-11	217	1590	4,5	2,2	
TM(G)-SESH-160/10-12	160			10,00/0,40	Y/YH-0 Δ/YH-11 Y/ZH-11	326	2136	4,5	2,0
TMG-SESH-250/10-12	250			Y/YH-0 Δ/YH-11	460	2954	4,5	1,9	
TMG-SESH-400/10-12	400			Y/YH-0 Δ/YH-11	565	4181	4,5	1,8	
TMG-SESH-630/10-12	630			Y/YH-0 Δ/YH-11	695	6136	5,5	1,2	
TMG-SESH-1000/10-12	1000			Y/YH-0 Δ/YH-11	956	9545	5,5	1,2	

**Specifications of TMG-SESH, TM-SESH, TMGF-SESH, TMF-SESH transformers of insulation voltage class 15, 20, 35 kV, series 11**

Designation	Rated power, kVA	Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage %	No-load current %
TMG-SESH-100/35(20)-11	100	Y/YH-0 Δ/YH-11	430	1900	6,5	3,0
TMG-SESH-160/35(20)-11	160		450	3200	6,5	3,0
TMG-SESH-250/35(20)-11	250		650	3700	6,5	2,2
TMG-SESH-400/35(20)-11	400		900	6400	6,5	2,0
TMG-SESH-630/35(20)-11	630		1150	8500	6,5	1,6
TMG-SESH-1000/35(20)-11	1000		1700	12000	6,5	1,4
TMG-SESH-1600/35-01	1600		2500	18000	7,0	1,3
TMG-SESH-2500/35-01	2500		3900	25000	7,2	1,0

## Impedance matching transformers

### Specifications of TMG-SESH, TM-SESH transformers - matching 15 series

Designation	Rated power, kVA	Voltage combination, kV		Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage %	No-load current %
		HV	LV					
TMG-SESH-400/10-15	400	10,00 (6,00)		Y / YH-0 Δ / Y-11 Δ / Y-11 Δ / Δ-0	830	5900	5,5	1,8
TMG-SESH-630/10-15	630				1100	8000	5,5	1,6
TMG-SESH-1000/10-15	1000				1600	11000	5,5	1,2
TMG-SESH-1250/10-15	1250				1800	14400	6,0	1,2
TMG-SESH-1600/10-15	1600				2200	15800	6,5	1,0
TMG-SESH-2500/10-15	2500				2900	26300	6,7	0,8

### Advantages of transformers with connection diagram Y/ZH-11

Windings in three-phase transformers can be interconnected using several types of connection: "star" (designated "Y"), "delta" (designated "Δ") and "zigzag" (designated "Z"). The transformer with Y/YH - 0 circuit may have the so-called balance winding enveloping all windings of three phases. This balancing winding is shortened on itself and has no external terminals. Transformers with this connection diagram are designated as Y(Δ sym)/YH-0 (or TMGSU). Asymmetrical operating modes are possible during three-phase transformers operation caused by phase difference of loads. It can result both in secondary linear voltages unbalance which negatively affects the quality of electrical energy supplied to consumers, and in phase voltages unbalance of HV windings (in practice it is referred to as zero point displacement) which leads to excessive over voltages and to magnetic core saturation.

Zero phase-sequence Z<sub>0</sub> (electromagnetic parameter specifying the potential phase voltage distortion level), represents the governing analysis parameter characterizing operation of three-phase transformers with various windings` connection diagrams.

The higher is the Z<sub>0</sub> value of the transformer, the more load resistance unbalance affects the phase voltages unbalance of transformer windings. Transformers with "zigzag" and "delta" windings connection diagrams are used in order to eliminate the zero sequence current distorting influence upon the HV windings phase voltage system. Full compensation of zero sequence current effect upon the primary HV winding can be achieved in transformers with Y/ZH-11 windings connection diagram with complete electromagnetic coupling between the windings, resulting in complete elimination of phase voltage distorting.

In transformers with Y(Δ sym)/YH-0 windings connection diagram (TMGSU) load asymmetry effect on voltage asymmetry is higher than in transformers with Y/ZH-11 and Δ/YH-11 windings connection diagrams, since it has high zero phase-sequence resistance.

Consequently, transformers with Y/ZH-11 windings connection diagram are most stable in asymmetric operating modes, followed by Δ/YH-11, Y(Δ sym)/YH-0 (TMGSU) in stability descending order. Y/YH-0 connection diagram is unstable.

# TRANSFORMERS FOR POWER SUPPLY OF SUBMERSIBLE PUMPS

TMPNG-SESH type oil transformers with power capacity up to 1200 kVA with 3 kV and 6 kV voltage classes, hereinafter referred to as “transformer” with tap-changing without excitation (NLTC), are designed for power supply of submersible installation of electrical centrifugal pumps to export formation fluid from oil wells.

Operating frequency range - 35-70 Hz.

Transformers for outdoor installation.

Transformers can be operated both with indoor and outdoor installation in regions with moderate and tropical climate, at that:

- Altitude above sea level - no more than 1000 m;
- Operating mode - continuous;
- Ambient temperature: from -60 °C to +40 °C;
- Relative air humidity - 100% at 25 °C;
- Transformers are not designed for operation in conditions of shaking, vibration and shocks, in explosive and aggressive environment;
- Transformers are manufactured and tested in accordance with requirements of GOST R 52719-2007 and IEC 60076.



**TMPNG-SESH type transformer**

## Specific features of transformers for submersible pumps:

The tank of the transformers for power supply of submersible pumps consists of the upper frame, corrugated walls, smooth side wall and the bottom. The front smooth wall is provided with holes for insulators and protective cover is attached hereto. LV and HV bushing terminals are located on the smooth side wall of the tank. The following equipment is installed on the TMPNG-SESH type transformer tank cover: two switch actuators, float-type oil level gauge, thermometer, pressure relief valve and lifting lugs. Transformers are provided with the over pressure relief valve, operating at internal pressure increase over 50 kPa ensuring emergency gas outflow.

## Technical data of transformers for power supply of submersible pumps

### Specifications of TMPNG-SESH transformers of 11 series with number of control steps 25, 36.

Transformer type	HV winding voltage, V		LV winding voltage, V	No-load losses, W	Short-circuit losses, W	Short-circuit voltage, % no more than	No-load current %
	max/min	rated					
TMPNG-SESH-63/3-11; 0.92/0.38; 1.14/0.44; YH/YH-0	1140/440	920	380	500	1400	7,0	6,0
TMPNG-SESH-100/3-11; 1.30/0.40; 2.40/0.63; YH/YH-0	2400/630	1300	400	550	2600	7,0	6,0
TMPNG-SESH-125/3-11; 1.30/0.40; 2.40/0.63; YH/YH-0	2400/630	1300	400	650	3100	7,0	8,0
TMPNG-SESH-160/3-11; 1.36/0.40; 2.40/0.60; YH/YH-0	2400/610	1360	400	650	4100	7,0	8,0
TMPNG-SESH-250/3-11; 2.00/0.40; 3.10/1.23; YH/YH-0	3100/1230	2000	400	650	4300	7,0	1,9
TMPNG-SESH-260/3-11; 2.26/0.42; 3.30/1.10; YH/YH-0	3300/1100	2260	420	750	4300	7,0	1,9
TMPNG-SESH-300/3-11; 2.15/0.40; 2.98/1.12; YH/YH-0	2980/1120	2150	400	900	4700	7,0	1,8
TMPNG-SESH-400/3-11; 2.47/0.40; 3.10/1.41; YH/YH-0	3100/1410	2470	400	900	5800	7,0	1,8
TMPNG-SESH-426/6-11; 2.99/0.38; 4.51/1.99; YH/YH-0	4510/1990	2990	380	1150	4500	7,0	1,8
TMPNG-SESH-520/6-11; 2.68/0.48; 3.82/1.10; YH/Δ-0	3820/1100	2680	480	1250	8000	7,0	1,6
TMPNG-SESH-630/3-11; 2.69/0.40; 3.81/1.12; YH/YH-0	3810/1120	2690	400	1100	9400	7,0	1,6
TMPNG-SESH-700/6-11; 5.50/0.38; 5.50/1.60; YH-YH-0	5500/1600	5500	380	1100	10800	7,0	1,2
TMPNG-SESH-800/3-11; 2.81/0.38; 3.81/1.10; YH-YH-0	3810/1100	2810	380	1950	11000	7,0	1,4
TMPNG-SESH-900/6-11; 5.50/0.38; 5.50/1.60; YH/YH-0	5500/1600	5500	380	1950	8800	7,0	1,4
TMPNG-SESH-1000/6-11; 2.36/0.40; 4.29/1.49; YH/YH-0	4290/1490	2360	400	1950	13000	7,0	1,2
TMPNG-SESH-1023/6-11; 4.00/0.48; 4.80/1.60; YH/Δ-0	4800/1600	4000	480	1950	13000	7,0	1,4
TMPNG-SESH-1200/6-11; 3.01/0.38; 5.61/1.98; YH/YH-0	5610/1980	3011	380	2500	12000	7,0	1,2

Important information: insignificant changes in overall, installation and connection dimensions of transformers are possible due to ongoing design improvement. Production of tailor-made transformers is also possible.



When manufacture of non-standard transformers, the manufacturing possibility and the minimum lot volume are agreed upon additionally.

## Specifications of TMPNG-SESH transformers of 12 series with number of control steps 49

Transformer type	HV winding voltage, V		LV winding voltage, V	No-load losses, W	Short-circuit losses, W	Short-circuit voltage, % no more than	No-load current %
	max/min	rated					
TMPNG-SESH-100/6-12; 1.57/0.38; 3.40/0.64; YH/YH-0	340/640	1570	380	210	1475	7,0	2,2
TMPNG-SESH-125/6-12; 1.94/0.38; 3.60/1.10; YH/YH-0	3600/1100	1940	380	250	1690	7,0	2,2
TMPNG-SESH-160/6-12; 2.15/0.38; 3.60/1.43; YH/YH-0	3600/1430	2150	380	300	2000	7,0	2,0
TMPNG-SESH-200/6-12; 2.16/0.38; 3.60/1.43; YH/YH-0	3600/1430	2160	380	350	2330	7,0	1,8
TMPNG-SESH-250/6-12; 2.70/0.38; 4.60/1.66; YH/YH-0	4600/1660	2700	380	425	2750	7,0	1,8
TMPNG-SESH-315/6-12; 2.70/0.38; 4.65/1.71; YH/YH-0	4650/1710	2700	380	520	3370	7,0	1,6
TMPNG-SESH-400/6-12; 2.70/0.38; 4.80/1.65; YH/YH-0	4800/1650	2700	380	610	3850	7,0	1,6
TMPNG-SESH-500/6-12; 2.90/0.38; 4.50/2.10; YH/YH-0	4500/2100	2900	380	720	4530	7,0	1,4
TMPNG-SESH-630/6-12; 2.82/0.38; 4.50/1.91; YH/YH-0	4500/1910	2820	380	860	5400	7,0	1,4
TMPNG-SESH-800/6-12; 3.00/0.38; 4.80/2.00; YH/YH-0	4800/2000	3000	380	970	7300	7,0	1,2
TMPNG-SESH-1000/6-12; 3.86/0.38; 5.80/2.82; YH/YH-0	5800/2820	3860	380	1100	9500	7,0	1,2

# TRANSFORMERS FOR POWERS SUPPLY OF 24 PULSE VARIABLE- FREQUENCY ASYNCHRONOUS VALVE ELECTRIC DRIVE WITH LOW- HARMONICS CURRENT OPTION

Converter transformers of TMPG-SESH type with power capacity range from 260 to 1000 kVA, of 10 kV voltage class, with windings` tap changing without excitation (NLTC), are designed for power supply of 24-pulse variable-frequency asynchronous valve electric drive with option of low-harmonics current generated into the network.

One of efficient ways of compensation of higher harmonics of the current, generated by thyristor converter, is the use of three-phase phase shifting converter transformer installed between the power line and the thyristor converter. Higher harmonics of the current are circulating in inner circuits of the transformer and do not enter the network.

Valveside windings (VW) of lower voltage for 480 V voltages are non-regulated. Network windings (NW) of higher voltage with voltage regulation  $\pm 2 \times 2.5\%$  are powered from the three-phase 6 kV power source. Voltage regulation is performed via windings` tap-changing by means of two switches (no-load tap changer-NLTC) with de-energized transformer.

The operation principle of the phase shifting transformer with low-harmonics current option is based on the following provisions:

- transformer power splitting into four three-phase groups, with each three-phase group powering its part of the inverter.



**TMPG-SESH type sealed transformer  
without conservator**

Designation	HV winding voltage, V		Rated power, kVA	No-load losses, W	Short-circuit losses, W	Short-circuit voltage, %	No-load current %
	NW (network windings)	VW (valveside windings)					
TMPG-SESH-260/10	6.0	0.48	260	950	3500	4,5	1,0
TMPG-SESH-520/10	6.0	0.48	520	1050	8300	7,5	0,6
TMPG-SESH-1000/10	6.0	0.48	1000	1700	14000	6,5	0,6

# TM-SESH AND TMN-SESH TYPE GENERAL PURPOSE 1000 - 6300 kVA OIL POWER TRANSFORMERS WITH VOLTAGES UP TO 35 kV

TM-SESH type oil power transformer with tap-changing without excitation (no-load tap changing - NLTC) and TMN-SESH-type general purpose three-phase two-winding 1000-6300 kVA transformers with voltage regulation under load (on-load tap changing) with voltages up to 35 kV inclusive, designed for transmission and distribution of alternating current electric energy in networks with voltages up to 35 kV inclusive used for the purposes of economic needs of the country.

## Component parts of the transformer:

- Active part: carcass, windings, taps, assembly units and insulation parts.

The carcass serves as the main structural and mechanical base of the transformer. Magnetic core is the main part of the carcass. HV and LV windings are made of rectangular aluminum wire and of interlayer insulation of cable paper.

Taps are intermediate current-carrying elements providing connection of with bushing terminals and with the NLTC device (for TM-SESH-type) or with the voltage regulation device under load (for TMN-SESH-type) to form the required electrical circuit.

Taps are made out of paper insulated aluminum wires and of aluminum rolled wires.

Assembly units and insulation parts are designed for current-carrying parts insulation.

- Transformer tank consisting of the frame, bottom and side walls.
- The transformer cover to which the active part is fixed.
- Rolls for transformer relocation.
- Expansion tank - serves for protection of transformer from oil humidification and oxidation under environmental impacts.



TMN-SESH

## Specifications of TM(N)-SESH transformers

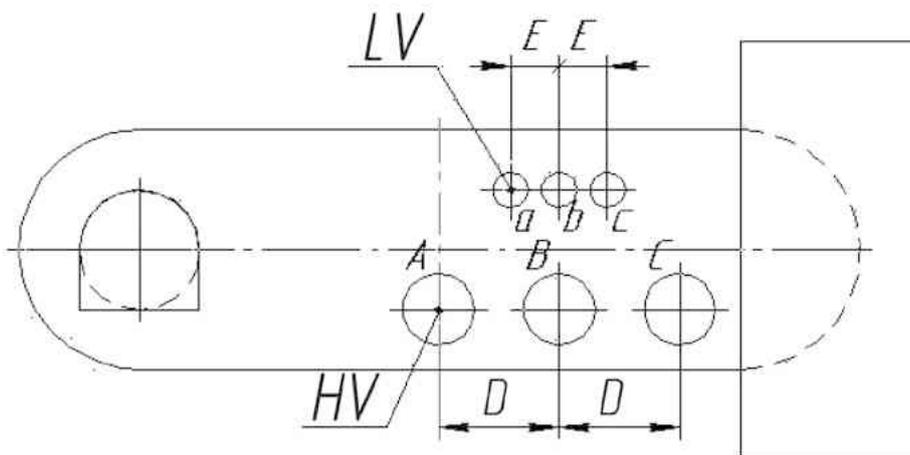
Transformer type	Rated value, kV		Scheme and vector group	Type, range and quantity of voltage adjustment stages on the HV side	Rated power, kVA	No-load losses, kW	Short-circuit losses, kW	No-load current %	Short-circuit voltage on the main tap, %	
	HV	LV								
TM-SESH-1000/35	35	6.3; 10.5	Y/Δ-11	NLTC ±2x2.5%	1000	2,0	11,6	1,4	6,5	
TMN-SESH-1000/35		6.3; 11		On-load tap-changing ±4x2.5%	1000	2,10	11,6			
TM-SESH-1600/35		6.3; 10.5		NLTC ±2x2.5%	1600	2,75	16,5	1,3		
TMN-SESH-1600/35		6.3; 11		On-load tap-changing ±4x2.5%	1600	2,90	16,5			
TM-SESH-2500/35		6.3; 10.5		NLTC ±2x2.5%	2500	3,90	23,5	1,0		
TMN-SESH-2500/35		6.3; 11		On-load tap-changing ±4x2.5%	2500	4,10	23,5			
TM-SESH-4000/35		6.3; 10.5		NLTC ±2x2.5%	4000	5,30	33,5	0,9		7,5
TMN-SESH-4000/35		6.3; 11		On-load tap-changing ±4x2.5%	4000	5,60	33,5			
TM-SESH-6300/35		6.3; 10.5		NLTC ±2x2.5%	6300	7,60	46,5	0,8		
TMN-SESH-6300/35		6.3; 11		On-load tap-changing ±4x2.5%	6300	8,00	46,5			

## Basic weight parameters of transformers TM(N)-SESH

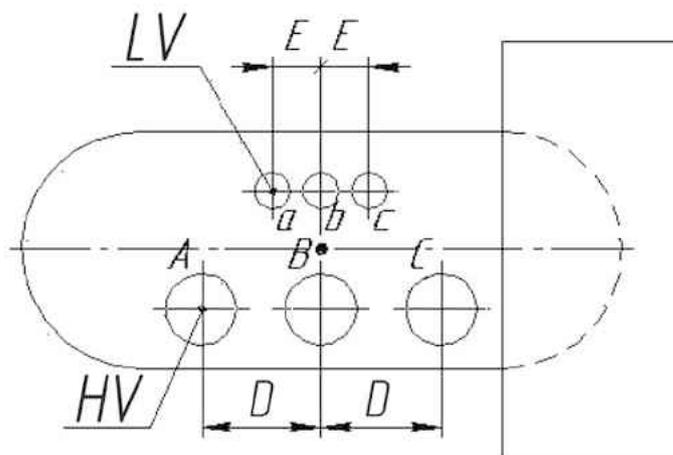
Transformer type	Overall demensions, mm, no more than				Weight, no more than			
	length	width	height		total, kg	specific, kg/kVA	of oil, kg	transportat., kg
			total	up to the over				
TMN-SESH-1000/35	3700	1550	3600	1900	7000	7,000	2650	6900
TM-SESH-1600/35	2700	2100	3000	1700	4850	3,030	1180	3500
TMN-SESH-1600/35	3700	2250	3650	2000	8000	5,000	2850	7900
TM-SESH-2500/35	3250	2200	3100	1950	6600	2,640	1640	5450
TMP-SESH-2500/35	3700	2250	3750	2150	10000	4,000	3600	8000
TM-SESH-4000/35	3300	2250	3300	2200	9000	2,250	2150	7100
TMN-SESH-4000/35	4020	3350	3800	2200	12900	3,230	3980	11200
TM-SESH-6300/35	3750	2400	3950	2450	12200	1,937	2850	93600
TMN-SESH-6300/35	4250	3420	4080	2350	16600	2,640	5350	12400

## Rated primary and secondary currents of built-in current transformers

Rated power, kVA	Rated voltage upper limit, kV	Transformers ratios
1000-6300	35,0	200-150-100-75/5
6300		300-200-150-100/5



Distance between the bushing axis for TMN-type transformers



Distance between the bushing axis for TM-type transformers

Rated power, kVA	Rated voltage upper limit, kV		Distance between the bushing axis, mm not less then	
	HV	LV	D	E
1000-6300	35,0	10,5	400	200
		11,0		

# TNG-SESH AND TNGF-SESH-TYPE 14 SERIES POWER TRANSFORMERS FILLED WITH FIRE RETARDANT DIELECTRIC LIQUID FOR 10 kV DISTRIBUTION NETWORKS

## Features of transformers

Tree-phase two-winding distribution transformers of the following types: TNG-SESH, TNGF-SESH with tap-changing without excitation with 25-2500 kVA power capacity designed for operation in 6 and 10 kV networks. Climatic transformer design "U".

Transformers may be operated with indoor installation in regions with moderate climate, at that:

- altitude above sea level - no more than 1000 m;
- operation mode - continuous;
- ambient temperature: from - 45 °C to +40 °C;
- relative air humidity - no more than 100% at 25 °C;
- transformers are not designed for operation in conditions of shaking, vibration and shocks, in implosive and aggressive environment;
- transformers are manufactured and tested in accordance with requirements of GOST R 52719-2007 and IEC 60076.

HV and LV bushing terminals, switch actuator, float type oil indicator, thermometer and pressure relief valve are installed on the tank cover of TNG-SESH, TNGF-SESH-type transformers.

Transformers are provided with the overpressure relief valve, operating at internal pressure increase over 50 kPa ensuring emergency gas outflow.

The transformers is filled under vacuum with cooling flame proof dielectric liquid with the following characteristics:

- flash point in an open cup 330 °C;
- flash point in a closed cup 180 °C;
- ignition temperature 340 °C;
- self-ignition temperature 380 °C, confirmed by conformity certificate of FBGU "POZHTEST" certification body of the Ministry of Emergency Situations of Russia. Dielectric liquid performs 2 functions: electrical insulation and heat transfer from heated winding parts to the corrugated walls of the housing.

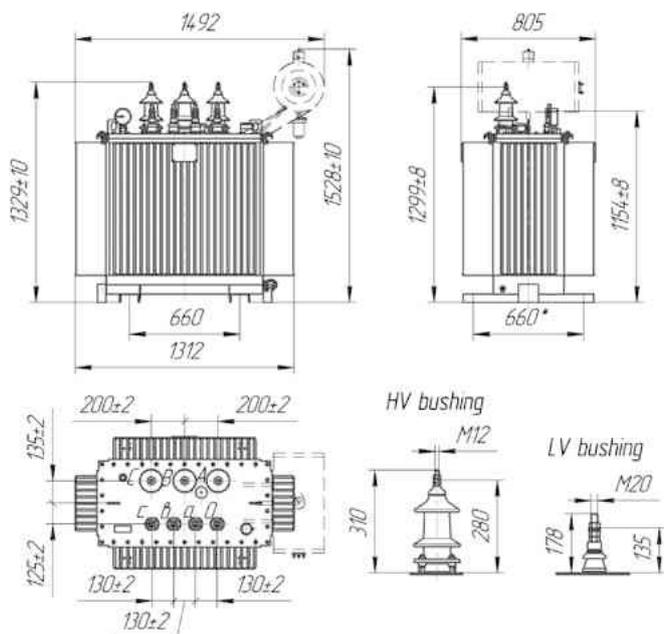


**TNGF-SESH**

## Specifications of TNG-SESH, TNGF-SRSH type transformers 14 series, voltage class 10 kV

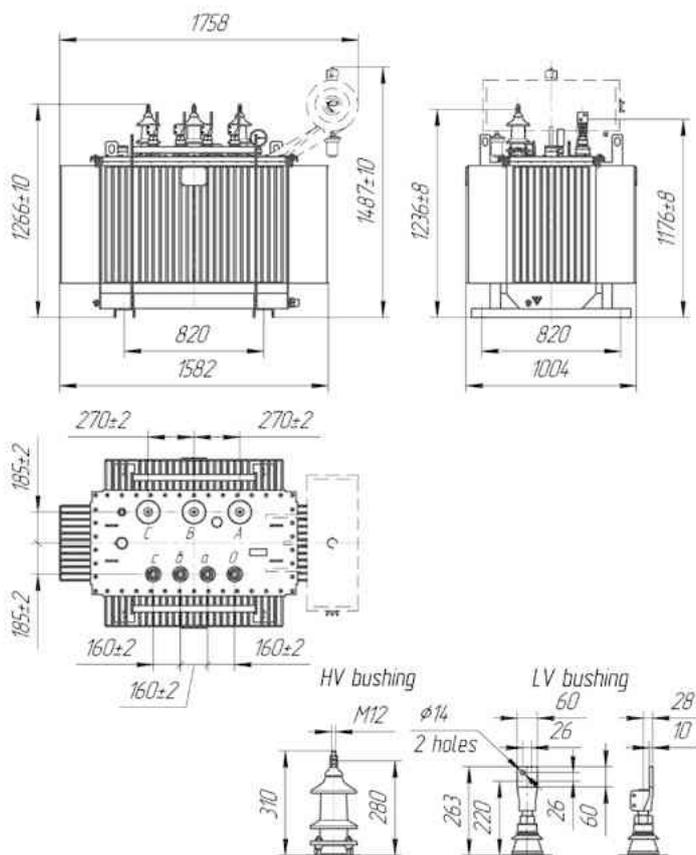
Distination	Rated power, kVA	HV winding voltage, kV		Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage, %	No-load current of HV, LV winding, %
		HV	LV					
TNG-SESH-25/10-14	25	6.0;10.0	0.4	Y/Y <sub>H</sub> -0 Δ/Y <sub>H</sub> -11	190	680	5,0	5,0
TNG-SESH-40/10-14	40	6.0; 10.0	0.4		260	1020	5,0	5,0
TNG-SESH-63/10-14	63	6.0; 10.0	0.4		340	1600	5,5	4,0
TNG-SESH-100/10-14	100	6.0; 10.0	0.4		400	2600	5,0	4,0
TNG-SESH-160/10-14	160	6.0; 10.0	0.4		560	3600	6,0	4,0
TNG(F)-SESH-250/10-14	250	6.0; 10.0	0.4		650	4100	4,5	3,5
TNG(F)-SESH-400/10-14	400	6.0; 10.0	0.4		830	6200	4,5	1,5
TNG(F)-SESH-630/10-14	630	6.0; 10.0	0.4		1050	8300	6,0	1,4
TNG(F)-SESH-1000/10-14	1000	6.0; 10.0	0.4		1600	11800	5,5	1,3
TNG(F)-SESH-1250/10-14	1250	6.0; 10.0	0.4		1800	17000	6,0	1,2
TNG(F)-SESH-1600/10-14	1600	6.0; 10.0	0.4		2200	18200	6,0	1,1
TNG(F)-SESH-2500/10-14	2500	6.0; 10.0	0.4		3600	28000	6,0	1,5

## Examples of overall and installation dimensions of 6 kV and 10 kV transformers



**TMG-SESH (TM-SESH) - 400/10-11**

Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMG-SESH-400/10-11	1240	690	240	1260
TM-SESH-400/10-11	1270	705	255	1290

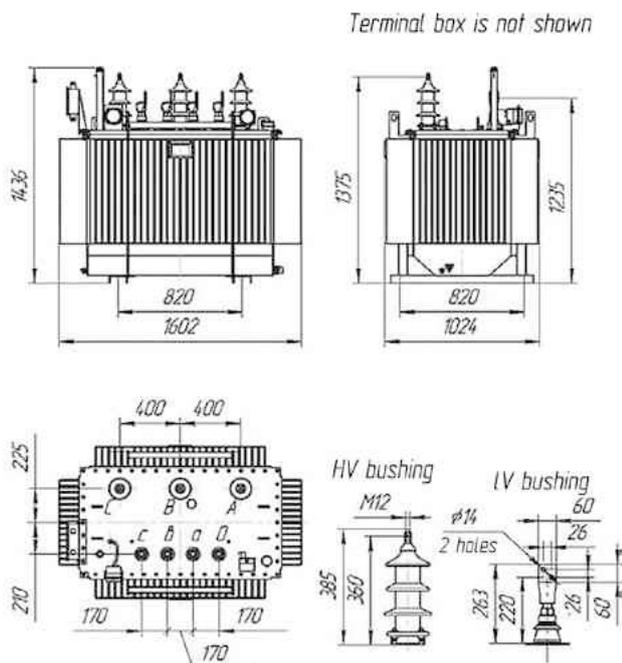


**TMG-SESH (TM-SESH) - 630/10-11**

Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMG-SESH-630/10-11	1710	925	430	1740
TM-SESH-630/10-11	1755	945	455	1785

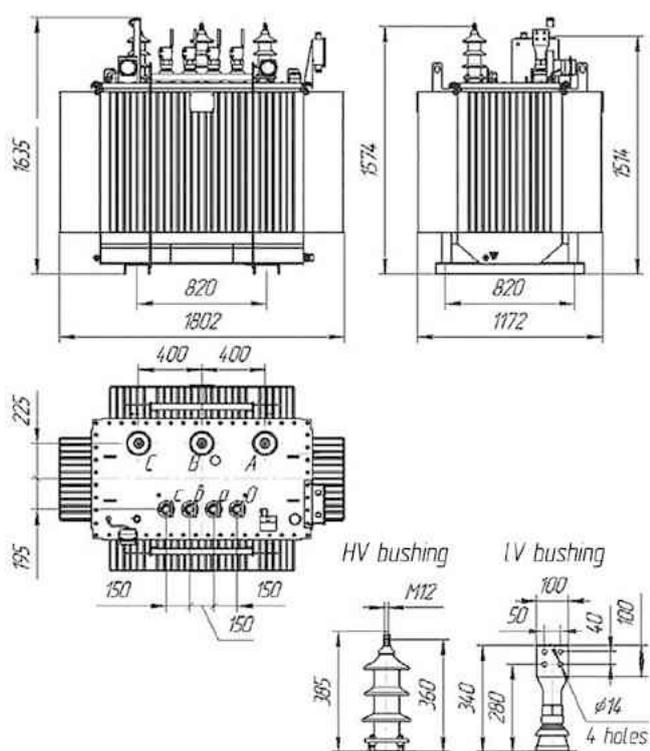
## Examples of overall and installation dimensions of 20 kV transformers

### TMG-SESH -630/20(15)-11



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMG-SESH-630/20(15)-11	2170	1170	550	2190

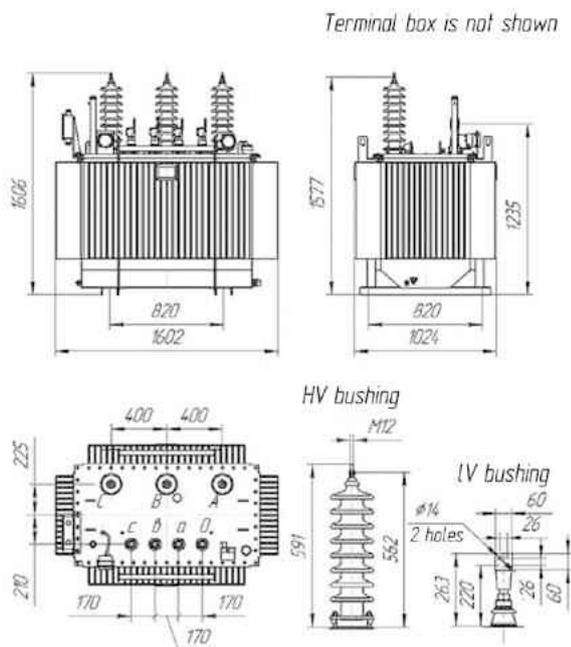
### TMG-SESH -1000/20(15)-11



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMG-SESH-1000/20(15)-11	2785	1520	650	2800

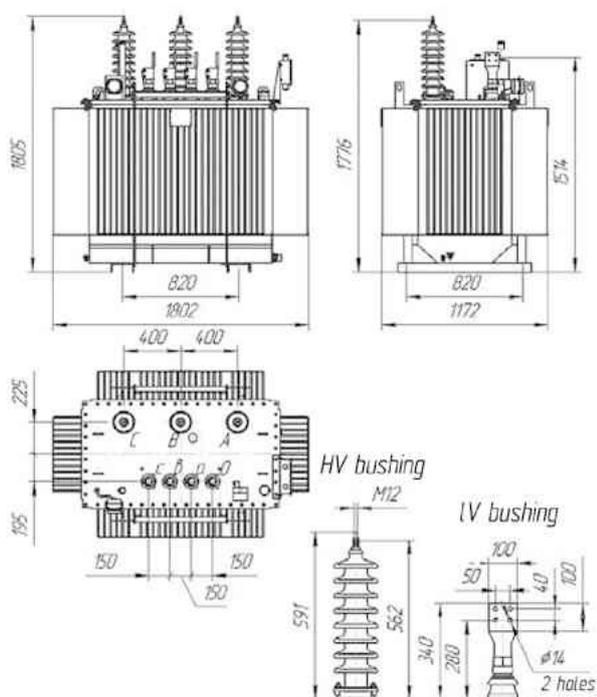
## Examples of overall and installation dimensions of 35 kV transformers

### TMG-SESH -630/35-11



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMG-SESH-630/35-11	2250	1250	550	2270

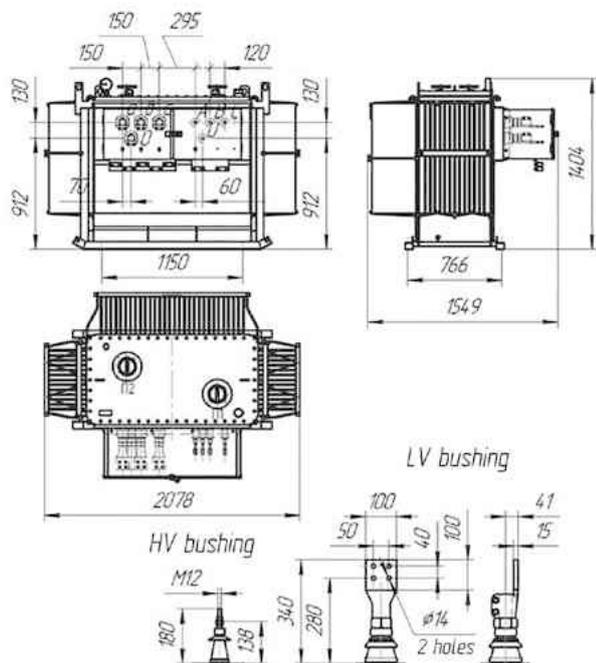
### TMG-SESH -1000/35-11



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMG-SESH-1000/35-11	2785	1520	650	2800

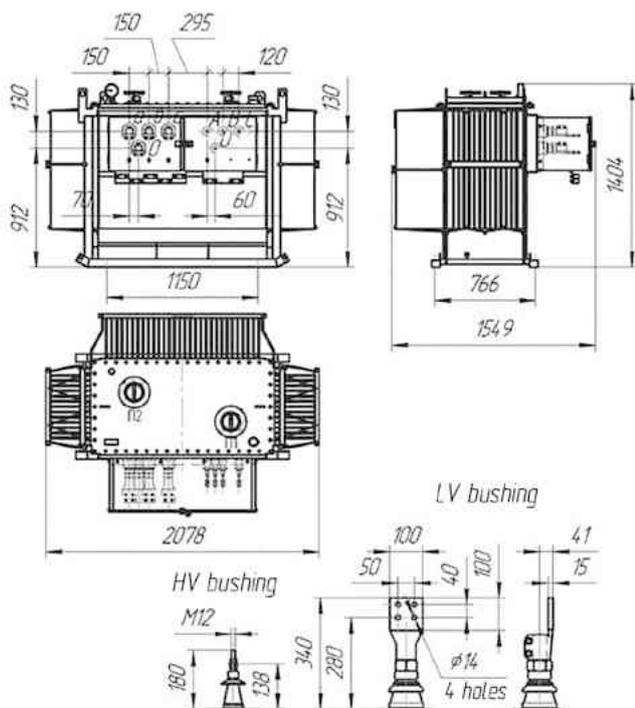
## Examples of overall and installation dimensions of TMPNG-SESH transformers (for power supply of submersible oil pumps)

### TMPNG-SESH -900-11



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMPNG-SESH-900-11	2900	1300	770	2900

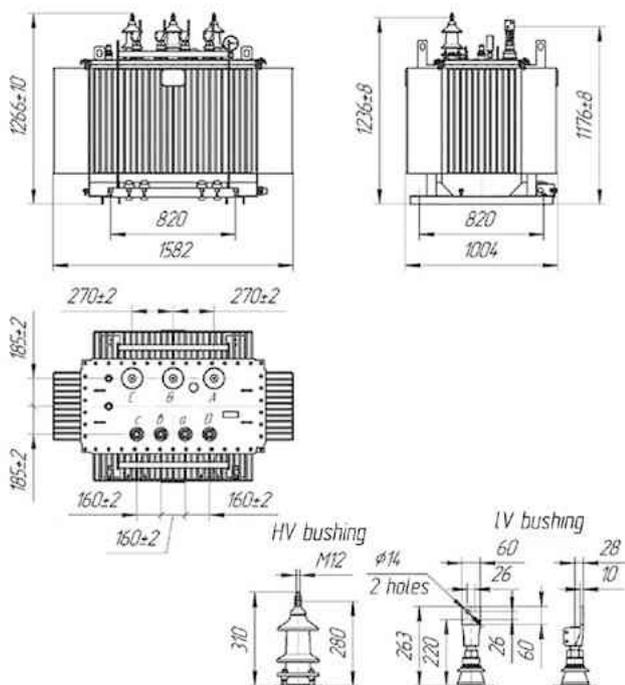
### TMPNG-SESH -1000-11



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMPNG-SESH-1000-11	2960	1440	690	2960

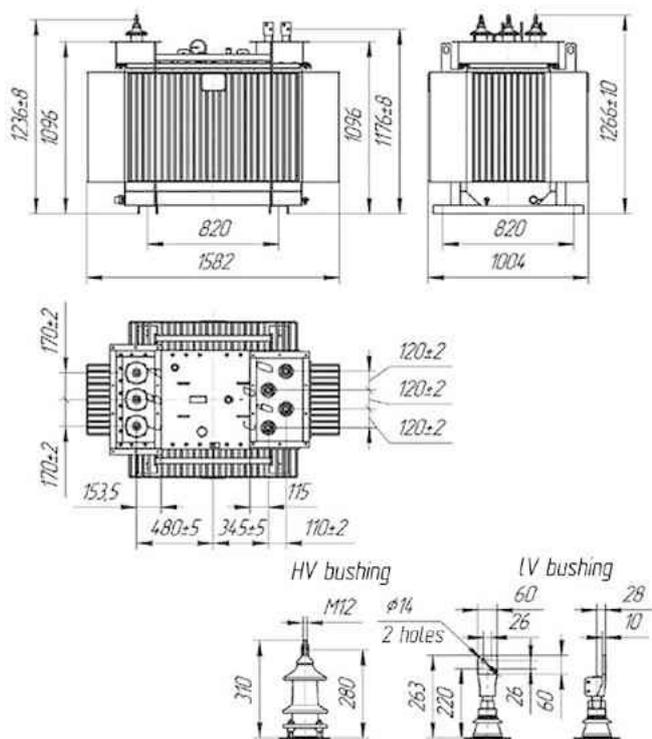
## Examples of overall and installation dimensions of 6 (10) kV TNG-SESH transformers

### TNG-SESH -630-14



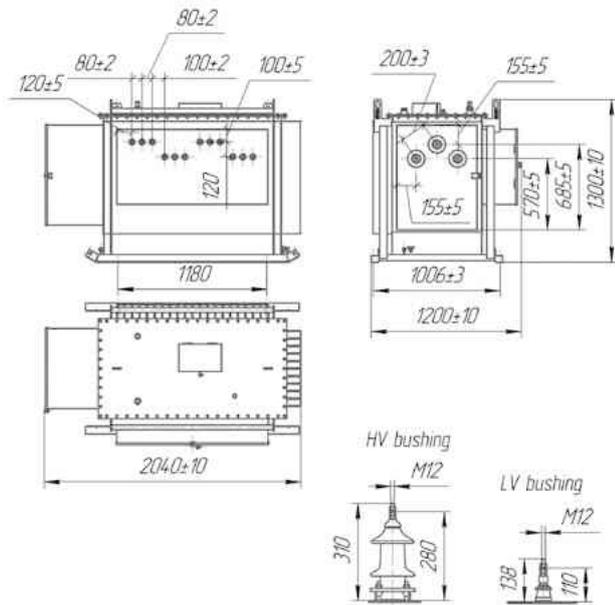
Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TNG-SESH-630-14	1710	925	430	1740

### TNGF-SESH -630-14



Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TNGF-SESH-630/10-14	1720	935	430	1750

## Examples of overall and installation and connection dimensions of TMPG-SESH transformers



### TMPG-SESH -260

Transformer type	Weight,kg			
	total	of active part	of oil	transportation
TMPG-SESH-260	2300	1000	850	2300

# DISTRIBUTION DRY-INSULATED TRANSFORMERS TLS(Z)-SESH TYPE, 6 (10) kV

## Purpose

**Distribution transformer** step down transformer with power in three phases up to 100 kVA inclusive, with separated high and low voltage windings, with distribution network voltage classes up to 6, 10 kV, powering immediate electric power consumers. Distribution transformers of 6 and 10 kV voltage classes are commercially manufactured with 25, 40, 63, 100 kVA power capacities. Climatic category and placement category - moderate climate, indoor installation. Ambient temperature: from - 45 °C to + 40 °C.

## Basic design versions of transformers by the external design structure:

**TLS-SESH** - dry transformer without protective cover with protection degree IP00;

**TLSZ-SESH** - dry transformer in protective cover with protection degree IP41.

## TLS-SESH transformers design version:

**00** - transformer design without voltage regulation and temperature sensors, connection diagram  $\Delta/Y_H-11$ ;

**01** - transformer design with voltage regulation and without temperature sensors, connection diagram  $\Delta/Y_H-11$ ;

**02** - transformer design without voltage regulation and with temperature sensors, connection diagram  $\Delta/Y_H-11$ ;

**03** - transformer design with voltage regulation and temperature sensors, connection diagram  $\Delta/Y_H-11$ ;

**04** - transformer design without voltage regulation and temperature sensors, connection diagram  $Y/Y_H-0$ ;

**05** - transformer design without voltage regulation and with temperature sensors, connection diagram  $Y/Y_H-0$ .

HV winding tap-changing (-01; -03 transformer design)  
no-load tap changing without excitation (NLTC).

Voltage regulation range relative to the voltage  $\pm 2 \times 2.5\%$ .

HV winding tap-changing is not available (transformer design -00; -02).

TLS-SESH-25 transformers are manufactured only in version -00 and -02 without (NLTC).



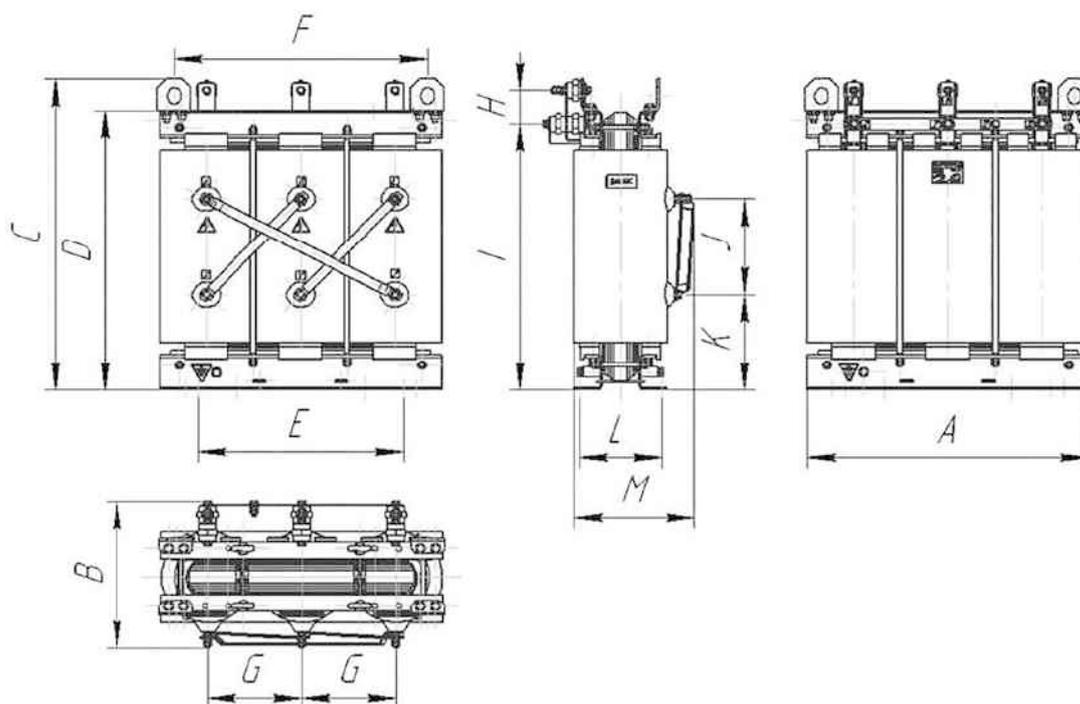
**TLS-SESH-63 transformer**



**TLS-SESH-100 transformer**

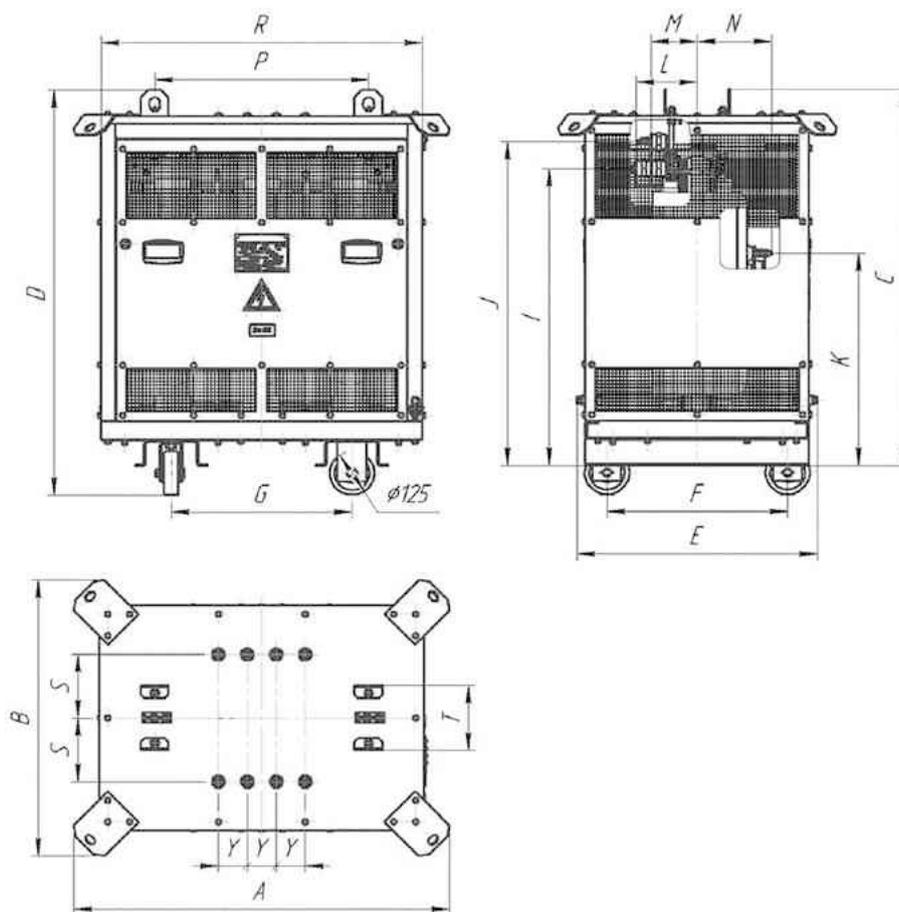
## Basic technical data of TLS(Z)-SESH transformers

Designation	Rated power, kVA	Voltage combination, kV		Scheme and vector group	No-load losses, W	Short-circuit losses, W	Short-circuit voltage, %	No-load current %	Weight, kg
		HV	LV						
TLS(Z)-SESH-25/10	25	10.0; 10.5	0.4	Δ/YH-11 Y/YH-0	140	470	3,2	2,5	225
TLS(Z)-SESH-25/6	25	6.0; 6.3	0.4						
TLS(Z)-SESH-40/10	40	10.0; 10.5	0.4		180	700	3,6	2,5	290
TLS(Z)-SESH-40/6	40	6.0; 6.3	0.4						
TLS(Z)-SESH-63/10	63	10.0; 10.5	0.4		250	900	4,0	2,0	410
TLS(Z)-SESH-63/6	63	6.0; 6.5	0.4						
TLS(Z)-SESH-100/10	100	10.0; 10.5	0.4		250	1550	6,0	1,0	565
TLS(Z)-SESH-100/6	100	6.0; 6.3	0.4						



## Overall, installation and connection dimensions of TLS-SESH distribution transformers

Power, kVA	A	B	C	D	E	F	G	H	I	J	K	L	M	Weight, kg
25	655	345	656	580	300	590	220	80	550	185	208	186	290	225
40	655	345	731	655	480	590	220	80	625	225	224	190	290	280
63	730	365	866	790	400	557	245	80	755	225	295	192	315	390
100	836	415	970	896	400	715	280	70	854	320	296	198	375	565



## Overall, installation and connection dimensions of TLS(Z)-SESH distribution transformers

Power, kVA	A	B	C	D	E	F	G	I	J	K	L	M	N	P	R	S	T	Y	Weight, kg
25	1040	770	1052	1134	666	500	500	624	704	469	165	124	190	592	890	178	182	80	300
40	1040	770	1052	1134	666	500	500	700	780	525	167	125	185	592	890	178	182	80	355
63	1040	770	1052	1134	666	500	500	830	905	594	169	128	205	592	890	178	182	80	465
100	1255	900	1142	1224	795	600	500	930	1000	690	173	131	225	750	1105	177	188	150	670

# SERVICE SOLUTIONS

**Electroshield Samara provides a warranty and post-warranty service of its own manufactured equipment, as well as modernization of the obsolete equipment of other manufacturers.**

**The aim of the service team is to provide the complex service team is to provide the complex service support and safe, effective equipment usage.**

Advantages of Electroshield Samara:

- **Installation supervision and commissioning works**

The specialists of Electroshield Samara make the efforts to implement the project as efficiently as possible and deliver it on time.

- **Inspection and modernization of equipment**

At the stage of reconstruction of switchgears, the specialists of Electroshield Samara are ready to inspect, develop recommendations and implement a project for modernization (replacement) of obsolete equipment based on solutions of the equipment manufactured by Electroshield Samara.

- **Restoring to working condition**

Specialists of Electroshield Samara provide the necessary measures to restore the equipment operability to the specified performance characteristics.

- **Personnel traineeship**

Highly qualified personnel is one of the key factors of reliable operation of equipment. The set of training programs and their practical orientation will help the personnel to operate correctly and safely.

- **Spare parts supply**

For repair and quick recovery of equipment operability, availability of spare parts has great importance. The specialists of Electroshield Samara developed the extended sets of SPTA. They can be purchased together with the equipment separately.

- **Equipment repair**

For inspection of equipment and performing repair works, service engineer promptly visits the site.

**Answers to your questions can be obtained at our website: <http://electroshield.ru>**



Adjustment August 2020



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