CJSC «ELECTROSHIELD» TM Samara Group

Oil transformers for power supply to electric submersible pumps for oil extraction of TMPNG-SESH type with power 1023 kVA voltage class 6 kV 11 series

OPERATING MANUAL

0PT.142.225 OM

Samara

CONTENT

INTRODUCTION

The present operating manual is used for oil transformers for electric submersible pumps of TMPNG-SESH type with power 1023 kVA and TMPNG-SESH with voltage class 6 kV of series -11.

The operating manual contains technical description, installation and operation instructions and is intended for usage by the qualified installation and operating personnel having work experience with transformers. Transformers comply with the requirements TU 3411-077-15356352-2012 «Oil transformers of TMPNG-SESH type with power from 63 up to 1200 kVA, voltage class 3, 6 kV».

During installation and operation of the equipment it is required to use additionally Electrical Installation Regulations (EIR), Regulations for Operation of Consumer Electrical Installations and Interbranch rules on labor safety (safety rules) in operation of electrical equipment.

1 PURPOSE

1.1 Three-phase distribution two-winding transformers of TMPNG type with power 1023 kVA with two off-circuit tap changers are intended for power supply to electric submersible pumps of oil extraction as part of variable-frequency drive with the working frequency range from 35 up to 70 Hz on condition with the compliance with the law U/f=const. Load currents of regulation stages should not exceed their passport values.

Attention! It is not allowed to operate with the transformers with control stations without harmonic filters.

1.2 Climatic execution and location category as per GOST 15150 of the specific transformer is indicated in the passport for the product. It is allowed to increase the range of working temperature indicating in the passport and by agreement with the customer.

1.3 Transformers can be used if installed indoors and outdoors in the regions with moderate cold climate provided that:

- altitude above sea level not more than 1000 m;
- operating mode - continuous;
- ambient air temperature:

from -45^{o}C up to +40^{o}C – for transformers of «U» execution;

from -60^{o}C up to +40^{o}C - for transformers of «UHL» execution;

from -10^{o}C up to +50^{o}C – for transformers of «T» execution.

- relative air humidity (as per GOST 15543.1):

not more than 80% at +15^{o}C and 100% at +25^{o}C for transformers of «U» execution;

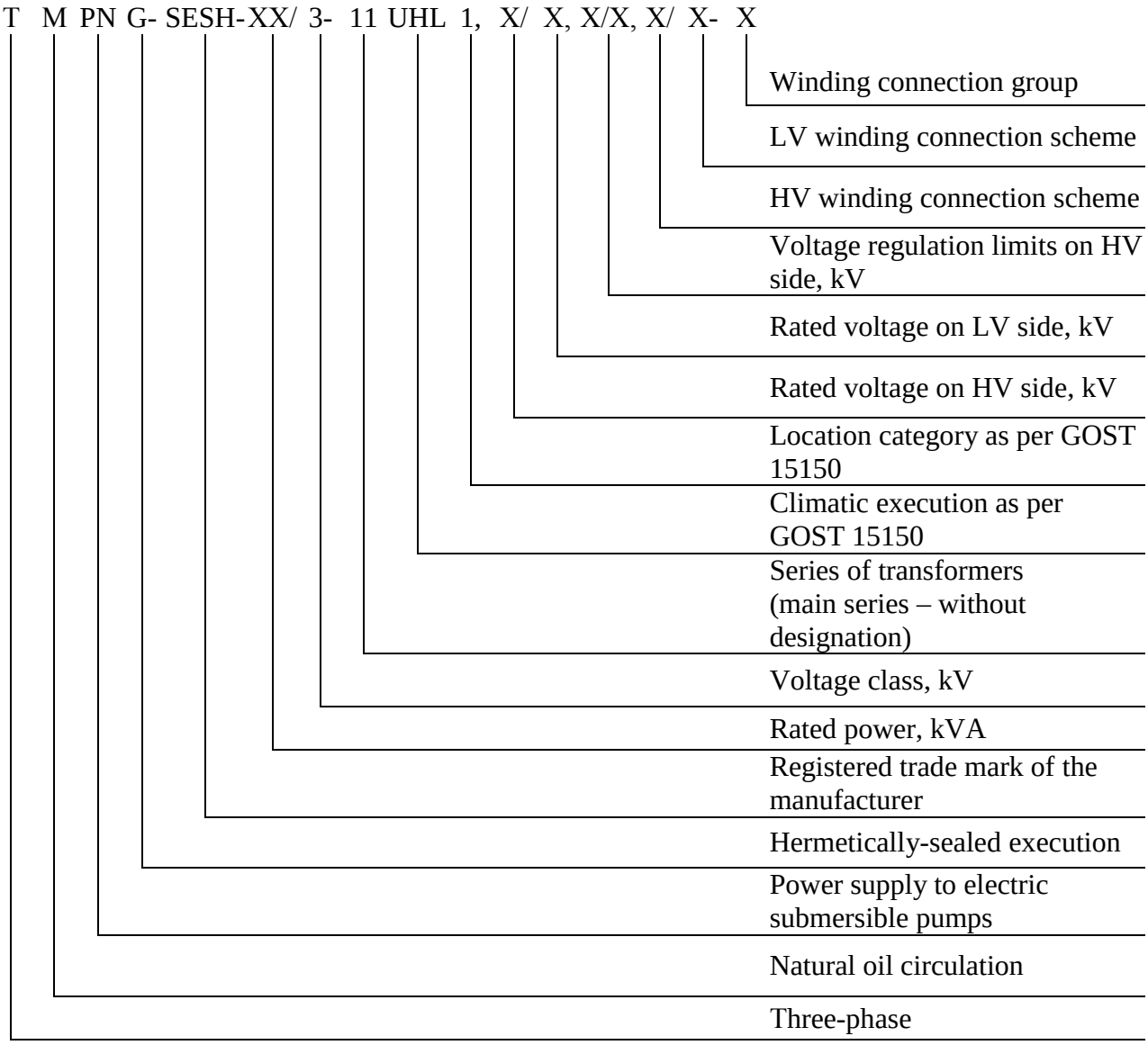
not more than 80% at +15^{o}C and 100% at +25^{o}C for transformers of «UHL» execution;

not more than 98% at +27^{o}C and 100% at +35^{o}C for transformers of «T» execution.

-transformers are not intended for the operation under the conditions of shaking, vibration, shocks, in explosion hazardous and aggressive area.

1.4 Reference designation of transformers:

Example of reference designation of the sealed transformer, with power 250 kVA, insulation voltage class 3 kV; series –11; climatic execution - UHL, location category - 1;
with rated voltage on HV side – 2,00 kV, on LV side –
0,40 kV, HV regulation range from 3,10 kV up to 1,23 kV; scheme and winding connection group $Y_н/Y_н$-0, during the order and in the documentation of the other product: «**Transformer TMPNG-SESH-250/3-11UHL1; 2,00/0,40; 3,10/1,23; $Y_н/Y_н$-0 TU 3411-077-15356352-2012».**



2 TECHNICAL DATA

2.1 Transformer type, value of rated power, rated voltages, rated currents, short-circuit voltage and short-circuit losses, short-circuit current and short-circuit losses, scheme and winding connection group, other technical data are indicated on the nameplate and in the transformer passport.

2.2 Protection degree of the terminals – IP33, upon the customer's request can be performed other protection degree.

2.3 Voltage regulation on HV side is performed with two off-circuit tap-changers on high voltage side. The combination of tap changers position P1 and P2 corresponds to each regulation stage.

2.4 Overall and installation dimensions, weight of transformers are presented in appendix 1.

3 TRANSFORMER STRUCTURE

3.1 Transformer structure comprises the following constituents:

– tank;
– bushings;
– active part (frame, windings, insulation, taps, switch);
– control-measuring and protective equipment;
– auxiliary reinforcement

3.2 Transformer tank is the metallic welded structure of rectangular form consisting of the shell, cover and protective case.

3.2.1 The shell consists of upper frame, corrugated walls, front smooth wall and bottom. In the front smooth wall there are openings for insulators. The protective case is fixed to it. Two support beam channels with skids are welded to the bottom. On the tank bottom there is the oil drainage valve and two grounding contacts. Extra grounding unit is allowed.

3.2.2 HV and LV bushings are installed on the smooth wall of transformer tank TMPNG.

3.2.3 On the tank cover of TMPNG transformers are installed: drive of switch P1, drive of switch P2, oil indicator of float type, thermometer tube and pressure relief valve.

Vacuum pressure gauge and electronic contact thermometer with the terminal block are installed on the tank cover upon the customer's request.

3.2.4 External surface of the case is painted with polyether powder painting of light-grey colour.

3.2.5 Connection of the cover and case of the tank – bolted connection, connector sealing – rubber gaskets. Upon the customer's request is allowed to produce gaskets from other materials.

3.3 Transformer bushings are removable and allow to replace the insulator without lifting the active part when the oil is drained and the protective cover is removed.

3.3.1 To the upper part of the current conducting rod of HV bushings is fixed the special contact clamp with the tightening bolt ensuring the connection of feeder cables. Contact clamp is locked with a nut.

3.3.2 Bushing drawings are indicated in Appendix 1 for the corresponding transformers. Contact clamps drawings are indicated in Appendix 2.

3.4 Active part consists of the following units:

a) frame;

b) HV and LV windings;
c) HV and LV taps;
d) assembly components and insulation details;
e) P1 switch;
f) P2 switch.

3.4.1 Transformer frame is structural and mechanical base of the active part. Main part of the frame is the magnetic system which consists of vertical rods covered from top and at the bottom with horizontal yokes so that the closed magnetic circuit is formed. Magnetic system is laminated of sheets of cold-rolled electrotechnical steel. Yoke tightening is performed by means of yoke beams and tie rods. On the upper yoke beams are fixed switches of coarse and fine regulation.

3.4.2 Transformer windings are layer having cylindrical form which are located on the rod in the following order starting from the rod – LV winding (low voltage), HV winding (high voltage). LV windings are made of aluminium foil and interlayer insulation made of paper «diamond» or cable paper, HV winding made of copper or aluminium wire of rectangular section with paper insulation and interlayer insulation made of cable paper. Winding pressing is made by the tightening of yoke beams with vertical rods.

3.4.3 Taps represent intermediate current conducting elements ensuring the connection of windings with the bushings and switching devices in the required electrical diagram. HV winding connections are made with the wires, LV winding connections are made with the busbars.

3.4.4 The switches are intended for voltage regulation without excitation, when the transformer is deenergized by connection of the taps of HV windings.

3.5 Transformer is filled under vacuum with GK or VG transformer oil having the breakdown voltage not less than 70 kV, temperature of filling oil from 20^0C up to 60^0C and tested for hermeticity with the excess pressure 20 kPa.

4 CONTROL-MEASURING AND PROTECTIVE DEVICES

4.1 To measure oil level TMPNG transformers are equipped with the oil indicators of float type with a float in a transparent polymer flask located on the tank cover.

4.2 Transformers are equipped with the safety valve actuating with the increase of the internal pressure above 30 kPa and providing gas exhaust from the transformer in emergency modes.

4.3 To measure oil pressure in the tank transformers are equipped upon the customer’s request with the vacuum pressure gauges. On the rear wall is located the output electrical terminal block.

The recommended actuation limits of the device: lower limit: -0,2 kgs/cm^2; upper limit +0,3 kgs/cm^2.

4.3To define oil temperature of upper layers transformers upon the customer’s request are equipped with the pointer thermometer as TBP-63, electric contact

thermometer as TGP-100Эк-M1 or their analogue. Thermometer is supplied as the set with the transformer and installed on the place of operation.

4.4 Electrical connection schemes of the devices and terminal blocks are indicated in appendix 4.

5 MARKING AND SEALING

5.1 Marking:

– phase identification is made at HV and LV terminals;
– switch identification on the tank cover close to their drives;
– marking of grounding points is made as per GOST 21130.

5.2 Sealing:

Sealing does not allow disassembly of the transformer parts and oil drainage. When produced the following components should be sealed:

– transformer tank on the bolts fixing the cover with the frame of the transformer tank;
– drainage valve on the side wall of the tank bottom;
– pressure release valve on the tank cover;
– oil indicator on the tank cover;
– protective case;

ATTENTION! If the seal is damaged, the supplier has the right to remove the guarantee set by the technical conditions.

6 PACKING

6.1 Transformer is sent to the user completely assembled, filled with the transformer oil. Thermometer (if any) is packed separately and fixed in the protective case of the transformer together with the operating documentation.

6.2 When the transformer is delivered to the unloading site, the inspection should be performed by the customer together with the representative of the transportation organization. Sealing integrity, damages on the transformer and also oil runs on the transport vehicle and tank are checked. If some damages are detected on the transformer, the special act of the set form is made.

7 SAFETY MEASURES

7.1 During installation and operation of the equipment one should follow also Electrical Installation Regulations (EIR), Regulations for Operation of Consumer Electrical Installations, Interindustry labor safety rules (safety rules) during operation of electric equipment and fire safety regulations for industrial enterprises.

7.2 Transformer or its active part should be lifted only by the lifting lugs marked with the slinging sign.

7.3 It is strictly forbidden:

– to drain transformer oil;

– to lift the transformer with non-compliance of the requirements of the present manual;

– tap selector switching when the transformer is under voltage;

– to leave the switch in the intermediate position;

– to use the transformer with the defected bushings;

– to use the transformer without oil or with the low oil level;

– to energize transformer without case grounding;

– to break transformer hermeticity.

7.4 One should remember that the transformer oil is fast ignited material which has high burning temperature and it is difficult to extinguish. So all works related to welding and drying should be performed very carefully as per the prescribed fire safety rules. It is forbidden to perform welding works on the transformer tank higher the level of the filled oil in the tank. If required this work should be performed only after transformer oil filling up to the level higher the welding point for 200-250 mm to avoid oil inflammation.

7.5 In the area where the transformers are installed should not be kept highly inflammable liquids, it is forbidden to smoke, strike matches and use heating devices with open fire.

7.6 In emergency situations in the transformer: short-circuit, oil inflammability, strong crack, suspicious noise, crackling noise and etc. indicating insulation damage, insulation overlapping on the terminals and cable (wire) breakdown leading to transformer terminals one should take measures to deenergize the transformer till the reason is detected. It is forbidden for the operating personnel to come close to the transformer in case of emergency situations without deenergization of the transformer.

8 TRANSFORMER PREPARATION FOR OPERATION AND COMMISSIONING

8.1 Transformer is put into service without the revision of the active part.

8.2 Before energizing of the transformer it is required:

– to study accompanying documents;

– to perform visual inspection of the transformer;

– to clean insulators from dust and dirt;

– to perform bolt tightening fixing the cover to the frame of the case.

Requirements for tightening torque of the bolt connections of the cover:

Thread diameter	Tightening torque (not more), Nm
M8	23

M10	44

– to check nuts tightening on HV and LV insulators. If there is loosening of oil tightening connections, one should tighten nuts of connections.

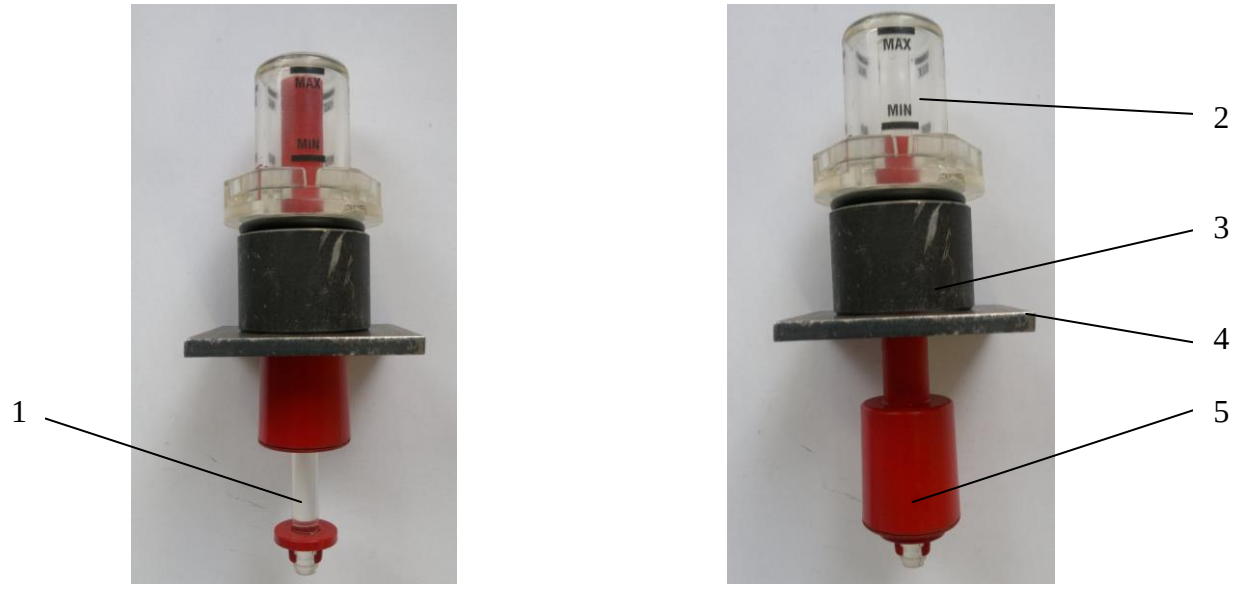
Requirements for tightening torque of the thread connections of insulators:

Insulator	Thread diameter	Tightening torque (not more), Nm
10/250	M12	14
3/250	M12	14
1/250	M12	14
1/630	M20	24
1/1000	M30	36
1/2000	M42	50

ATTENTION! For mechanical mounting of insulators on the smooth wall of the tank there is the lower nut on the insulator core.

– to remove the protective case of switch drives;

– to check oil presence for TMPNG with the oil indicator of a float type (fig. 8.1), for TMPN – with a pointer oil indicator. The criterion of the normal oil level is the float (pointer) location above the minimum mark. It is allowed oil presence in oil indicator flask. If the level is not sufficient, inform the manufacturer;



a) b)

Fig. 8.1 Position of the oil indicator float:

a) Level of full oil filling (red float is visible);

b) Emergency level of oil filling (red float is not visible);

1 – fixed transparent rod; 2 – transparent flask; 3 – coupler; 4 – cover plate; 5 - float.

For TMPNG transformers in case if the float is lower the minimal mark at negative ambient air temperature, one should perform the following: make sure that there is no oil leakage from the transformer, perform transformer heating as per i. 8.3 up to temperature +10°C. If after the heating, oil level is not restored above the minimum mark, inform the manufacturer about it;

- If required install the thermometer having filled before transformer oil in the thermometer tube used as heat-carrying medium;
- Measure insulation resistance LV - tank, HV – tank, HV -LV. Permissible values should be not lower the values indicating in «Electrical Installation Regulations». Measurement should be performed at insulation temperature not lower than +10°C. If insulation temperature is lower than +10°C, to measure characteristics of insulation, transformer should be heated as per i.8.3.
- Measure winding resistance to direct current. Resistance value should not differ more than for 5% from resistance value received on the same tap of other phases if in the passport for the transport is not indicated other value. Before measurements perform switching of tap selectors from the first position into the last one and back to remove oxide films from the contact systems;

– Measure transformation ratio on all positions of the tap changers, install and fix the tap changers of windings in the required position;

- For TMPN transformers perform oil sampling through drainage valve in the lower part of the tank, for TMPNG transformers oil sampling is not required (can be performed upon the customer’s request) and define oil breakdown voltage which should be not lower than 25 V. After oil sampling drainage valve should be sealed;

– for transformers with the expansion tank remove transportation bolt on the safety valve;

– remove shipping bracket from the pressure relief valve (safety valve) having loosened the bolt M4 (see fig.8.2);

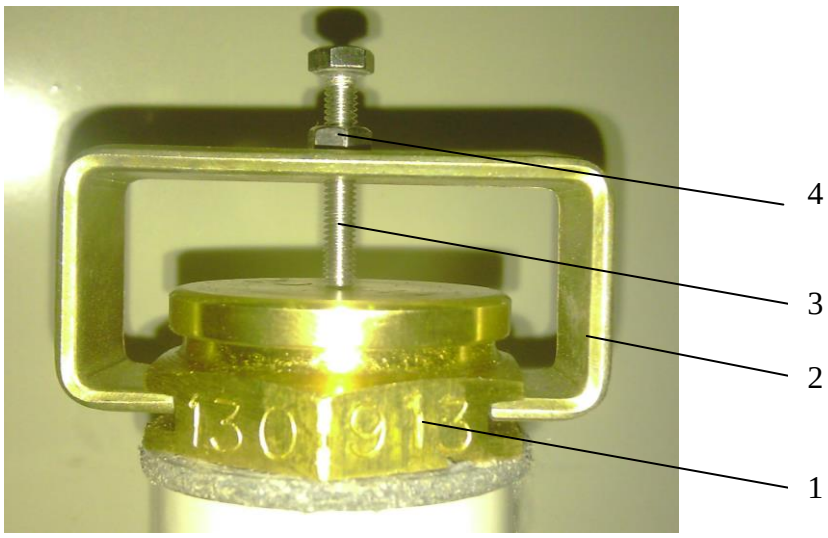


Fig. 8.2 Pressure relief valve with the shipping bracket

1 – pressure relief valve; 2 – bracket; 3 – bolt M4; 4 – lock nut;
– ground transformer tank.

8.3 Transformer heating should be performed by one of the following methods:

- transformer arrangement in the heated space within one day;
- heating with short-circuit currents as per Industry building code 342-75 «Installation instructions for power transformers with voltage up to and including 110 kV».

8.4 During connection of cables and busbars is not allowed turning-through of bushing studs. Tightening torque for the thread connection of cables and busbars are as per GOST 10434-82.

Thread diameter, mm	Tightening torque, (not more) N·m, for bolt connection
M8	22
M10	30
M12	40
M16	60
M20	90
M24	130
M30	200
M36	240

Note: For bolt connections made of copper it is recommended to apply tightening torques which values exceed in 1,5-1,7 times set values in the table.

ATTENTION! To fix cables and busbars there are two upper nuts on the insulator stud.

8.5 Revision of the active part is performed in exceptional cases (if there is violation of requirements of the present manual for transportation and storage which led to defects appearance in the transformer and the defects can not be removed without opening of the active part) and with written authority by the manufacturing plant. If revision of the active part is groundless, the manufacturing

plant has the right to remove guarantee set by the technical conditions. Revision procedure is indicated in appendix 4.

8.6 The first actuation of the transformer should be performed without load as per «Operating instructions for stations and networks» for rated voltage for drying and observation for transformer condition for not less than 30 min.

8.7 It is allowed the re-actuation of the transformer with the rated load at any negative temperature as per UHL, provided that the transformer was not transported and the works with insulation properties change were not performed after the actions performance specified in i.8.2 of the present manual.

9 TRANSFORMER OPERATION

9.1 Transformer operation is performed as per the requirements of GOST R52719 and technical conditions for the transformer.

Transformers should withstand hazardous overloads as per GOST 14209 and overvoltage supplied to any HV winding tap higher than the rated voltage of the tap:

- in a continuous manner not more than for 5% – with power which is not higher than the rated power;
- episodically (but not more than 6 hours a day), not more than for 10% with power which is not higher than the rated power;
- transformers should allow hazardous overloads for 30% higher than the rated current with the duration not more than 3 hours a day if the previous load was not more than 80% of the rated current of the transformer.

Change of switch position should be performed only on HV and LV side when the transformer is deenergized in the following sequence:

- lift up the switch handle, perform rotation of the switch 3-5 times in all positions and in both directions;
- set the switch in the right position. The correctness of the selected switch position is indicated by the figure which can be seen on the switch handle, it should be located in front of the indicator;
- check with the megohmmeter the absence of phase circuit break of HV windings.

9.2 Abnormal duties of transformer operation.

If some obvious damage characteristics (crackles, clicks and other symptoms inside the tank) are detected, one should deenergize immediately the transformer. Perform visual inspection and check of the transformer (measurement of insulation resistance, winding resistance to the direct current, circuit integrity check of HV and LV windings (if there is break), transformation ratio, oil test etc.) to identify the damage reason. If during the inspection oil leakage is revealed, one should take measures to eliminate the leakage and fill up the oil in the tank.

The transformer can be put into operation only when the detected faults are eliminated.

ATTENTION! Leakage elimination and oil filling up should be performed only when the transformer is deenergized.

If oil overheating is revealed, one should perform the inspection of the transformer and check load rate.

9.3 Guaranteed service life is set as five years from the commissioning date but not more than 5,5 years from the shipping date if other term is not specified in the contract for the delivery of the transformer.

10 TECHNICAL MAINTENANCE

10.1 Transformer which is in operation should pass regularly the current operation control under load and scheduled inspection and repair.

10.2 Transformer inspection without deenergization should be performed in the following terms with the registration in the special log:

In electric installations with permanent operating staff – once a day;

In electric installations without permanent operating staff – not less than once a month;

In transformer units – not less than once per 6 months.

unscheduled – in abnormal operation modes as per i. 9.2.

10.3 During inspections one should check:

– insulator condition (identifying presence or lack of cracks, porcelain chips, oil leakage through the gasket);

– fixation condition of contact terminals of bushings and busbars;

– temperature of upper oil layers and oil level correspondence;

– transformer humming behavior (during the operation moderate, evenly buzzing sound should be heard without strong noise and crack);

– grounding condition;

– integrity of measuring and protective devices (oil indicator, pressure relief valve etc.);

– silicagel condition in the dryer (if any).

10.4 Preventive inspections and repairs should be performed as per «Operating rules for electric stations and networks» and «Testing norms of electric equipment».

10.5 The scope of preventive repair comprises:

– visual inspection and elimination of detected defects which can be eliminated on the site;

– cleaning of the insulators and the tank;

– gaskets check;

– when drop condensate is formed on the internal surface of the cover fixation point with the case frame, one should tighten the nuts on the bolts fixing

the cover to the case frame, requirements for tightening torque of bolt connections of the cover see i. 8.2;

– when drop condensate is formed in the point of contact of the insulator and the case, adjust the insulators, tighten the lower nut on the insulator core, requirements for tightening torque of thread connections of the insulators see i. 8.2;

ATTENTION! The lower nut on the insulator core is provided for the mechanical fixation of the insulators on the smooth wall of the tank.

– rotation of the switching device in the whole range (not less than 10 cycles).

If it is required to perform works on the active part of the transformer to eliminate the defects, one should follow the instructions of appendix 5 of the present manual.

11 TRANSPORTATION AND STORAGE

11.1 Transportation.

11.1.1 Transportation conditions in a part of mechanical effect as per group «C» GOST 23216, in a part of climatic factors – as per storage condition group 8 GOST 15150.

Transformers are delivered to the customer completely assembled, filled up with oil.

11.1.2 Inside the case there are: operating documents packed in the tight polyethylene bag ensuring safety during transportation and storage, accessories (by order).

11.1.3 Transformer transportation is performed by a railroad, water, motor transport as per the instructions specified in the contract for the delivery.

11.1.4 Overload number of transformers – not more than 4.

11.1.5 Transformer mounting on transport vehicles is performed as per the rules valid for the particular transport vehicle. Platform floor covering of the motor and railway transport should be wooden.

11.1.6 Transformer mounting on transport vehicles is performed as per the rules valid for the particular transport vehicle. Platform floor covering of the motor and railway transport should be wooden. During transportation the transformer should be rested on the platform floor covering of the transport vehicle with the whole surface of support beam channels on the case bottom. Transformer transportation on the rollers is not allowed.

Transformer mounting on the motor vehicle should be performed as per unfixturing scheme. Steel wire with the diameter of 6 mm can be used as the stretcher. Stretchers are fixed to the slinging hooks of the motor vehicle body and transformer lugs.

As struts can be used wooden bars which are fixed to the wood platform flooring with the nails.

It is not allowed to transport transformers which are not unfixed relatively the transport vehicles.

11.1.7 Calculation of transformer mounting on the transport vehicle should be performed considering the influence of the following specific inertial forces on it:

– in longitudinal direction – 1000 kg for 1 ton of the transformer weight;

– in transversal and vertical direction – 330 kg for 1 ton of the transformer weight.

During transportation the influence on the transformer should not exceed above mentioned specific inertial forces, also during transportation as part of the cubicle.

11.1.8 Handling operations should be performed properly following the operating safety rules. Sling transformers as per slinging diagram (see appendix 3). Slinging points should be marked with the corresponding sign.

11.1.9 It is required to lift and unfasten the transformer by specially marked slinging lugs on the transformer tank.

ATTENTION! One should avoid mechanical influence on the corrugated wall of the tank as it is made of thin plate steel.

11.1.10 Do not tilt the transformer. If transported by a railway transport vehicle do not hump.

11.2 Inspection upon arrival

Upon arrival to the place of destination perform inspection of the transformer and its components, check scope of delivery. During inspection special attention should be paid to:

– the condition of the transformer tank, seals, gaskets, locking devices, plugs. Transformer tank should not have dimples or any other damages. All seals and gaskets should be in order. The tank and transport vehicle should not have the traces of oil leakage;

– condition of all other units of details. Units and details should not have mechanical damages.

11.3 Unloading

11.3.1 Transformer unloading should be performed by a lifting crane with the proper lifting capacity. Slinging diagrams of the transformers are presented in appendix 3.

11.3.2 Unloading works should be performed following safety requirements and measures ensuring safety of components.

11.4 Storage

11.4.1 It is required to take the measures to decrease the time till the minimum when the transformer is in travelling condition.

11.4.2 During storage of the transformer one should provide regular control for the condition of the transformer and its components.

If there are no damage marks of transformer hermeticity after transportation and unloading during the storage period, one should control the lack of oil leakage.

During the storage period of the transformer more than 1 year one should control the value of breakdown voltage of the oil from the transformer tank. The value of breakdown voltage of the oil from the transformer tank should be not less than 25 kV.

11.4.3 If the transformer is stored under the negative temperature, it should be placed on the platform preventing it from the freezing to the ground. In case of freezing before slinging one should remove ground from the supports.

12 UTILIZATION

12.1. Transformer should be utilized after the decision is taken regarding the uselessness of its repair after the end of service life and in case of breakdown.

12.2. Utilization is performed by the special organizations or by the «Customer».

12.3. It is possible to perform partial utilization if during the assessment of the technical condition the components and materials can be used for further usage as spare parts.

12.4. Utilization of components and materials is required in the operation as the result of breakdown, after guarantee removal or in the result of the current repair.

12.5. During utilization of the transformer by the Customer one should:

- drain used transformer oil in the reservoir and send it for oil recovery. Oil recovery should be performed in special enterprises or by the «Customer» if there is special process equipment;
- metallic transformer components (copper and aluminum of windings and taps, electrotechnical steel and structural steel) should be given to the enterprises for the processing of ferrous and non-ferrous metals;
- porcelain insulators, electrocardboard, rubber seals, plastic materials, silicagel (for TM transformers) should be sent to the solid domestic waste landfill.

- **APPENDIX 1**

OVERALL, INSTALLATION AND CONNECTING DIMENSIONS OF THE TRANSFORMER

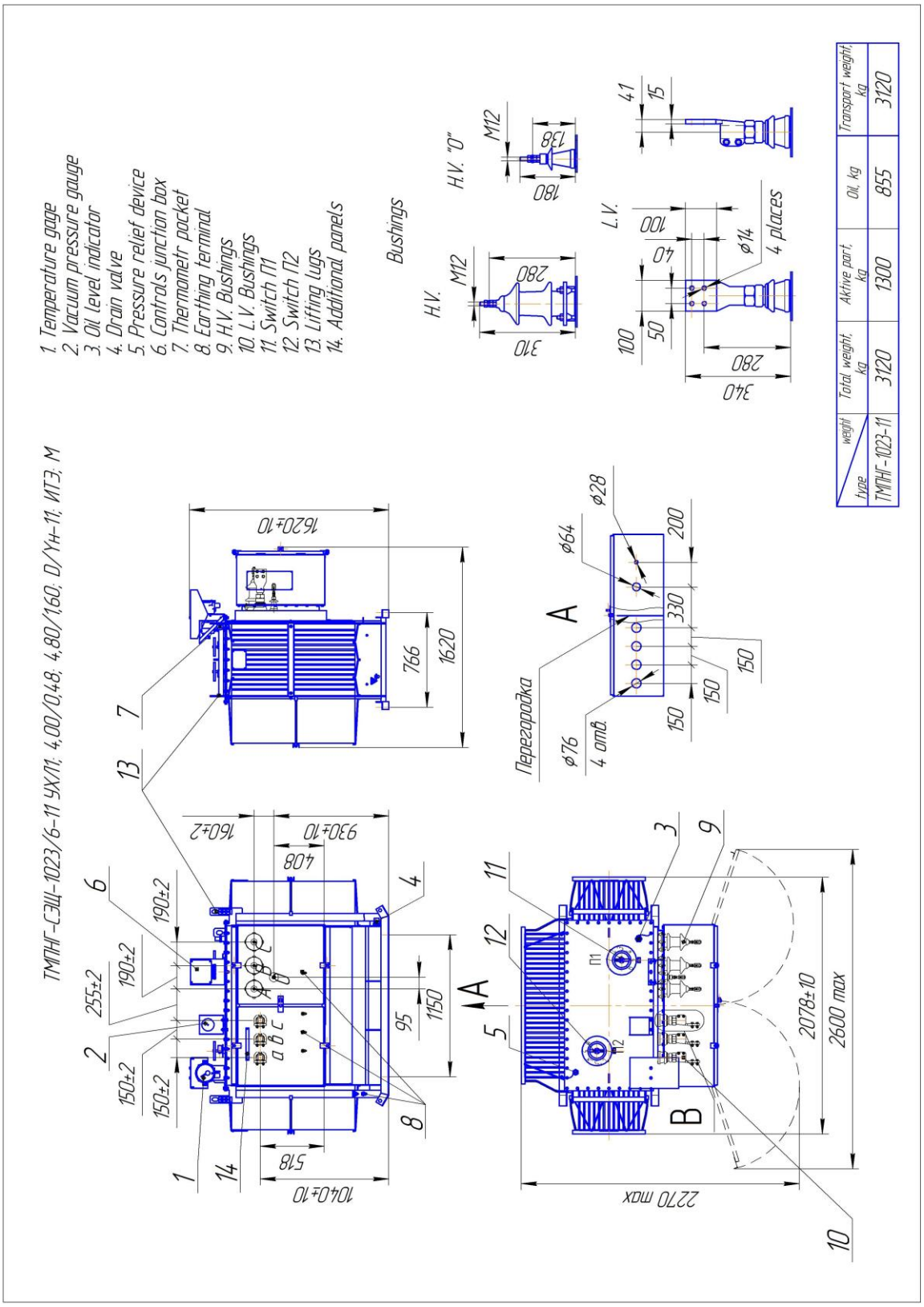


Fig. P1.1 Overall, installation and connection dimensions of transformers TMPNG -1023/6-11 UHL1; 4.00/0,48; 4,80/1,60 Yн/D-11

APPENDIX 2

TERMINAL ENDS WITH CABLE CLAMPS FOR HV BUSHINGS

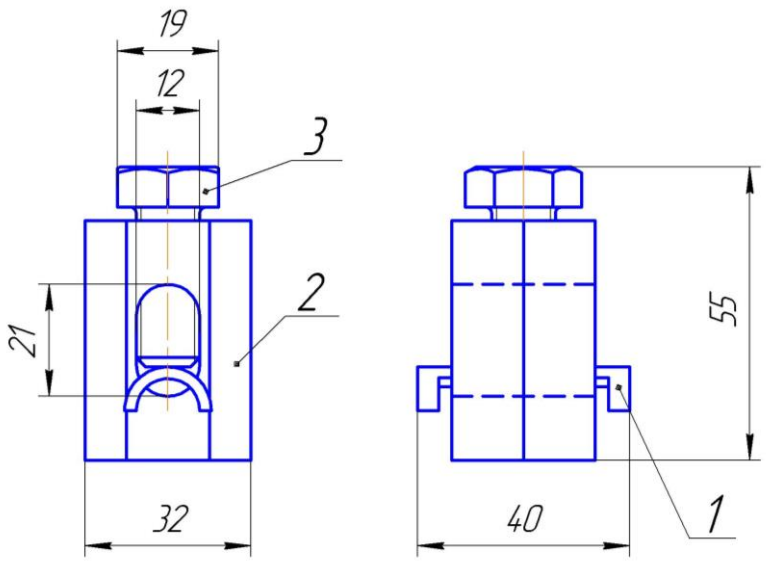


Fig. P2.2 Terminal end with cable clamp for HV bushings.
1 – clamp, 2 – sleeve with oval hole, 3 – clamping bolt.

Installation rules of the wire into the terminal end for HV bushing:

1) Sleeve with oval hole having dimension 21x12 mm is screwed on the bushing stud until the stud bolt is seen out of the hole for 1,5 – 2,0 mm;

2) Sleeve should be locked with a locknut;

3) In the oval hole of the sleeve should be installed the bare wire of the connected cable;

4) In the oval hole of the sleeve over the wire is installed the clamp with the length 45 mm;

5) The end of the connected cable is pulled out the end of the clamp for 10-15 mm;

6) In the round vertical hole with the thread M12 is screwed the clamping bolt up to the stop in to the wire;

ATTENTION! The wire should be pressed to the tap stud.

Tightening torque of the clamping bolt – 40 N·m.

APPENDIX 3

SLINGING DIAGRAM OF THE TRANSFORMER

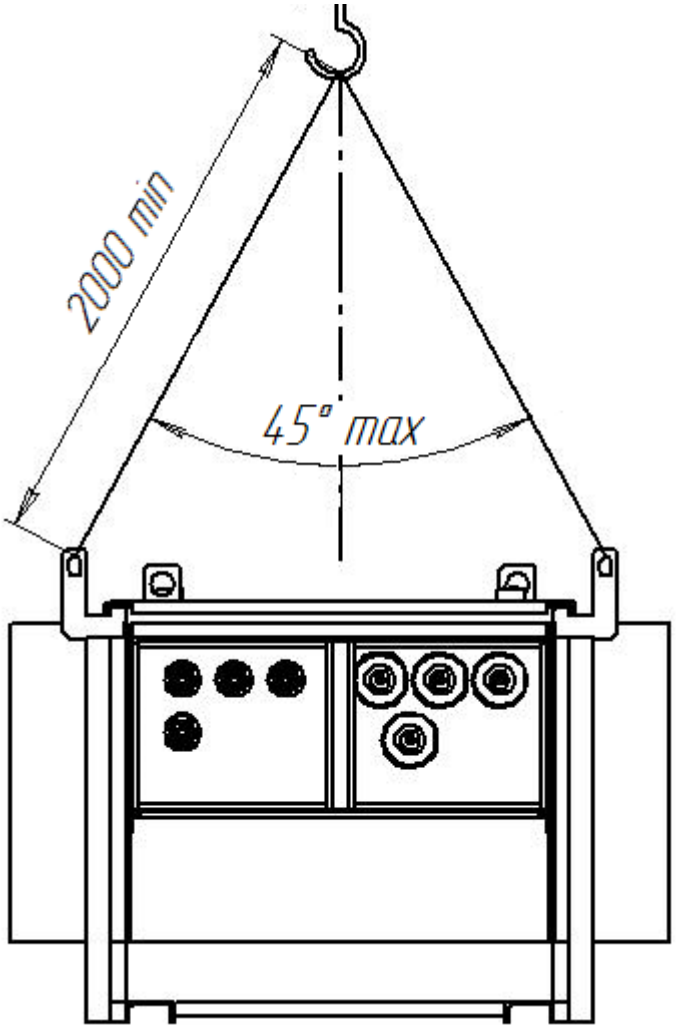
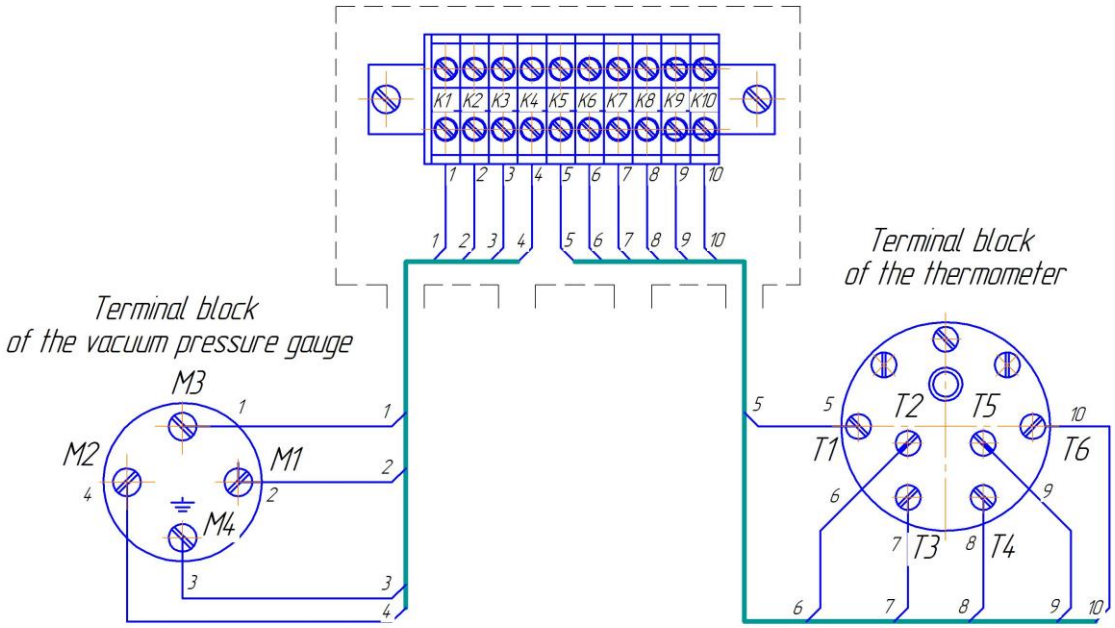


Fig. P3.1 Slinging diagram of the transformer

APPENDIX 4

DIAGRAM OF EXTERNAL ELECTRICAL CONNECTIONS OF THE ELECTRIC CONTACT THERMOMETER AND VACUUM PRESSURE GAUGE TO THE TERMINAL BOX



Device	Conductor	Connection	Note
Vacuum pressure gauge	1	M3 : K1	Upper limit
	2	M1 : K2	Indicator
	3	M4 : K3	–
	4	M2 : K4	Lower limit
Thermometer	5	T1 : K5	Open contact -40°C
	6	T2 : K6	Common contact -40°C
	7	T3 : K7	Closed contact -40°C
	8	T4 : K8	Open contact 100°C
	9	T5 : K9	Common contact 100°C
	10	T6 : K10	Closed contact 100°C

APPENDIX 5

TRANSFORMER REVISION

1 Requirements for revision performance and its terms.

1.1 Transformer revision is performed by the agreement with the manufacturing plant in exceptional cases if there is non-compliance with the requirements of the present instruction regarding transportation, storage, unloading and operation which led to the defects in the transformer and defects can not be removed without opening of the active part of the transformer. Results of the revision are registered by the act. The start of the revision is oil drainage.

1.2 Temperature of the active part of the transformer in the process of inspection should exceed the dew-point temperature not less than for 5°C and in all cases should not be lower than 10°C. If the natural conditions of the ambient temperature do not ensure fulfilling of this requirement, the transformer before the inspection should be heated.

1.3 Transformer inspection should be performed if the weather is stable and clear without precipitation. The duration of works related to the depressurization of the tank performed with adherence to the conditions of i.1.2 should not exceed:

– 24 hours at relative humidity less than 70%;

– 16 hours at relative humidity less than 80%.

If the inspection time exceeds the specified time but not more than in 2 times so the test heating of the transformer should be performed.

1.4 If relative air humidity is more than 80%, the transformer should be inspected only indoors.

2 Scope and sequence of operations.

2.1 Drain oil from the transformer through the drainage valve which is located in the lower part of the tank. Transformer oil should be drained in a specially prepared dried container. When the drainage is finished one should tilt the transformer in the direction of the drainage valve at the angle of 30° to the horizon and drain remaining oil in the container for utilization.

2.2 Level the transformer checking the horizontal position of the tank frame.

2.3 Disconnect the handles of switch drives.

2.4 Remove the tank cover having unscrewed the bolts and lift it up. During removal of the cover one should ease off the bolts evenly along the whole perimeter. Lifting should be performed strictly following the safety rules and the operating manual, meanwhile one should follow that the gap between the tank and the active part was along the whole perimeter.

2.5 Disconnect inside the tank the taps from HV and LV bushings having unscrewed the bolts connecting LV and HV bushings with the taps.

2.6 Unscrew the bolts fixing the active part to the tank.

2.7 Lift the active part by the lifting lugs on the magnetic conductor core. Lifting should be performed strictly following the safety instructions and the present operating manual.

2.8 Install the active part on the wood covering. It is forbidden to perform the works if the active part is in suspension.

2.9 Install temporary racks or platforms ensuring convenience and safety of works during the revision of the active part.

2.10 Inspect the active part if there are any damages. Check the tightening of steel studs, yoke beams, brackets for fixation of tap selectors and other elements of the active part. If loosening is noticed, one should tighten the nuts.

Thread diameter	Tightening torque, N·m
M12	40
M16	50

2.11 Check the condition of contact surfaces of the switches, check the proper functioning of the switches.

2.12 All revealed defects on the active part should be removed.

2.13 Wash the active part with the transformer oil jet.

Washing should be made after performance of all measurements and inspections on the active part just before putting it inside the tank.

2.14 Remove the remaining oil from the tank bottom. Wash and clean the available internal surfaces of the tank.

2.15 Fix HV and LV bushings on the wall of the tank.

2.16 Put the active part inside the tank

2.17 Fix the active part with the bolts to the brackets on the tank.

2.18 Connect HV and LV bushings to the taps and tighten the nuts on HV and LV bushings (tightening force as per i. 8.2 of the present manual).

2.19 Check tightness and tighten plug connections of the taps, tighten lock nuts, check insulation of available parts of the windings, taps, switches and other elements.

2.20 Install the cover, install the handles on the switch drives and perform tightening of the bolts fixing the cover to the case of the tank (tightening force as per i. 8.2 of the present manual).

2.21 Perform control of insulation condition with the megohmmeter. The value of insulation resistance: LV-Tank, LV-HV, HV-Tank should be not less than 300 MOh.

2.22 Fill up the transformer with oil in the following sequence:

– Open the pressure relief valve located on the tank cover;

– Through this hole fill up the transformer with oil checking the level by the oil indicator located on the tank cover meanwhile oil temperature should be not less than 10°C and temperature of the active part is higher oil temperature; leave the transformer for remaining air output for not less than 48 hours;

– After transformer settling one should fill up the oil up to the required level of the oil indicator, check integrity and condition of the gasket and close the pressure relief valve.

– Perform control of the insulation condition with the megohmmeter. The value of insulation resistance: LV-Tank, LV-HV, HV-Tank should be not less than 300 MOh.