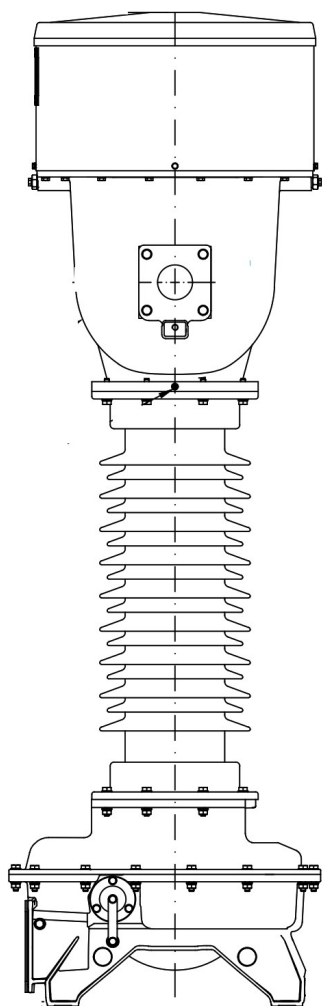




INSTRUCTION MANUAL - 19401

72.5kV COMBINED TRANSFORMER

TYPE KOTEF-72





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Warning!

Any person involved with transport, installation, energizing, operation and maintenance of 72kV Combined Transformer type KOTEF72 must read these instructions prior to any action related to these current transformers.

These Combined Transformer are built under strict conditions which guarantee the Highest Quality achievement. In order to keep this high quality during Combined transformers lifespan, it is utmost important that the instructions in this Manual be thoroughly read and complied with.

THESE COMBINED TRANSFORMERS CAN NOT BE STORED IN A HORIZONTAL POSITION.

Preliminary Remarks

During reception of the Combined Unit, it is important to check unpacking attentively in order to control the condition of the transportation crate and the transformer itself. Any irregularities shall be recorded on the transport delivery note and a formal communication shall be sent to the responsible person immediately.

The supplied insulator can be made of porcelain, therefore, sudden movements that could cause damage due to cracks shall be avoided.



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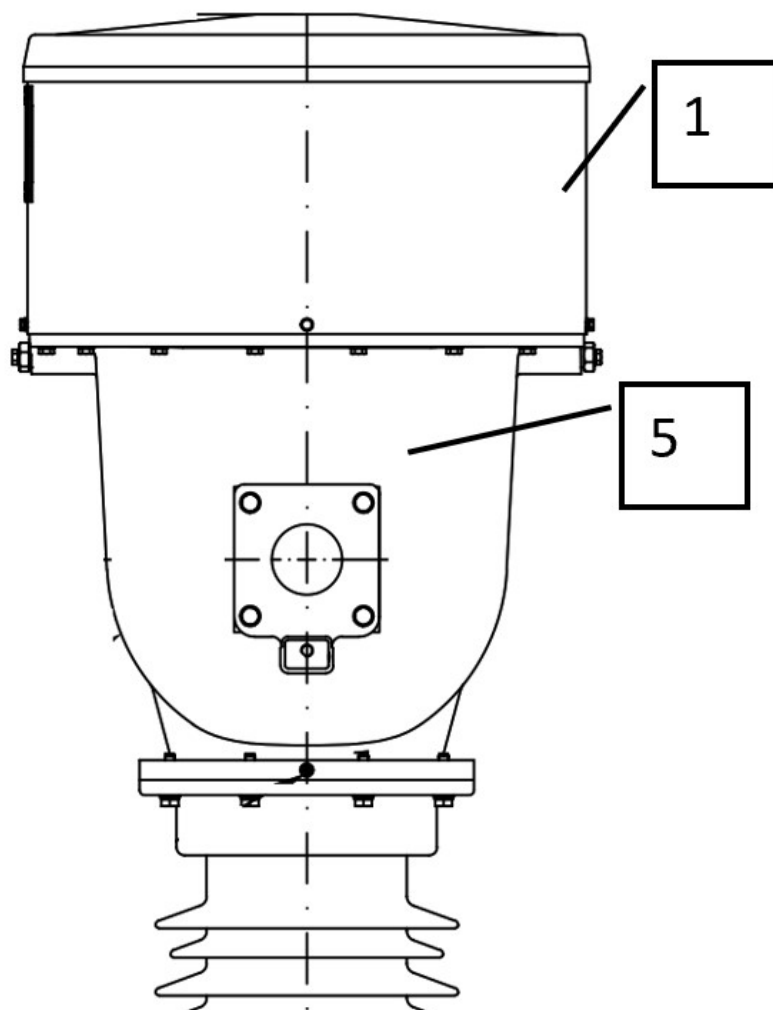


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1. GENERAL DRAWING

Description and characteristics of the KOTEF72 Combined Transformers. For more details, see set of drawings.

1. Top Cover
2. Oil Level Indicator (metallic bellows)
3. Lifting eyes (4x)
4. Primary terminals: aluminum or tinned copper alloy
5. Cast aluminum tanks (upper-CT and bottom-VT)
6. Insulator: Porcelain or Composite
7. Secondary terminal box



General Drawing of KOTEF72



2. DESIGN AND CONSTRUCTION

2.1. Inverted construction and primary circuit for CT part

The active part of the CT current transformer part is located above the insulator. The advantages of this construction concern the primary circuit conception. The primary circuit is short, rigid and straight, minimizing heating. In addition, it bears electrodynamic forces more easily, allowing high level performance, relating to electrodynamic and thermal effects, in a presence of short-circuit currents. The primary bar (simple or multiple ratios) with magnetic circuits are centered to assure a distributed magnetic flow in uniform way to avoid local saturation. This arrangement allows also better accuracy in transient conditions.

2.2. Secondary circuit for the CT part

The ring-shaped magnetic circuits are manufactured either from very high permeability grain oriented steel or from nickel alloy. In order to achieve a satisfactory transient behavior, protection cores can also be provided with gaps.

CT part of the KOTEF72 may have metering and protection cores with different loads and different accuracy classes. Secondary turns are evenly wound around the circumference of the ring-shaped cores. Changing ratio is available by means of taps on the secondary or primary side.

All secondary windings are enclosed in an aluminum box which protects them against high frequency disturbances while acting as a low voltage shielding electrode. This aluminum box is extended up to the base by an aluminum tube which contains all secondary leads. The cross section of the earth connections is designed to support defect currents.

The bottom of the hermetic and watertight secondary terminal box is closed by a fitted plate, with or without cable gland depending on customer requirements.

2.3. Paper-oil insulation

Insulation between primary and secondary circuits is made by multiple layers of insulating papers impregnated with mineral oil.

To protect the oil from the environment, the KOTEF72 head is closed by a metallic bellows. Due to its wave shape construction, the bellows adapts to the changes in oil volume without producing any increase or decrease in internal pressure. This bellows resists aging and corrosion.



2.4. Cast aluminum tanks

The active parts, CT and VT, are housed in a cast aluminum tank.

2.5. External metallic parts

The external metallic parts do not require maintenance and they are naturally protected against corrosion effects.

3. TRANSPORT, RECEPTION, UNPACKING AND STORAGE

3.1. Transportation

The KOTEF72 shall be transported in in vertical position in an appropriated packing. Wooden crates are designed to withstand paved or unpaved roads. The crates cannot be stacked.

3.2. Reception

Whether the shipment is of manufacturer or customer responsibility, the customer inspector or the service agent must check the following on receipt of delivery:

If the crates show any signs of impact, blows or fractures, or if the transformers have any sign of damage or oil leakage, the customer inspector or the service agent in charge of receipt shall make a written remark on shipment documents. The receipt control, mainly for the porcelain insulators and the secondary terminal box, shall be done in the presence of the forwarding agent, if possible. The remarks regarding the condition of the

goods shall clearly state details of the damages found at the time of reception.

In case of damages, the customer inspector in charge of receipt shall notify GE and the insurance representative. All contact information is indicated on shipment insurance documents. This declaration shall be made within eight days after receipt of the material.

3.3. Unpacking

Material required for unpacking and lifting the transformer up to vertical position:

Qty	Description
1	Crane, munck or hoist
1	Swing-bar of 0.7 to 0.9m of length with 2 holes
1	Graphite grease MOLYKOTE type P37 or equivalent.
3	Slings of 2.0m of length (capacity 10000N / 1000 kg)

Unpacking the transformer shall be made with caution:

- 1) Remove the smaller extremities;
- 2) Remove the upper cover;
- 3) Remove the larger extremities.

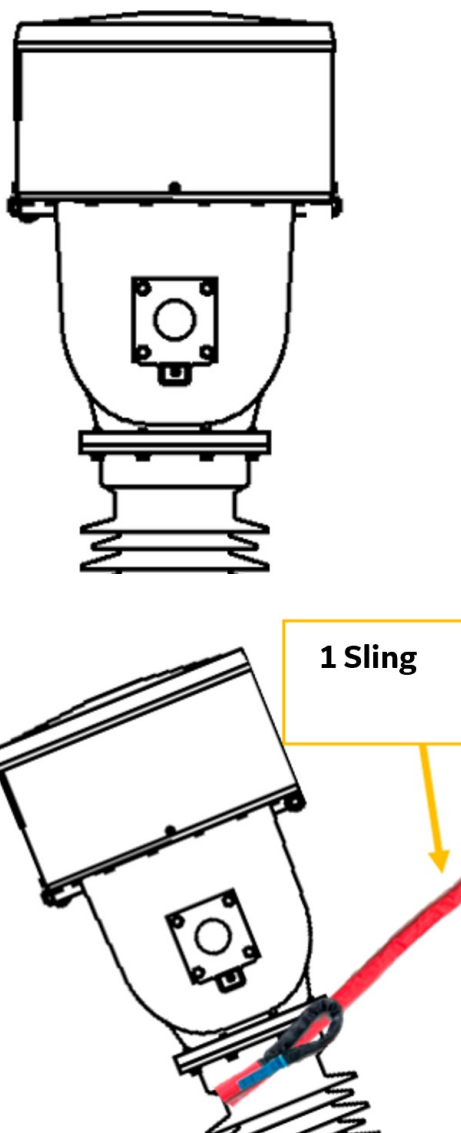
NEVER lift a KOTEF72 combined transformer by its primary terminal. Lift it by the lifting eyes on the transformer top. See pictures to proceed:



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To lift the transformer with crane or munck, follow the marks on the wooden crate, once they indicate the right position for the slings (nylon belts reinforced) and avoids blows and vibrations.

Follow the instructions shown in the drawing below for lifting the CT. All cables or slings shall be kept in vertical position during the lifting. It is recommended to lift the transformer slowly.



3.4. Storage

The transformer shall be stored in vertical position on a flat and stable surface, keeping a reasonable distance from any kind of traffic (people or vehicle).

NOTE: The units stored outside in vertical position must be screwed on to the ground, even if the storage is foreseen for a short period of time.

4. BELLOWS BLOCKING SYSTEM AND ASSEMBLY IN THE STRUCTURE

4.1. Bellows blocking system

For transportation purposes, the metallic bellows device is blocked (secured from movement) using cushions of synthetic foam slightly compressed by the top cover. A protection of plastic film is also put in place on the periphery of the bellows to protect it against contact with the top cover.

In order to remove the blocking system, place the current transformer in vertical position on a flat surface.

Remove the bellows blocking device, following the procedure below:

- 1) Mark the position of the top cover with respect to the head of the transformer with a vertical line (using a marker, chalk or pencil);
- 2) Remove the screws that fix the top cover;
- 3) Remove the bellows blocking device and the protection film;
- 4) Confirm by visual check that the



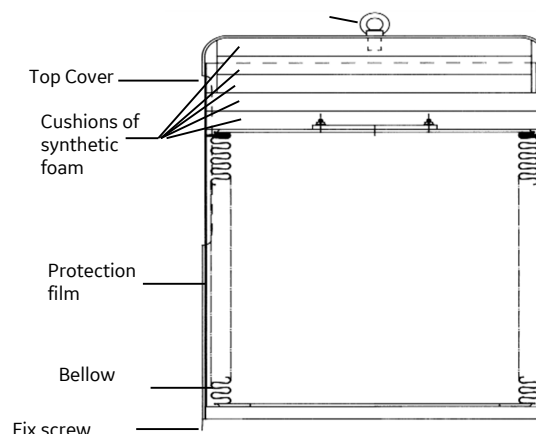
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bellow device is in good condition:

- a) Geometry: Top of the bellow is horizontal (i.e. not tilted due to possible deformation of the bellows convolutions). No distortion and/or asymmetry of the bellows (i.e. convolutions are evenly displaced around the circumference of the bellows)
- b) Surface: no damage or deformation such as dents and/or buckling in the bellow

TO AVOID DAMAGE TO THE BELLOW DEVICE, NEVER SUPPORT ANY MATERIAL ON THE BELLOW.

- 5) Reinstall the Top Cover with care lining up the vertical marker line with the head of the transformer to ensure that original fixing position is maintained. Confirm that the bellows is free for internal movement and in a vertical position. The green oil level marker shall be clearly visible through the window.
- 6) Tighten the fixing screws. The threads shall be lubricated with grease << MOLYKOTE P37>> or equivalent. The screws shall be tightened to a maximum torque of 7N.m for screw M6 and 16N.m for screw M8.



4.2. Assembly in the structure

The combined transformer shall be set up in vertical position.

It is very important that the surface on which the Combined Transformer will be set up is flat (tolerance for no more than 1mm).

Verify if the four feet are supported on the structure. If not, it is necessary to insert a shim before putting the fixation screws.

Remove the lower lid of black plastic, if applicable, from secondary terminal box. It is only used for transport. It cannot be used as tube guide.

5. CONTACT SURFACES PREPARATION

It is recommended to clean all aluminum contact surfaces with sandpaper 150 grain in order to eliminate the oxidation layer. Scrub the contact surfaces with a metallic brush (diameter of the thread 0.3mm) and impregnate with grease of the type "PENETROX" or equivalent. All the



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surfaces must be completely covered with grease.

For silver or tinned contacts, only clean (do not use sandpaper) and polish the side of the aluminum. Cleaning silver or tinned surfaces with sandpaper could cause damage to the protection layer.

6. CONNECTIONS

6.1. Primary Terminals

Connect the high voltage cable, or tube, to the primary terminals with appropriate connectors so that they assure a good contact.

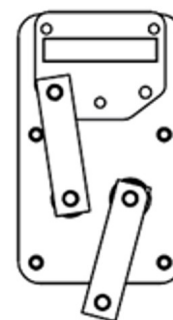
6.2. Primary bar type (if applicable)

Primary bar is always supplied completely assembled with the delivered CT. Clean the primary terminal as explained in "CONTACT SURFACES PREPARATION"

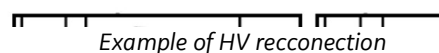
6.3. Two bar or Four bar Reconnection Primary type (if applicable)

The current ratio of the Combined Transformer can be single with only one single bar, double or triple primary ratio. Double or triple primary ratio can be easily changed by the user following the instruction of the approved set of drawing. This changing ratio is made by means of reconnection bars located in the top tank, closer to primary terminals. See set of drawing to know how the reconnection bars need to be

positioned in order to have the required ratio.



SERIE RECONNECTION



Example of HV reconnection

6.4. Grounding

The Combined Transformer bottom tank (VT part) has one grounding pad that should be linked to the substation ground system through an appropriate grounding connector.

6.5. Secondary terminals

Connect protection and/or measure instruments to the secondary terminals as shown on the nameplate. See the tightening torque in the drawings of the project

A point of each secondary terminal must be connected to the ground in order to fix the potential.



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CT terminals: Secondary terminals not used must be short-circuited and grounded. NEVER leave the secondary terminals of a current transformer in open circuit.

VT terminals: Secondary terminals not used shall stay in open circuit. NEVER short circuit or earth more than one point of each secondary terminals of a voltage transformer

6.6. Terminal marking

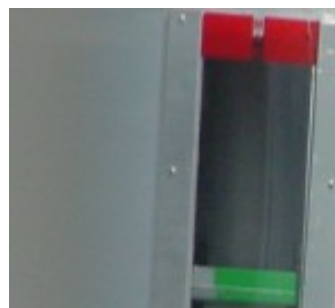
Primary and secondary terminal marking are done according to the specified standard. See set of drawing. Primary and secondary connection scheme are shown on schematic plates, fixed on the Combined Unit.

7. OIL LEVEL INDICATOR

The position of the oil indicator can be verified through the rectangular window of the top cover.

The plate of the indicator is divided in three areas. Central area shows the green strip and higher and lower areas are shown with a red strip. In normal conditions, the indicator shows the green strip of the indicator.

In case of oil level indicator is in either of the red areas, the transformer must be removed from operation and GE informed immediately.



8. INSPECTION BEFORE FIRST ENERGIZING

Verify terminals connections to assure the correct tightening torque.

Verify if there are no open-circuited secondary terminals for the CT and shorted terminals for the VT.

Verify if one point of each secondary terminal is connected to ground.

Verify the ground connections of the ground pad.

Verify the correct position of the primary terminal (transformer with reconnection primary bars). See set of drawing.

Verify that the oil level indicator is in the green strip area.

Whilst all care is taken in the factory during oil filling, the surface near of screws and bellows could have a small quantity of oil. This shall not be considered as an oil leakage provided the bellows are positioned within the green strip area.

It is not necessary to remove oil samples for analysis. The Combined Transformer OSKF72 is hermetically sealed



If required, small quantity of oil can be taken. Always verify oil level indicator before take oil samples.

Never complete oil volume without prior formal authorization of GE.

Important remark:

During commissioning, it is recommended to register the values acquired for each of the performed tests in order to compare with future measurements during the Combined Transformer lifetime. The measurements taken in the factory are important as so the measurements during commissioning of each Combined Transformer. The comparison between test results measured at the field allows following the evolution of each parameter.

9. MAINTAINENCE AFTER ENERGIZING

After installation and energizing, the OSKF72 shall not require any further intervention. However, it is suggested performing visual inspections during the first weeks of service in order to:

- Verify the position of oil level indicator. KOTEF72 in the same circuits shall have similar oil levels. If the indicator is significantly below or above the green level, in comparison with other KOTEF72, it is recommended checking the presence of any of leaking. If leaking is found, remove the OSKF72 from operation and inform GE;

- Verify if there is no oil leakage;
- With an infrared imaging device, check if the primary terminal connections are not overheating. Compare with other KOTEF72 from the same circuit.

After one year of operation, it is advised a detailed inspection of tightening torques and oil leakage and thereafter twice per year according to the substation maintenance contract.

If possible, GE suggests disconnecting the KOTEF72 and to perform the following examinations:

- 1) Insulator: Depending on the pollution level, it is necessary to clean the porcelain;
- 2) Metallic components: check for corrosion;
- 3) Tightening torque of primary and secondary connections. Any adjustments shall be carried out as described in the item “Primary Terminals” of this document;
- 4) Secondary terminal box: If necessary clean inside the terminal box.
- 5) Verify oil level indicator and if there is any signal of oil leakage;
- 6) Remove the top cover to have access to the bellows and verify if there is any signal of oil leakage near the fixation of the bellows and / or if the bellows is in good condition.



Tests

It is recommended after the first few hours of operation and whenever there is a change in the KOTEF72 primary current (in the bar connection), performing the measurement of the primary terminal temperature with a proper temperature measuring instrument.

It is advised to perform the following tests before putting the KOTEF72 in operation and thereafter at four year intervals depending on availability of the KOTEF72:

- 1) Ratio (TTR);
- 2) Polarity (Polarity meter);
- 3) Saturation Voltage for CT (ac voltage source, Voltmeter and Ammeter);
- 4) Ohm Resistance (Wheatstone bridge);
- 5) Insulation Resistance with any megohmmeter;
- 6) Tan δ of the HV insulation (Double M4100, Omicron CPC100 or any equivalent).

Important remark:

During commissioning and tests, it is recommended recording the results acquired in the tests abovementioned.

In case of doubts, please contact the technical assistance support of GE: +55 35 3629 7042 or 7038 or 7000

10. PROPER DISPOSAL OF TRANSFORMERS COMPONENTS AFTER LIFESPAN

The instrument transformers are mainly composed of the following components, which after transformer's lifespans require a properly disposal in order to prevent environmental contamination.

Components	Recommended Disposal
Metallic materials	Metal recycling company
Resin and materials saturated with resin	Oil disposing company properly licensed to perform such activity
Oil (PCB-free) – classified as Class I hazardous residue	Oil disposing company properly licensed to perform such activity
Material contaminated with oil	Co-processing or incineration at a company properly licensed
Porcelain insulator	Industrial landfill properly licensed
Other materials	Industrial landfill properly licensed

The disposal of oil and components contaminated with oil directly into the soil or water is prohibited.

For further information or clarifications, contact GE environment department: +55 35 36297112.