

# KOTEF

## Combined CT/VT 72.5 kV to 420 kV



### Design and advantages

As with separate transformers, the current transformer part is located in the head housing and the voltage transformer part in the base tank. The bushings between high-voltage potential and ground potential are arranged in opposite directions inside the insulator. The base dimensions remain the same as a voltage transformer of the same nominal voltage.

The CT and VT functions are fulfilled within a single unit. KOTEF utilizes the same components as the individual CTs and VTs. Both transformers are combined in a single metering unit and are available in porcelain or composite. This is an excellent solution for adding metering capability to either a new substation installation or a site being upgraded where space is at a premium. Consequently, considerable cost savings are realized in the initial purchase price, transportation, real estate and installation labor and materials compared to the equivalent costs of two separate transformers. The KOTEF line combines the advantages and design features of the OSKF and OTEF lines.

### Long Service Life and Near-Zero Maintenance

Insulation integrity is assured by the fact that the oil is hermetically sealed from the atmosphere by a metallic diaphragm assembly.

All external parts are of corrosionresistant material. Therefore, regular painting is not required. The KOTEF line is designed with a +30-year lifetime.



The KOTEF is designed to provide both current and voltage measurements from a single device.

### Main Features

- Metering and protection
- Characteristics:
  - High-quality paper-oil insulation
  - Oil expansion and hermetic seal by stainless-steel diaphragm bellows
  - Oil level indicator
  - Cores in heavy walled aluminum housing
  - Changing of primary ratio by primary connection (single, double or quadruple ratio) or by secondary taps
- Seismic designs available
- Compliance with ANSI/IEEE standards, other standards on request.

### Customer Benefits

- Price advantage
- Space savings: only one base
- Cost savings on transportation and installation
- Reduction in Inventory
- Protection against bursting
- Maintenance-free



## Current Transformer Design

Head type design, with active ports in the head. The primary is normally a straight bar type conductor with low inductance. Therefore primary surge protection is not required. Ratio change can be accomplished either by primary bar series-parallel connection (single, double or quadruple ratio) or by secondary tops. Combinations of series-parallel connection and secondary tops are also possible. The head type design also has the advantage of spreading the primary flux uniformly and symmetrically through the cores, avoiding local saturation and reducing the leakage flux.

Current transformers can have several toroidal laminated cores which are independent of each other. Cores with secondary windings are accommodated in a thick-walled core made of aluminum.

The core housing is mounted on a heavy gauge metal tube inside the insulator which leads to the base plate. Cross sections and connections have been dimensioned in such way that the current can be led to ground in the event of a short circuit, without an arc occurring in the area of insulator.

## Voltage Transformer Design

### Windings and ratings

During the winding of the primary coil, the double-enameled copper wire is continuously monitored by an electronic detector seeking faults in the insulation varnish. One or two secondary windings can be provided for metering and protection purposes, and optionally a separate winding can be supplied for ground fault detection.

A double ratio achieved by a secondary top is standard. All IEEE accuracy classes or other standards for metering and protection purposes can be provided. Accuracies beyond the requirements of normal standards like 0.15 Z are available.

### Thermal burden

The thermal burden rating is 3,000 to 7,500 VA (please see table on the last page). The VT can sustain that load continuously, however cannot be used for metering during the same time.

### Overvoltage factor

All VT's are designed for a standard overvoltage factor of 1.2 continuous and 1.73 for one minute (below 245 kV) and 1.4 for one minute (245 kV and above). Other values on request.

## Rated Currents

The maximum primary rated current is 5,000 A. The secondary rated current is 5 A. Other ratings are available upon request. Metering units have typically only one or two independent secondaries (cores), however, upon request, up to six cores can be fitted.

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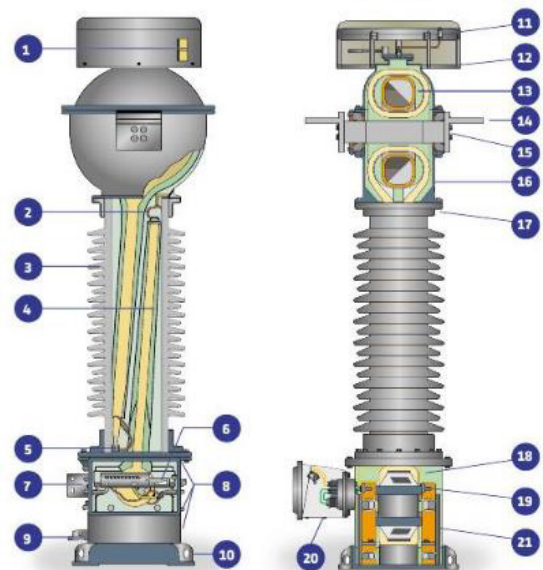
## Transformation Ratio Change

- Primary reconnection at the ratio of 1:2 (max. 4,800 A)
- Series connection up to 2,400 A
- Parallel connection up to 4,800 A
- Primary reconnection at the ratio of 1:2:4 (max. 3,600 A)
- Series connection up to 900 A
- Series and parallel up to 1800 A
- Parallel connection up to 3600 A
- Secondary tops available (multi ratio or dual ratio)

Combinations of the primary reconnection and the secondary tops are possible.

## Thermal and Dynamic Rating

An advantage of the head design is that the primary current takes the shortest path through the CT portion. As a result, a high thermal and dynamic short-circuit capability is achieved: max. 150 kA for one second, dynamic current of max. 375 kA.



KOTEF 72.5 to 420 kV

- |  |   |
|--|---|
| 1. Oil level indicator                               | 12. Aluminum flange and cover   |
| 2. Potential connection                              | 13. CT core   |
| 3. Insulator   | 14. Primary terminal  |
| 4. Capacitive graded bushing                         | 15. Primary conductor   |
| 5. Ground connection                                 | 16. Core housing  |
| 6. Secondary terminals                               | 17. Hotdip galvanized gray iron flange (composite insulators use marine-grade aluminum flanges) |
| 7. Ground pad  | 18. VT high voltage winding   |
| 8. Aluminum bases tank, cover plate and terminal box | 19. VT low voltage winding  |
| 9. Oil sampling valve                                | 20. Access plate  |
| 10. Lifting eye (4x)                                 | 21. Laminated core  |

## High Quality Insulation

The insulation paper is applied mechanically, guaranteeing a homogenous, high-density paper insulation. Defined grading layers with field-optimized electrode rings achieve a uniform field distribution along the insulator between line and ground. Most of the insulation is from Kroft paper. The coil insulation is a closed style design resulting in a compact unit with good dielectric withstand characteristics. Surge arrestors to protect the KOTEF are not necessary. High-quality mineral oil with excellent aging stability and gas-absorbing properties is used. The oil meets IEC 296 and IEEE C57.106 requirements and contains no PCBs. Controlled vacuum and temperature treatments withdraw humidity and gas from the paper insulation and insulation oil. The impregnation process results in a high-grade dielectric system.

## Hermetically Sealed

The KOTEF maintains a completely sealed and pressure-free system through the use of a stainless-steel metallic diaphragm assembly. The diaphragm assembly provides oil expansion and pressure compensation, protects the interior from air and moisture and preserves the dielectric strength of the CT-VT. The movements of the compensation system are registered by an oil level indicator which is visible behind a window fitted in the transformer head. Effectively, oil maintenance, change or inspection is eliminated and the KOTEF operates pressure-free.

## Leakproof design

The head housing is made of corrosion-proof aluminum alloy. Every housing is subjected to a vacuum leak test by helium leak detection. An overall leak test is performed on every completely assembled unit before oil filling. All seals are formed by single-piece O-Rings in fully machined grooves.

## Primary terminals and rounding

Standardized primary terminals consist of flat busbar aluminum terminal pods with 4, 6, 8, or more holes depending on current rating.

## Overvoltage factor

All VTs are designed for a standard overvoltage factor of 1.2 continuous and 1.73 for one minute (below 245 kV) and 1.4 for one minute (245 kV and above). Other values available upon request.

Two grounding pads on opposite corners of the base are provided.

## Secondary terminal box

The terminal box is very spacious and has a removable plate located at the bottom which allows for in-factory or on-site drilling of the conduit entrances for the insertion of cable glands as desired. The secondaries are brought out through an oil/air seal block assembly and terminated on separate terminal blocks with 8-32 screws. Other terminals are available upon request. The neutral end of the primary winding is terminated in the secondary box. It is grounded with a lead and can be used to perform on-site tests up to 4 kV.

## Insulator

The outer insulation consists of aluminum oxide porcelain in grey (ANSI 70). Standard creepage distances are available according to the dimension tables. Larger creepage distances and composite insulators are available upon request.

## Protection Against Bursting

The enhanced insulation structure and mechanical design ensure a high quality insulation for service lifetime. The following additional measures are taken to prevent the insulator from bursting in the event of an inner insulation breakdown, e.g. in case of lightning strikes:

- The active ports are positioned in aluminum housings above and below the common insulator.
- Internal fault current connections are led through the insulator.
- The capacitive grading in the high voltage insulation is designed to withstand transient overvoltages to be expected during service life.
- A pressure relief plate is located in the expansion assembly on the head.
- Upon request, a composite insulator consisting of fiberglass reinforced tube and silicone rubber sheds can be provided instead of the porcelain insulator.

## Transport And Installation

KOTEF can be transported and stored horizontally. Vertical transportation is possible for lower voltage units depending on the permitted transportation height. The KOTEF is supplied ready for energizing. No special tools are required for connection.

## Service Life and Maintenance

KOTEF transformers have been designed for a +30-year lifetime. They have no specific maintenance requirements and no pointing is required:

- All hardware is made of stainless-steel. Housing are made of marine-grade of marine grade aluminum alloy.
- Porcelain fittings are made from cast-iron hot dip galvanized.
- Angle brackets are made from steel and hot dip galvanized.

Besides regular transformer surface cleaning, no routine maintenance is required. The hermetic seal alleviates the need for oil sampling or moisture checks unless unusual operating conditions occur.

### Additional Information

#### Dielectric loss factor

Tan  $\delta$  smaller than 0.005 up to the power-frequency test voltage

#### Radio Influence Voltage (RIV)

Less than 2500  $\mu\text{V}$  at 1.1 Um

#### Internal partial discharge

Less than 10 pC at 1.0 Um

#### Frequency

60 Hz. Other values available upon request.

#### Ambient temperature

-40 degrees  $^{\circ}\text{C}$  + 35  $^{\circ}\text{C}$  a 24-hr average. Other designs can be provided upon request for temperature ranges falling outside of the mentioned range.

#### Mechanical strength

The service load (applied to the terminal in any direction continuously is 650 lb., the short time load (impulse load like conductor whip) is 1595 lb. Other values available upon request.

# Dimensions

Except the ERCT line current transformers are for specific projects custom-made products. The following dimensions refer to certain standard versions. Other requirements might effect the dimensions. The base tank size can vary based on transformer output requirements and/or frequencies less than 60 Hz. The head size of the CT portion depends on the ratings of the cores, the primary current and the thermal short-time current. Other head sizes and longer creepage distances can be provided.

# Testing

Testing is in conformance with notional, international and internal quality standards. When performing the power frequency test, the dielectric loss angle, capacitance and the internal partial discharge level are measured as a routine test. Tests reports are provided with each unit.

# Dimensions

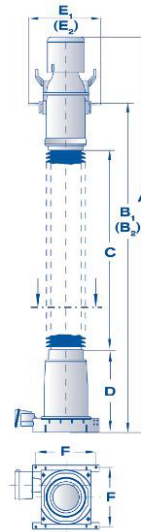


Fig. 1 KOTEF 72.5, KOTEF 123, KOTEF 145, KOTEF 170, KOTEF 245

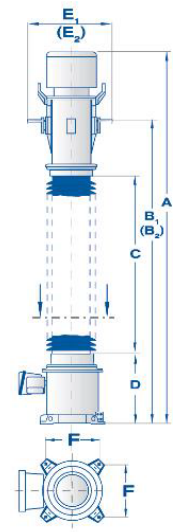


Fig. 2 KOTEF 362

TYPE		KOTEF 72.5	KOTEF 123	KOTEF 145	KOTEF 170	KOTEF 245	KOTEF 362						
Head Size		SK2	SK2	SK2	SK2	SK2	SK3A						
Maximum system voltage (Um)	kV	72.5	123	145	170	245	362						
Impulse test voltage (BIL)	kV	350	550	650	750	900	1,300						
Minimum creepage distance	mm	2,990	2,990	3,520	4,710	6,250	11,590						
	In	117.72	117.72	138.58	185.43	246.06	456.3						
		mm	In	mm	In	mm	In						
Dimensions	A	2,547	100.3	2,547	100.3	2,895	114	3,416	134.5	4,043	159.2	6,325	249
	B1	2,057	81	2,057	81	2,273	89.5	2,792	109.9	3,280	129.2	5,310	209.1
	(B2)	2,199	86.6	2,199	86.6	2,413	95	2,925	115.2	3,412	134.3	5,310	209.1
	C	990	39	990	39	1,115	43.9	1,500	59.1	2,000	78.7	3,361	132.3
	D	632	24.9	632	24.9	722	28.4	773	30.4	790	31.1	1,200	47.2
	E1	810	31.9	810	31.9	810	31.9	810	31.9	813	32	890	35
	(E2)	840	33.1	840	33.1	840	33.1	840	33.1	840	33.1	930	36.6
F	450	17.7	450	17.7	450	17.7	450	17.7	600	23.6	900	35.4	
Total weight (approx.)	kg	603	603	750	917	1,237	1,676						
Weight of oil (approx.)	kg	126	126	186	237	383	683						

Indicative values only - All indicated dimensions must be confirmed with order.

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