

# 3. COMBINED TRANSFORMERS

## Oil-paper insulation

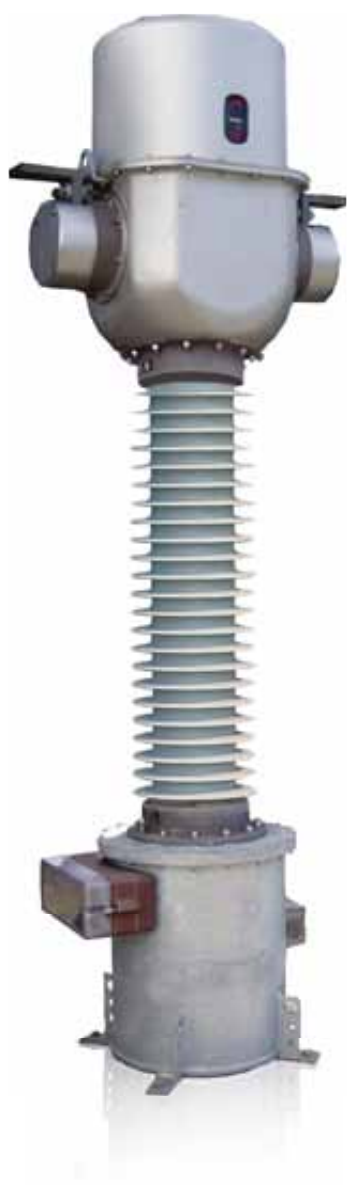


› 123 kV Combined transformers.

## INTRODUCTION

Combined instrument transformers contain a current transformer and an inductive voltage transformer within the same body.

Thus they are used in the same applications as their respective independent transformers; they separate meters, counters, relays, etc., from the high voltage circuit, and provide a scaled replica of the current and voltage in the HV line.

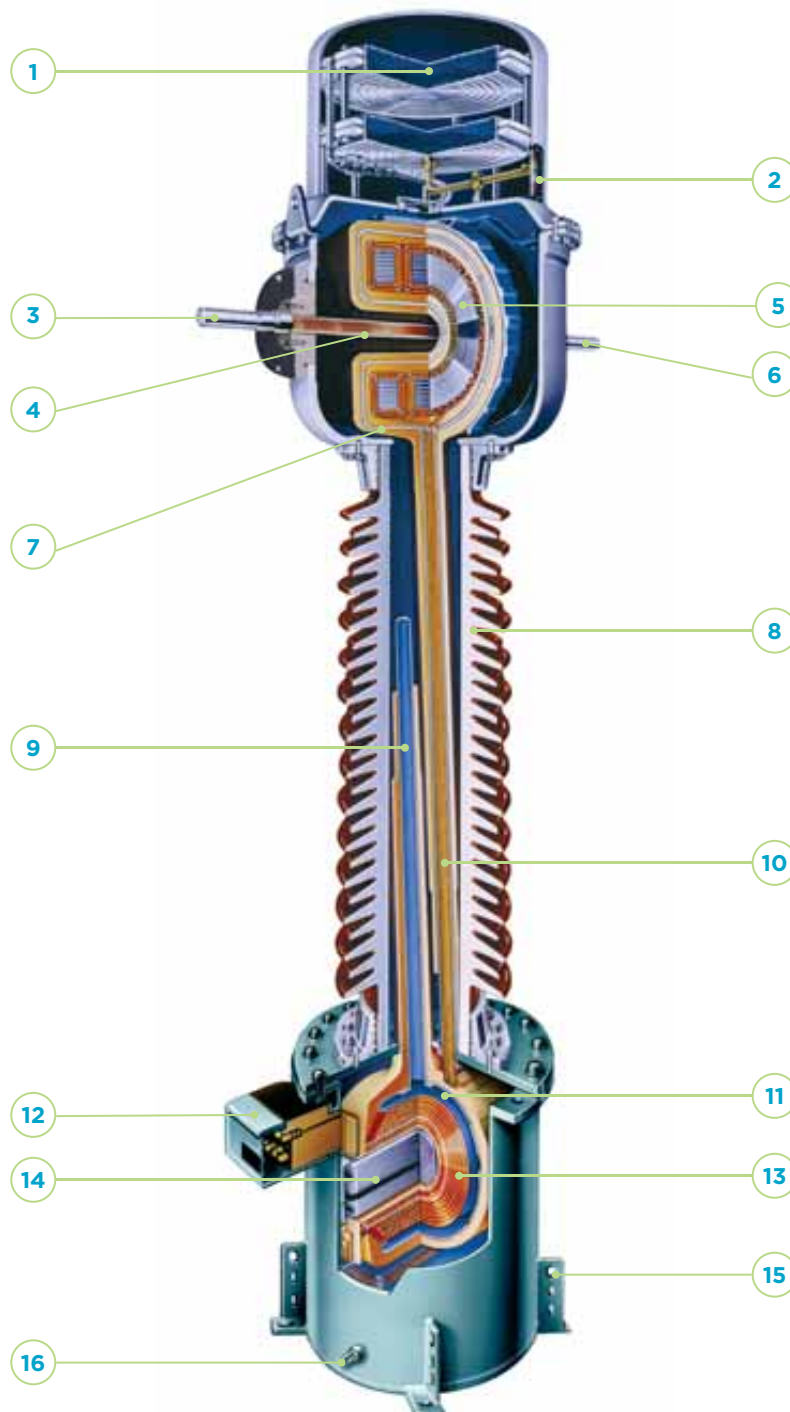


Model KA up to 245 kV.

> Model KA

## SECTIONS

- |   |                            |
|---|----------------------------|
| 1. Oil volume compensating system           | 9. VT capacitive bushing   |
| 2. Oil level indicator                      | 10. CT capacitive bushing  |
| 3. Primary terminal (P1)                    | 11. VT primary winding     |
| 4. CT primary winding                       | 12. Secondary terminal box |
| 5. CT secondary winding                     | 13. VT secondary winding   |
| 6. Primary terminal (P2)                    | 14. VT core                |
| 7. CT cores                                 | 15. Grounding terminal     |
| 8. Insulator (Porcelain or silicone rubber) | 16. Oil sampling valve     |



> Up to 245 kV

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## APPLICATIONS

Combined transformers are suitable for use in substations where space or installation costs make using independent transformers difficult.

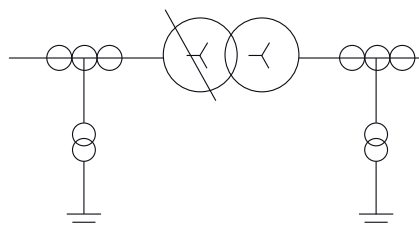
Ideal for installation at metering points due to their very high accuracy class, both in current and voltage.

Suitable for the discharge of high-voltage lines and capacitor banks.

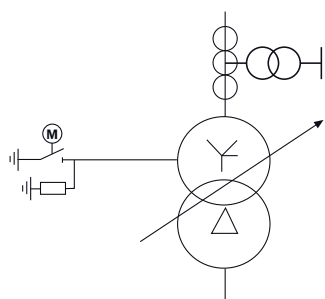
Excellent frequency response; ideal for monitoring power quality and measuring harmonics.

#### Examples of applications:

1. Protection for high voltage lines and substations.



2. Revenue metering.



> 72.5 kV Combined transformers in substation incoming line. L'ONE (Morocco).



## DESIGN AND MANUFACTURE

Combined transformers mirror the manufacturing characteristics of current transformers (CA type) and inductive voltage transformers (UT type).

The CT active parts are located in the top part inside a metal box that acts as a low-voltage shield; the main oil-paper insulation is wrapped around it, ending up with a high-voltage shield. The primary conductor can be a pass-through bar (with or without external reclosings) or a winding, depending on the case. The secondary cables run through an oil-paper insulated capacitive bushing with several shields for proper electrical field distribution.

Voltage transformers can have several secondary windings for metering and/or protection. The primary winding and all the secondary windings are wound around the same core, which is loaded with all the burden.

The core and the windings are located inside a metallic tank. The windings have an anti-resonant design, which makes the transformer work properly both at power frequency and during temporary high frequency transients.

ARTECHE'S experience with major transmission lines explains why we are a key figure in future power links between countries and continents.



- > Wide variety of primary terminals.
- > Can be transported horizontally.

### 3. COMBINED TRANSFORMERS > Oil-paper insulation

#### ADVANTAGES

- › Less space needed in the substation, and during transportation and storage.
- › Savings:
  - Support structures, connectors and installation time.
  - Inspection and maintenance.
  - Spare parts.
- › Excellent response under extreme weather conditions (from -55°C; up to +55°C), altitudes over 1,000 m.a.s.l., seismic hazard areas, violent winds, etc.
- › Robust mechanical strength and reduced size due to a compact design that is easy to transport, store and install, and which reduces visual impact.
- › Hermetically sealed to guarantee complete water tightness with the minimum volume of oil or gas (Each unit is tested individually).
- › Reinforced safety design, resistant to internal arc.
- › Oil level compensating system that effectively regulates changes in oil volume mainly caused by temperature.
- › Oil sampling valve for periodic analysis.
- › Maintenance-free throughout their lifespan.
- › Environmental-friendly design through the use of materials that are both recyclable and resistant to the elements. Its advanced design adheres to environmental regulations through the use of high quality insulating oils, free of PCB.
- › Each transformer is routine tested for partial discharges, tangent delta (DDF), insulation and accuracy and designed to withstand all the type tests included in the standards.
- › Compliance to any international standards: IEC, IEEE, UNE, BS, VDE, SS, CAN/CSA, AS, NBR, JIS, GOST, NF...
- › Officially homologated in-house testing facilities.
- › May be transported and stored horizontally or vertically.

#### OPTIONS:

- › Silicone rubber insulation.
- › Tangent delta measurement tap and capacitive tap.
- › Wide range of primary and secondary terminals.
- › Different cable glands and accessories available.

- › 123 kV combined transformers. ESB (Ireland).



## RANGE

ARTECHE combined instrument transformers with oil-paper insulation are named with the letters KA followed by 2 or 3 numbers indicating the maximum service voltage for which they have been designed.

The table on the next page shows the range of combined transformers currently manufactured by ARTECHE. These characteristics are merely indicative; ARTECHE can manufacture these transformers to comply with any domestic or international standard.

Current ratios: all types of combinations possible in a single device.

Secondary windings for:

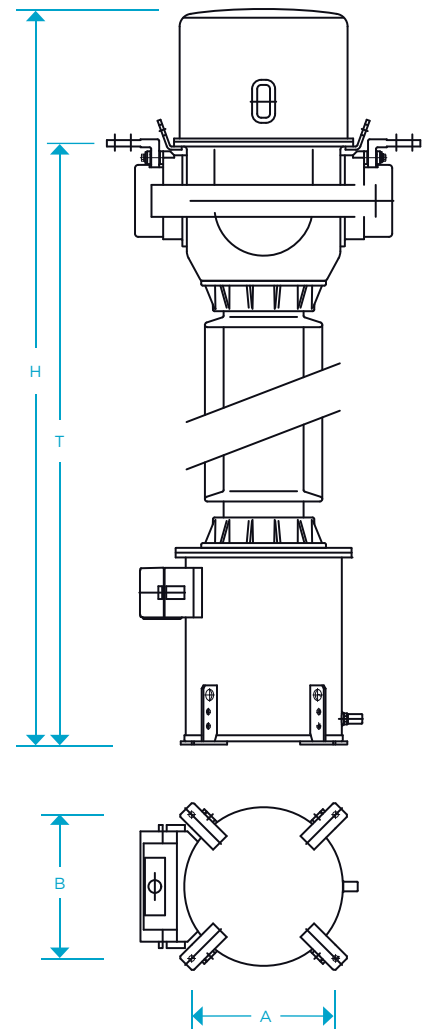
- > Protection: all possible types, including linear cores, low induction, etc.
- > Metering: accuracy classes for any metering/billing need (including high accuracy class 0.1 / 0.15 with extended range in current).

Number of secondary windings: as per customer needs.

**Standard accuracy classes and burdens for voltage transformer:**

- > According to IEC standards
  - 100 VA Class 0,2 / 3P
  - 250 VA Class 0,5 / 3P
- > According to IEEE standards
  - 0,3 WXYZ
  - 1.2 WXYZ, ZZ

Higher accuracy classes and burdens available.



> Model KA



- > 170 kV Combined transformers. Pechiney (The Netherlands).
- > 69 kV Combined transformers. Greenville Light & Power Systems (USA).

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Oil-paper insulation > Model KA										
Model	Highest voltage (kV)	Rated insulation level			Standard creepage distance (mm)	No. secondaries*	Dimensions			Weight (kg)
		Power frequency (kV)	Lightning impulse (BIL) (kVp)	Switching impulse (kVp)			AXB (mm)	T (mm)	H (mm)	
KA-72	72,5	140	325	-	1.825	TI 6	400x430	1.770	2.235	360
						TT 4				
KA-123	123	230	550	-	3.625	TI 6	450x450	2.285	2.785	580
						TT 4				
KA-145	145	275	650	-	3.625	TI 6	450x450	2.285	2.785	580
						TT 4				
KA-170	170	325	750	-	4.250	TI 6	450x450	2.445	2.945	755
						TT 4				
KA-245	245	395	950	-	6.125	TI 6	450x450	3.185	3.820	1.050
	300	460	1.050	-	7.500	TT 4				
		460	1.050	850			600x600	4.340	5.050	1.520

Approximate dimensions and weights. For special requirements, please consult.

\*TI: Current transformer      \*TT: Voltage transformer