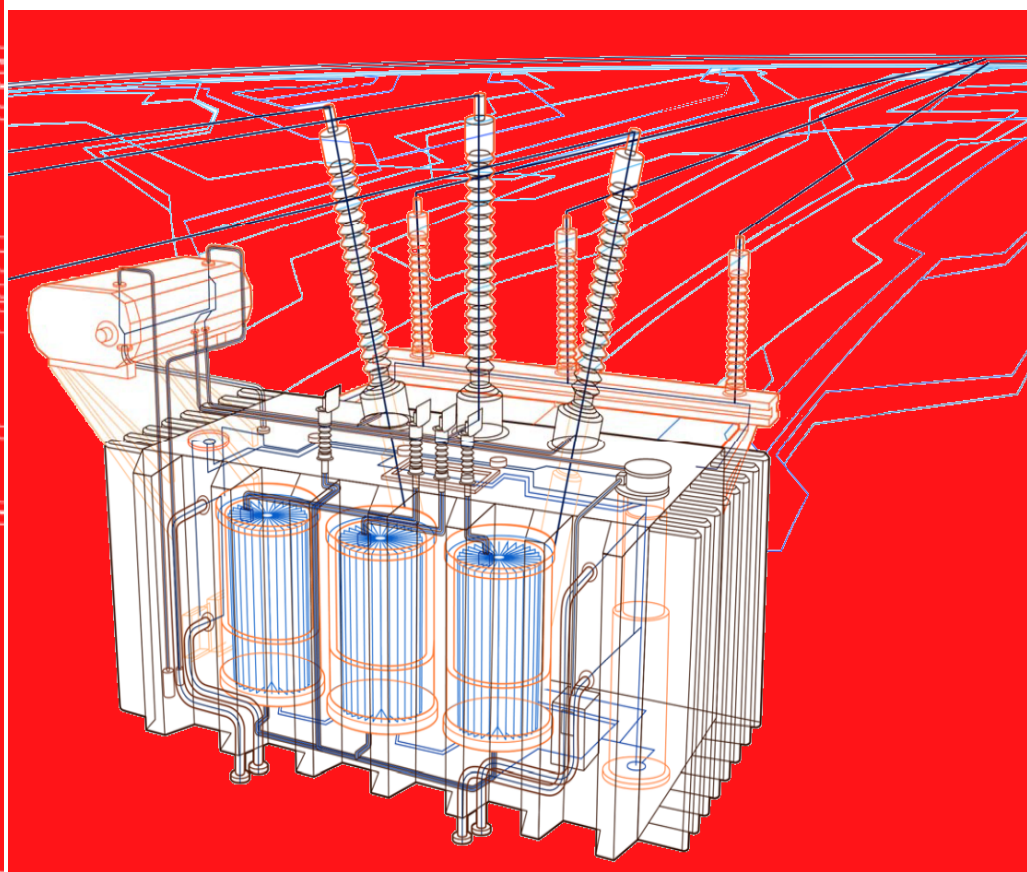




**SOTEK**

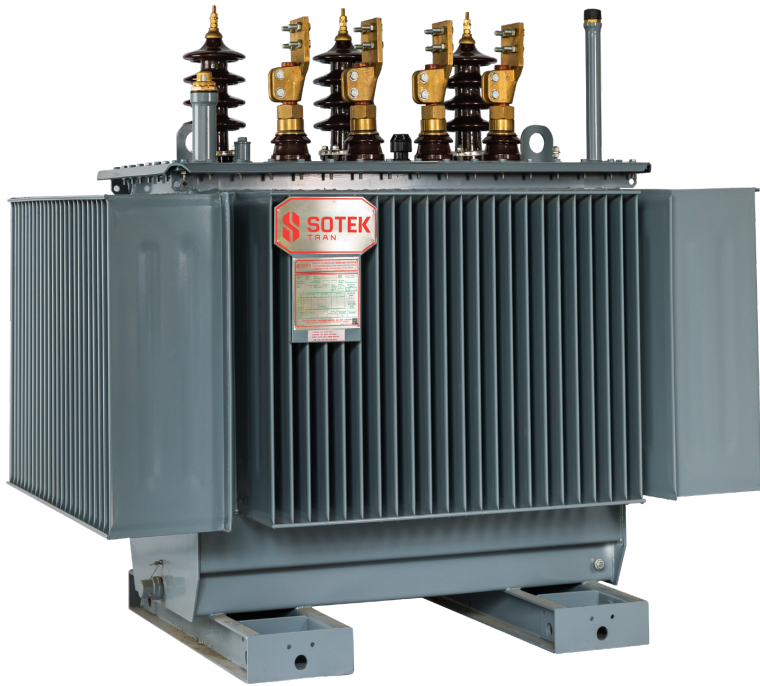
# **DISTRIBUTION TRANSFORMERS**



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# 1 - Product Portfolio

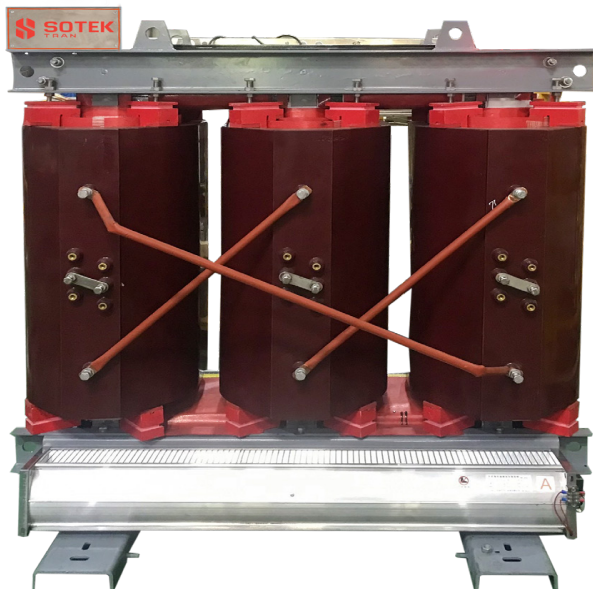


## OIL IMMERSED - 3 PHASE

Power	Up to 16 MVA
Voltage	Up to 40.5 kV
Core Steel	Silicon Steel Amorphous Alloy
Windings	Copper/Aluminium
Insulation liquid	Mineral oil/Natural Ester

## OIL IMMERSED - 1 PHASE

Power	Up to 500kVA
Voltage	Up to 40.5 kV
Core Steel	Silicon Steel Amorphous Alloy
Windings	Copper/Aluminium
Insulation liquid	Mineral oil/Natural Ester



## DRY TYPE - 3 PHASE

Power	Up to 6.3MVA
Voltage	Up to 40.5 kV
Core Steel	Silicon Steel Amorphous Alloy
Windings	Copper/Aluminium
Enclosure	IP23

## 2 – General Information

### A – Standards

The IEC and IEEE/ANSI Standards for transformers and their parts are the most widely applied standards in most countries where local electric authorities have either adopted one of these standards or created one that suits the needs, laws and regulations of their country.

The following list of main Standards refers to the most common electrical applications.

The Standards may have been amended, but the relevant amendments are not mentioned here.

#### **IEC 60076 Power Transformers**

##### **IEC 60076-1 General**

##### **IEC 60076-2 Temperature rise for liquid-immersed transformers**

##### **IEC 60076-3 Insulation levels, dielectric tests and external clearances in air**

##### **IEC 60076-5 Ability to withstand short circuit**

##### **IEC 60076-14 Liquid-immersed power transformers using high-temperature insulation materials**

##### **IEC 60137 Insulated bushings for alternating voltages above 1000 V**

##### **IEC 60529 Classification of degree of protection provided by enclosures**

##### **IEC 60354 Loading Guide for Oil-Immersed Transformers**

##### **IEC 60076-11 Dry-type transformer**

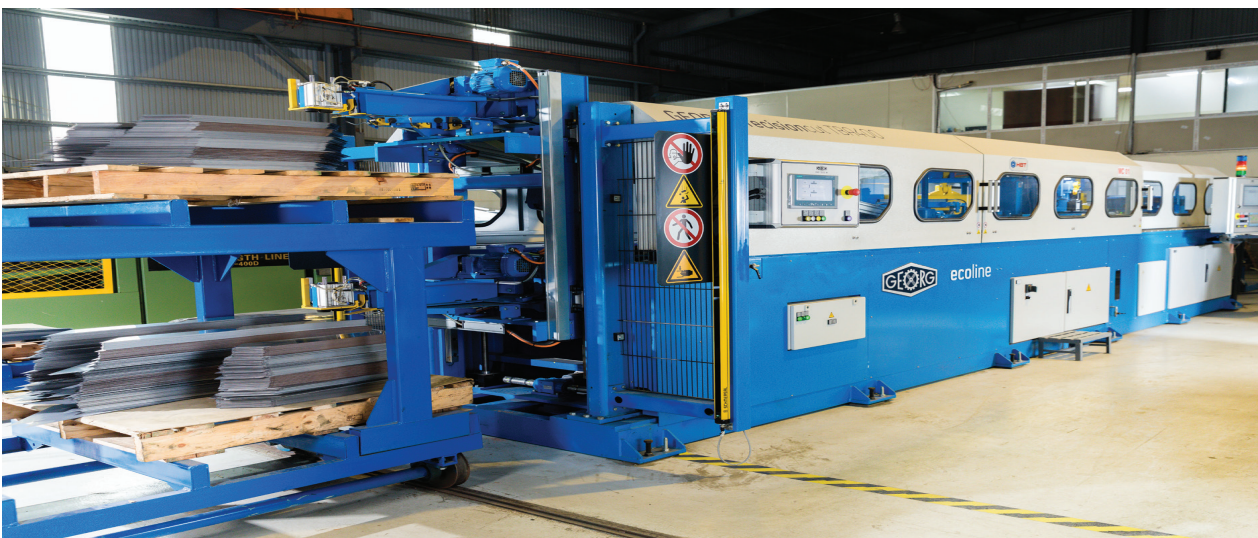


### B – Technical Aspects

#### **Core Steel**

Core is critical to determining such important factors as iron losses, vibration, sound levels and thermal stability, from a mechanical point of view it is important to design the core to take into consideration, heavy lifts in the workshop, clamping impacts during transport and stresses due to disturbances in the network resulting in short circuit current.

All cores are manufactured from cold-rolled grain-oriented electrical sheet steel coated with oil resistant inorganic material. Normal-oriented or laser treated super-oriented electrical steel may be selected depending on sound level requirement and evaluation of losses.



## 2 – General Information

### B – Technical Aspects

#### Winding Coils

SOTEK transformers are of core-type design. Their windings are arranged concentrically around a cylindrical core. The heart of every transformer, both from an electrical and mechanical point of view are the windings. In order to ensure low stray losses and to minimize the mechanical stresses occurring in the event of short circuit, it is necessary to achieve and maintain both overall and local ampere-turn balance between the windings and throughout the entire height of the winding.

We normally use copper conductors which are available in a large variety of sizes, from single to multi conductors with rectangular profiles and also multi-strand transposed cables. Copper in different tensile strengths is available for all conductor shapes to cope with different mechanical stresses during short-circuit and normal operation.



#### Insulation Liquid

No transformer is truly an 'ideal transformer' as each will incur some losses which gets converted into heat. If this heat is not dissipated properly, the excess temperature in the transformer has the potential to cause serious problems like insulation failure. The transformer requires a cooling system to prevent this from occurring.



## 2 - General Information

### B - Technical Aspects

#### Tank Types

The transformer tank is usually a non-rigid structure with corrugated panels, designed to withstand mechanical stresses, absorb oil expansion, and meet the thermal evacuation constraints.

For power rating above 3150kVA, the tank is usually designed with rigid structure, cooling radiators and conservator.



#### Testing

SOTEK transformers are routine tested to verify the quality and the design in accordance with both customer specifications and international standards. All test procedures are in accordance with international standards and the design criteria specified. We test transformers according to IEC, ANSI/IEEE, BS, AS, NZ and other international standards.



## 2 - General Information

### C - Technical Specification

<b>Standard</b>	IEC60076/ IEEE C57.12.00
<b>Transformer Type</b>	Single Phase/Three phase/Dry type
<b>Type of Tank</b>	Round tank/Corrugated Tank/Rigid tank/ Enclosure(for dry type)
<b>Power rating</b>	Single phase:Up to 500kVA Three phase: Up to 16MVA Dry type: Up to 6.3MVA
<b>Voltage (Highest system voltage)</b>	Up to 40.5kV
<b>Impedance</b>	Upon request
<b>Rated Frequency</b>	50/60Hz
<b>Connection and Vector Group</b>	Upon request
<b>Ambient Temperature</b>	-25oC to 55oC
<b>Losses</b>	IEC standard/MEPS/HEPS/customer request
<b>Winding</b>	Copper/Aluminium
<b>Type of Cooling</b>	Oil immersed transformer: ONAN/ONAF/KNAN/KNAF (Mineral/Natural Ester) Dry transformer: AN/AF
<b>HV Tapping</b>	DETC/OLTC
<b>Bushings</b>	Oil immersed transformer: Pocelain DIN standard/ Plug-in type Dry transformer: None
<b>Wheels</b>	Upon request
<b>Protective/Mornitoring Accessories</b>	Upon request

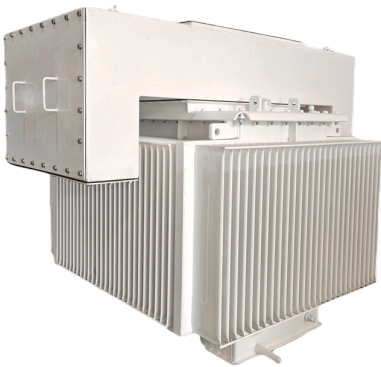
### 3 Standard Accessories



#### 1. Bushing

Transformer bushings connect the network cables to the primary and secondary windings through a metallic cover while electrically isolating them.

The bushing's rating is chosen depending on the voltage, current and applications.



#### 2. Cable Box

Cable boxes are enclosures for the transformer terminals. They provide protection from hazardous access to terminals, and protect the terminals from water, dust and mechanical impacts up to different degrees.

Protection degrees are described in IEC 60529. The cable box can be either top or side accessible depending on customer requirements.

The degree of protection which SOTEK offers is IP 54 according to IEC 60529.



#### 3. Oil Level Indicator

Transformers can be equipped with an oil level indicator on the conservator, on the cover or on the side, depending on the design.

Magnetic and prismatic types of oil level indicators are available.



#### 4. Thermometer

The dial type thermometer indicates the maximum highest oil temperature reached during a certain period.

Two contacts are optional to provide an electrical signal, the first is for an alarm and the second for tripping.



#### 5. Pressure Relief Valve

Hermetically sealed transformers can be equipped with a pressure relief device, preset to 0.3bar/0.43bar.

When a pressure exceeding 0.3bar/0.43 bar occurs inside the transformer, the pressure relief valve opens to evacuate the overpressure.

## 6. Earthing Terminal on Tank

Two earthing points are integrated in each tank, stainless stud, stainless flag with 12mm hole and stainless threaded M10 terminal are the available earthing point types.



## 7. Drain Valve

The drain valve is used to drain or sample the transformer oil from the transformer tank. These valves are fitted to the transformer tank by welding the pipe of the valve to the tank. These valves are 100% tested to ensure no leakages.



## 8. Tap Changer

The network voltage is usually not stable and varies between different locations. To keep the secondary voltage at a nominal value, a linear tap changer is used.

The transformer by default comes with 5 position and steps  $2x\pm 2.5$ .

Other types of tap changers and number of positions are available upon request. The different taps are indicated on the rating plate. The tap changer is off-circuit operated.

## 9. Lifting Lugs

Lifting lugs are used for untanking and lifting. 2 lugs are supplied for units weighing up to 3.5 tons, 4 lugs for heavier units.



## Optional Accessories

### 1. Oil Conservator

A cylindrical tank mounted on the supporting structure on the roof of the transformer (main tank). The main function of the oil conservator is to provide adequate space for expansion of oil inside the transformer for a breathing type transformer.

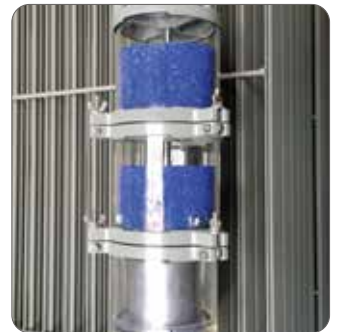


### 2. Buchholz Relay

The Buchholz Relay is used in conjunction with the conservator. Oil leakages, gas formations, and quick oil flow to the conservator are internal faults detected by the Buchholz Relay. Dry contacts are provided to signal these alarms.

### 3. Air Breather

The air breather is installed on the oil conservator. During normal operation the oil temperature changes resulting in an oil volume change, generating a bi-directional air flow from and to the conservator. The air breather contains silica gel which absorbs the air moisture. On delivery, the silica gel is pink, and becomes colorless when moisturized. Silica gel can be recycled by heating to 120 degrees until the color turns back to pink.



### 4. Roller

Bi-directional rollers are used for ground mounted units: diameter 125mm for ratings up to 630 kVA, diameter 150/200 mm for higher ratings.

### 5. Winding Temperature Indicator

This device measures the LV and HV winding temperature. A winding temperature indicator or WTI is also used as protection for the transformer.



### 6. Other Accessories

Other accessories could be updated upon customer request

## 4 - Applications

The distribution transformer provides the final voltage transformation in the electric power distribution system, stepping down the networks medium voltage to low voltage, the level used by the consumer, and is considered one of the most important links in the distribution network.

Distribution transformers are used in the following applications:



## 5 - Service

To complement its position as a market leader of transformer manufacturing and supply, SOTEK provides testing and commissioning services.

Our highly qualified and competent commissioning engineers undertake the complete electrical testing and commissioning of transformers and ancillary equipment.



### List of tests conducted:

- 1- Visual inspection
- 2- Measurement of insulation resistance
- 3- Measurement of winding resistance
- 4- Measurement of voltage ratio and vector group
- 5- Energizing the transformer

## 6 - Testing

SOTEK believes that quality means absolute congruity and compliance with customer requirements and international standards.

Therefore, SOTEK has equipped its testing lab with the most modern testing equipment and instrumentation devices to ensure conformity to the highest level of quality and safety, where every transformer produced by SOTEK is tested according to IEC Standards.



### **Routine Tests (applied to all transformers before leaving factory)**

- 1- Measurement of winding resistance
- 2- Measurement of voltage ratio and phase displacement
- 3- Measurement of short circuit impedance and load losses
- 4- Measurement of no-load losses and current
- 5- Dielectric routine tests  
(separate source AC voltage withstand test and short duration induced over-voltage withstand test)
- 6- Measurement of insulation resistance

### **Type Tests (subject to extra cost)**

- 1- Temperature rise test according to IEC 60076-2
- 2- Lighting impulse test according to IEC 60076-3

### **Special Tests (subject to extra cost)**

- 1- Short circuit withstand test (as per IEC 60076-5)
- 2- Measurement of zero-sequence impedance(s) on three-phase transformers
- 3- Determination of sound levels (as per IEC 60076-10)
- 4- Measurement of the harmonics of the no-load current

# 7 - Inquiry Form

Ref No: \_\_\_\_\_

Customer Name : \_\_\_\_\_

Project : \_\_\_\_\_

CRM sub-opportunity : \_\_\_\_\_

1- Installation location	<input type="checkbox"/> Indoor	<input type="checkbox"/> Outdoor	<input type="checkbox"/> Other
2- Winding Material	<input type="checkbox"/> Copper	<input type="checkbox"/> Aluminum	
3- Reference Standard	<input type="checkbox"/> I.E.C. 60076	<input type="checkbox"/> IEEE Standard	<input type="checkbox"/> Others
5- Bushing	<input type="checkbox"/> Top bushing	<input type="checkbox"/> L.V. Side	<input type="checkbox"/> H.V Side <input type="checkbox"/> LV , HV Side
6- Type of oil sealing	<input type="checkbox"/> Hermetically	<input type="checkbox"/> Conservator	<input type="checkbox"/> Gas cushion
7- Max. altitude from sea level of operating location of transformer	<input type="checkbox"/> < = 1000	<input type="checkbox"/> >1000	<input type="checkbox"/>
8- Parallel operation required with another transformer	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/>
9- DETC/OLTC	<input type="checkbox"/> DETC	<input type="checkbox"/> OLTC	<input type="checkbox"/>
10- LV Cable box	<input type="checkbox"/> Without	<input type="checkbox"/> Side	<input type="checkbox"/> Top
11- HV Cable box	<input type="checkbox"/> Without	<input type="checkbox"/> Side	<input type="checkbox"/> Top

1	Quantity	Unit	<input type="text"/>
2	Rated power	kVA	<input type="text"/>
3	Rated Primary Voltage at No Load & Connection Of Winding	V	<input type="text"/> <input type="checkbox"/> Delta <input type="checkbox"/> Star <input type="checkbox"/> Other
4	Rated Secondary Voltage at No Load & Connection Of Winding	V	<input type="text"/> <input type="checkbox"/> Delta <input type="checkbox"/> Star <input type="checkbox"/> Other
5	Rated Secondary Voltage at Full Load @ Spcified PF	V	<input type="text"/>
6	Voltage Sequence		<input type="checkbox"/> Step Down <input type="checkbox"/> Step Up
7	Rated frequency		<input type="checkbox"/> 60 HZ <input type="checkbox"/> 50 Hz
8	Vector group		<input type="checkbox"/> Dyn11 <input type="checkbox"/> Dyn5 <input type="checkbox"/> Ynd11
9	If any another remark, Please specify in detail		

Use Standard Accessories ( Oil level indicator - Oil thermometer - Pressure relief valve.)  Yes  No

In Case Of No Please Choose From List And Add Your Requirement

Winding temperature indicator	<input type="checkbox"/> Yes
Buchholz relay	<input type="checkbox"/> Yes
Pressure Gauge	<input type="checkbox"/> Yes
Wheels	<input type="checkbox"/> Yes
Rapid Pressure Rise relay	<input type="checkbox"/> Yes
DGPT2	<input type="checkbox"/> Yes

If any additional Accessories required Please Insert Here

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NO load Losses	:	<input type="text"/> Watt	Ambient Temp	<input type="text"/> C
Load Lossess	:	<input type="text"/> Watt	Oil Temp Rise	<input type="text"/> C
Voltage Impedance	:	<input type="text"/> %	Winding Temp Rise	<input type="text"/>



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