

# TECHNICAL SPECIFICATION OF THE SINGLE PHASE DISTRIBUTION TRANSFORMERS

## 1. SCOPE :

This specification covers the electrical, mechanical, and performance requirements for single phase, mineral-oil filled, overhead type distribution transformers for use on 13.2 Gd. Y/7.62 kv, 60 Hz, EC distribution systems.

## 2. GENERAL :

Distribution transformers are in conformity in all respects to the requirements of this documents. The transformers will be in a hot tropical climate with high humidities and high annual rain fall. The text, tables, figures and references to other standards supplement each other and are considered part of this document. All transformers shall be outdoor/indoor type application.

## 3. TRANSFORMER TYPES :

This specification covers the requirements for both CSP (completely self-protected) and conventional type transformers. CSP transformers include attached primary arrester, primary fuse and appropriate secondary over-load and short circuit protection. For conventional transformers , shall be included.

## 4. RATINGS :

1. Nominal ratings : 240

a. HV Winding

75 KVA & Over 13.2/7.62 kv
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b. LV Winding 240 V

120/240 V

240/480 V

2. Basic insulation level (BIL) :

Depend on the requirement of the insulation class

3. Operating frequency = 60 Hz / 50 Hz

4. Transformers are guaranteed to have the following impedances to any impedance requested can be applied.

<u>Size (KVA)</u>	<u>Impedance</u>	<u>Tolerance</u>
10 through 75	2.0/4	± 10 %
100 through 250	3.0/4	± 10 %
333 through 500	3.5/4,5	± 10 %

test reports are submitted to show % IR, % IZ and % total impedance for each type and transformer size.

5. Ambient air temperature is as requested by customers specification up to 45°. Average winding temperature rise above ambient does not exceed 65°C when measured by the resistance method.

The hottest spot temperature rise of the insulating liquid does not exceed 85°C over ambient.

Temperature rise of the insulating liquid does not exceed 65°C above ambient when measured near the top of the tank.

Temperature limits is not be exceeded when the transformer is operated at rated KVA output and rated secondary voltage for twenty-four (24) hours.

Our transformer's losses are fixed following the customer standards and requested.

### Design Information :

KVA	15	25	37	50	75	100	167
Load loss	½ load	76	102	134	175	198	280 Watts
	¾ load	172	230	301	394	444	630 Watts
	Full load 230	305	408	535	700	790	1120 Watts
No load loss	28	46	59	71	98	126	205 Watts
Excitation current		0.06000	1.6000	1.6000	0.06000	0.9000	1.6000 Amps
Full load current		3.94	5.83	7.87	11.81	15.75	26.30 Amps
Impedance		1.60%	1.80%	1.80%	2.00%	1.50%	1.80%
Resistance		1.22%	1.10%	1.07%	0.93%	0.79%	0.67%
Total weight		180	220	240	420	485	725 Kg
		397	485	529	926	1069	1599 lbs
Weight of oil		40	60	72	97	88	158 litres
		33	50	72	97	88	158 litres
		73	110	132	179	161	291 lbs
Regulation	Unity p.f	1.225%	1.113%	1.080%	0.949%	0.798%	0.685%
	0.8 p.f	1.597%	1.737%	1.726%	1.812%	1.399%	1.543%
Efficiency	Unity p.f	99.022%	99.130%	99.181%	99.272%	99.353%	99.419%
	½ load						
	¾ load	98.840%	98.960%	99.008%	99.126%	99.240%	99.333%
	Full load	98.596%	98.738%	98.788%	98.936%	99.084%	99.207%
	0.8 p.f ½ load	98.778%	98.912%	98.976%	99.090%	99.191%	99.274%
	¾ load	98.550%	98.700%	98.760%	98.907%	99.049%	99.167%
Ful load	98.245%	98.422%	98.485%	98.670%	98.855%	99.008%	

## Design Information :

KVA		25	37	50	75	100
Load loss	½ load	52	70	86	106	167 Watts
	¾ load	118	158	194	240	376 Watts
	Full load	209	281	345	425	668 Watts
No load loss		59	80	100	122	135 Watts
Excitation current		0.0600	0.9000	1.6000	0.0600	0.9000 Amps
Full load current		3.94	5.83	7.87	11.81	15.75 Amps
Impedance		1.50%	1.60%	1.60%	1.90%	1.90%
Resistance		0.84%	0.76%	0.69%	0.57%	0.67%
Total weight		264	310	395	525	532 Kg
		583	683	871	1157	1174 lbs
Weight of oil		69	62	98	105	102 litres
		58	51	82	88	85 Kg
		127	114	180	194	187 lbs
Regulation	Unity p.f	0.844%	0.769%	0.700%	0.583%	0.684%
	0.8 p.f	1.417%	1.455%	1.421%	1.548%	1.607%
Efficiency	Unity p.f	99.110%	99.188%	99.255%	99.391%	99.396%
	½ load					
	¾ load	99.058%	99.142%	99.216%	99.358%	99.319%
	Full load	98.928%	99.024%	99.110%	99.271%	99.197%
	0.8 p.f	98.888%	98.985%	99.69%	99.239%	99.245%
	½ load					
	¾ load	98.823%	98.928%	99.020%	99.198%	99.149%
	Ful load	98.660%	98.780%	98.888%	99.088%	98.996%

6. Transformers with ratings of 200 KVA or less have additive polarity and transformers with ratings of over 200 KVA have subtractive polarity.

7. Audible Sound Level

a. Transformers are designed so that, the average sound level does not exceed the levels listed in NEMA Std TRI 1974 less 9 dB when tested in accordance with ANSI/IEEE 57.123.90.1987

**Power Ratings**

**Average Sound Level (dB)**

75 and less

42

100 to 300

46

8. Power ratings are as shown in Table 1.

**5. DESIGN :**

1. Transformers are designed in accordance with the latest revisions of ANSI standards C57.12.00 (1) - 57.12.20 (2) and CEI76.1.2.3

2. Transformers are class OA (self-cooled), core or shell type. High voltage winding is of high conductivity copper and the secondary winding may be either high conductivity copper or aluminium. The core is manufactured from high quality, cold rolled, grain oriented, silicon steel, properly annealed after cutting, rolled to ensure smooth edges and provided with a heat resistant insulating coating. The manufacturing process does not stress the core beyond the elastic limit of the material.

3. Transformer are a high-voltage no-load a tap changer with two, 2-1/2% a taps below rated voltage and two, 2-1/2 %, a taps above rated voltage. The no-load tap changer is operable by an external handle or lever and provision is made for fastening or sealing the handle to prevent unauthorised or inadvertent operation of the mechanism. A small decal is also placed near the operating handle to warn against operation of the tap-changer while the transformer is under voltage.

4. HV Bushings :

a. Industry standard, outdoor type porcelain.

b. Connectors is bolted ring type suitable for copper or aluminium conductors. Connectors accommodate the range of conductor sizes indicated in Table 1.

c. All CSP transformers have one (1) high voltage bushing and two (2) position support lugs. All conventional type transformers have two (2) high voltage bushings and one (1) position support lugs.

5. LV Bushings :

a. Industry standard, outdoor type, porcelain.

b. Connectors are in accordance with Table 1 and Figure 3. Where bolted ring type connectors are used, they are suitable for use with copper or aluminium conductors and accommodate the range of conductor sizes shown in Table 1.

c. CSP transformers have two (2) low-voltage bushings for 240 V operation. Conventional transformers have three (3) low voltage bushings. The outside tank ground strap be connected for 240 V operation.

There is no internal ground or tank connection to any of the low voltage bushings for either type of transformer.

d. Conventional transformers 75 KVA and over, are factory connected at 240 V operation full capacity and use the first (left) and center low voltage bushings. The third low voltage bushing shall serve in the event of reconnection to 480 volts.

Conventional transformers 50 KVA and under, are factory connected at 240 V operation full capacity and use the first (left) and third low voltage bushings. The center low voltage bushing serves in the event of reconnection to 120 V operation.

6. TANK

a. Transformer tank is a sealed type design complete with cover and gaskets.

b. Tank is supplied with a tank grounding bolted ring-type connector suitable for use with copper or aluminium conductors. The connector have a range of # 6 to #2 AWG.

c. There is a low voltage (no internal ground) grounding provision with a removable copper strap. Grounding provisions is as shown in figures 1 and 2.

d. Tank have permanent lugs for lifting the complete unit.

e. There is facilities for lifting the core and coil assembly.

f. The tank have permanent hanger bracket for installing the unit.

g. Tank is cleaned thoroughly by sandblasting before painting. Internal and external surfaces are given an acid and phosphate dip treatment to remove rust and scale and to provide an adherent, moisture resistant coating.

Internal and external surfaces are primed with two coatings of red oxide zinc chromate paint to a minimum dry film thickness of 0.075 mm. The external surfaces be given a finishing coat of paint to conform to light gray no. 70, munsell notation 5 BG 7.0/0.4.

h. Rating in KVA shall be painted in three (3) inch letters on front of the tank in the position as shown in Figures 1 and 2.

i. The letters "NEA" and below (same size) "IFB-77" are painted in three inch letters on the front of the tank in the position shown in figures 1 and 2.

j. The nameplate is made of stainless steel and has on the following information:

Serial Number

Class

Number of phases

Frequency

Voltage rating

Power ratings

Design Ambient temperature

Temperature rise, degrees C

Polarity

Percent impedance

Total weight (in Kg)

Oil weight (in Kg)

Connection diagram

Name of manufacturer

Date and place manufactured

Installation and operating instructions reference manuals

The word "transformer"

Type of insulating liquid (generic name preferred)

Conductor material of each winding

7. Insulating oil : Insulating oil is a mineral oil and meets the requirements of ASTM D3487 (5).

8. Lockwashers : All electrical connections, bushing mounting bolts and cover attachment bolts require lockwashers. Lockwashers shall be fabricated from material that complies with the requirements of ANSI B18.21.1 (4).

## **6. TESTS :**

All tests are performed as per the latest revision of CEI 76.1.2.3 ; ANSI Standard C57.12.90.

Factory tests includes, but are not limited to, the following :

1. Resistance measurement of all windings.
2. Ratio test
3. Polarity and phase relation test
4. Test to determine no-load losses at rated voltage and frequency
5. Excitation current at rated voltage and frequency
6. Impedance voltage and load loss measurement
7. Induced potential tests of insulating oil in addition to the above, the following tests shall be made on one transformer of each type and size in a contract :
  1. Impulse and temperature rise tests
  2. Short circuit test

## **7. BIBLIOGRAPHY OF REFERENCE STANDARDS :**

1. ANSI C57.12.00 : Test code for liquid immersed, Distribution, Power and regulating Transformers.
2. ANSI C57.12.20 : Requirements for overhead-type Distribution Transformers, 67000 volts and below, 500 KVA and smaller.
3. ANSI C57.12.90 : general requirements for Dry-type Distribution and power transformers.
4. ANSI B18.21.1 : Lock Washers
5. ASTM D3487 : Standard Specifications for mineral insulating oil used in electric apparatus.



**TABLE A**

NEA Code No	Type & KVA Rating Conn.	HV Bushing		LV Bushing		Support Lug & No. Positions
		Type Conn.	Cond Range	Type Conn.	Cond Range	
6932 42 11	CSP-10	3a	6sol-2str	3a	6sol-1/Ostr	2-type A
6932 42 13	CSP-15	“	“	“	“	“
6932 42 15	CSP-25	“	“	“	“	“
6936 25 09	Conv-5	“	“	“	“	1-type A
6932 41 11	Conv-10	“	“	“	“	“
6932 41 13	Conv-15	“	“	“	“	“
6932 41 15	Conv-25	“	“	“	“	“
6932 41 17	Conv-37.5	“	“	“	“	“
6936 41 19	Conv-50	“	“	“	2sol-4”/Ostr	“
6936 25 21	Conv-75	“	“	“	“	1-type B
6932 41 21	Conv-100	“	6sol4/Ostr	“	“	“
6936 41 23	Conv-167	“	“	3b	Spade H	“

# TUNISIE TRANSFORMATEURS S.A

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