SB-TDMS-2014

SPECIFICATIONS

FOR

DISTRIBUTION (POLE MOUNTED) LOW LOSS AMORPHOUS TRANSFORMERS 24kV 400/230 VOLTS

Table of Contents

1.0 SCOPE

This Sistan & Balouchestan Electric Power Distribution Company (SBEPDC), TAVANIR Distribution Material Specification (TDMS) specifies the minimum technical requirements in respect of design, engineering, manufacturing, inspection, testing and performance of outdoor (Pole- mounted) mineral oil immersed, three (3) phase distribution transformers intended to be used in 20 kV,50Hz system of the Sistan & Balouchestan Electric Power Distribution Company (SBEPDC), Islamic Republic of IRAN. It is not intended that this specification shall apply to dry type transformers.

2.0 CROSS REFERENCES

This TDMS shall always be read in conjunction with the Table A-1 titled "General Requirements for installation and operation IRAN Equipment/Material" latest revision, which shall be considered as an integral part of this TDMS. This TDMS shall also be read in conjunction with SBEPDC Purchase Order (PO) requirements.

Table: A-1

NO	DESCRIPTION	UNIT	REQUIREMENTS
1	Rated Voltage Primary	kV	20
2	Max. system Medium Voltage	kV	24
3	Rated Voltage Secondary	V	400/231
4	Frequency	Hz	50
5	Number of phases	-	3
6	Type of Designation	-	Pole mounted Low loss Amorphous Hermetically sealed
7	Rated powers	KVA	25,50,75,100
8	Vector Group	-	Y zn 5
9	Impedance Voltage (U_k)	%	4
10	Max. average. temperature	ºC	50
11	Min. average. temperature	ºC	-25
12	Altitude	m	1000
13	Humidity	%	67
14	Max. earthquake gravity	g	0.3
15	Pollution	-	Very Heavy
16	LV side earthing system type (neutral)	-	Effectively earthed
17	Corrosion level	-	high

3.0 APPLICABLE CODES AND STANDARDS

The latest revisions of the following Codes and Standards listed shall be applicable for the equipment/material covered in this TDMS. In case of conflict, the vendor/manufacturer may propose equipment/material conforming to one group of Industry Codes and Standards quoted hereunder without jeopardizing the requirements of this TDMS

11/1029	TAVANIR Specification, Requirement and Test of power Distribution Transformer 20 kV – (TDMS– 2009).
No. 31	Standard for technical specification of Distribution Transformer - Ministry of Energy, IRAN. (1995).
I E C 60076	Power Transformers (All Part).
I E C 60296	Specification for New Insulating Oils for Transformers and Switchgear
I E C 60551	Measurement of transformer and reactor sound level
I E C 60137	Bushings for alternating voltages above 1kV
I E C 60354	Loading guide for oil-immersed Transformers.
H D 428.1S1	Harmonization Standard for Transformation.

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General:

Transformers shall be suitable for outdoor (Pole mounted) usage; Low loss Amorphous, three phases having two separate mineral oil immersed copper windings in mild steel tanks. It should be suitable for base mounting with MV& LV bushings inside cable boxes for overhead line structure.

(Base or side mounting) with top MV bushings and side LV bushings in cable box

4.2 Ratings:

All transformers shall be designed for secondary voltage of 400/230Volts.
The standard ratings shall be:

- Pole mounted: 25, 50, 75 and 100KVA

Transformer rated KVA shall be calculated on the following assumptions:

- Constant flux regulation.
- Continuous steady load.
- Design temperature of 30ºC.
- 50ºC average winding temperature rise and 45ºC top oil temperature rise limits above ambient.
- Maximum winding hot spot temperature of 98ºC.

4.3 Losses

Capitalization Formula:

Transformer vendors/manufacturers shall be evaluated by using the following capitalization formula:

T=P+250000x**C**+ 90000x**W**

Where:

- **T =** Total capitalized cost in IRAN, Thousand Riyals
- **P** = Initial cost of transformer in IRAN, Thousand Riyals
- **C** = Iron (Core) losses in KW (No-Load Losses)
- **W**=Copper (Winding) losses in KW at rated load (Load Losses)

Maximum Losses:

The indicated figures below are the maximum acceptable values.
Transformers with losses exceeding these values will be rejected.
(HD 428.1 S1)

Table: A-2 ,LOSSES

Transformer Rating [KVA]	No – Load Losses (Watts)	Load Losses (Watts)
15	90	500
25	95	550
50	125	875
75	168	1175
100	210	1475
125	247	1695

Guaranteed Values:

No-load and Load losses submitted in the tender shall be treated as guaranteed values. Any increase in these values at the time of testing shall not be accepted.(according to tolerances given)

4.4 Emergency Loading:

After thermal equilibrium has been reached at 75% of rated load, the transformer shall be capable of sustaining the overload conditions listed in the following table without the transformer winding hot spot temperature exceeding 140ºC:

Table: A-3

Load Percent of rating (%)	Minimum Duration in Minutes at Ambient Temperature of	
	30ºC	40ºC
133	240	155
150	98	65

The supplier shall demonstrate by test and calculation that these requirements are met.

4.5 Cooling:

Cooling shall be by natural circulation of oil internal to the transformer and external air i.e. ONAN.

4.6 Transformer Oil:

Transformer shall be supplied initially filled of uninhibited transformer Mineral oil complying with IEC 60296.

4.7 Tap Changer:

M.V.

Transformer shall be fitted with a lockable 5 positions, manual, off- load (off–circuit) Tap Changer having the following taps:

Tap No.1	+ 5%	of rated voltage
Tap No.2	+2½%	of rated voltage
Tap No. 3	0 %	of rated voltage
Tap No.4	-2½%	of rated voltage
Tap No.5	-5%	of rated voltage

4.8 Vector Group:

Unless otherwise specified, the transformer shall be connected star-zigzag in accordance with vector group reference Yzn5.

4.9 Impedance Voltage:

The impedance voltage at normal tap shall be 4%

4.10 Temperature Rise:

At the rated power the transformer shall comply with the following Maximum temperature rises:

Top oil	45°C Max.
Winding	50°C Max.
Hot Spot	98°C Max.
Avg. Temp. Due to short circuit	250°C Max.

4.11 Noise Level:

The noise level emitted by a transformer, at full load, shall not exceed 45~ 49 dB table A-4 below. Measurements shall be in accordance with IEC Standard 60551.

25	50	75	100	125	KVA
45	47	48	49	50	dB

4.12 Short Circuit Level:

The short circuit current that transformer should withstand for two seconds is: 25 times full load current for ratings of 25, 50, 75, 100, 125KVA

4.13 Degree of Protection:

Transformer and its cable boxes shall be designed to have adequate protection level suitable for outdoor usage.

4.14 Dimensions:

The maximum dimensions of the transformer shall be as follows for pole mounted transformer:

Tabel: A-5

Rating (KVA)	Width (mm)	Depth (mm)	Height (mm)
25 & 50	835	740	1370
75 & 100	1350	900	1450

4.15 Tanks

Tank fabrication:

i. Transformer tanks shall be made of mild steel of 3mm thickness, and shall not leak. The criterion of leakage shall be discoloration by oil of white wash applied externally to the suspended part at an oil temperature 90ºC
ii. All pipes, radiators, fins, or corrugations that are welded to the tank shall be externally welded.
iii. The tank shall be of hermetically sealed construction, and shall withstand an internal pressure of 30kN/m² without permanent deformation.
iv. Top cover shall be bolted type and fitted with neoprene cork seals suitable for temperatures as specified in this specification. The cover shall be in such a design and construction as to prevent the ingress of moisture and accumulation of rainwater.

Tank corrosion protection and finish:

i. The transformer tank and its accessories shall be adequately protected against corrosion.
ii. Hot dip galvanizing followed by painting is the preferred method of base protection. Otherwise tanks shall be shot-blasted and then immediately zinc sprayed to an average weight deposit of not less than 550g/m², followed by zinc or zinc chromate based primary paint, and two coats of durable oil and weather resisting
iii. Paint. Finish color shall be Cement Grey, RAL7032. All bolts and fixings shall be suitably protected against corrosion.

Refer to TDMS specification for paint (Color, Tests and Maintenance).

4.16 MV bushings:

Bushings shall generally comply with the requirements of IEC Standard 60137. The MV bushings shall be labeled U, V, W. by using indelible black color paint. Phase identification by adhesive stickers is not acceptable. All MV bushings have insulated cover and arcing horn for surge arrested.

4.17 LV bushings/terminals:

The low voltage leads of all transformers shall be brought out of the transformer tank on the opposite side of the HV bushings inside a cable box. The LV bushings shall be connected to conductors/cables by means of cable lugs, however, the manufacturer shall supply all bolts, nuts and washers. The LV bushings shall be labeled u, v, w, n by using indelible black color paint. Phase identification by adhesive stickers is not acceptable.

4.18 Pole-mounted transformer:

The MV terminals shall be 3 composite bushings fitted on the top of the transformer tank. Bushings shall be of the outdoors-weatherproof type and provided with M12 screwed stems and nuts with washers.

The LV terminals shall be suitable to connect the following Aluminum cables:

Transformer Rating [KVA]	Cables to connected Up to
25 ,50,75,100	One 4 c x 185 mm 2

4.19 Supplementary Fittings

Pressure Relief Vent:
A vent shall be provided to prevent rupturing of the transformer. This shall be capable of withstanding the variations of pressure in normal service.

Lifting Lugs:
Lift lugs shall be permanently attached and arranged on the tank to provide a distributed balanced lift in a vertical direction for the completely assembled transformer and shall be designed to provide a safety factor of 3(assuming that the transformer is filled with oil).The safety factor is the ratio of the ultimate stress of the material used to the working stress. The working stress is the maximum combined stress developed in the lifting provision by the static load of the completely assembled transformer including oil.

Tank Earthing:
Two stainless steel M10 studs with nut and washer shall be provided diagonally opposite on the tank for pole mounted transformer, If the base assembly is detachable then the earthing facilities shall be located on the tank wall. Suitable precautions shall also be taken to avoid corrosion attack on earthing facility.

Oil Drain Facility:
Facility for oil draining and filling and sampling shall be provided. The drain pipe size shall be one inch with opening valve and sealing plug, the filling facility size shall be one inch with sealing plug.

Cable Clamps:
All LV cable support clamps to the transformer body should be made of a non-ferrous material.

Mounting Channels:

For Pole-mounted transformers, mounting channels shall be designed with slots/holes suitable for transformer platform in Fig (1).For 25KVA up to 100KVA support clamps shall be designed as per Fig (2).

4.20 Name Plate:

Each transformer shall be fitted with a rating plate of weatherproof material, fitted in a visible position, showing the information listed below. Etching, engraving or stamping shall legibly mark entries on the plate.

Manufacturer's name	-
Manufacturer's serial number	-
Owners serial number (to be applied by TAVANIR)	-
Year of manufacture	-
Specification	- IEC 60076
Number of phases	- 3
Rated power	- KVA
Rated frequency	- 50Hz
Rated voltages	- kV
Rated currents	- A
Connections symbol (Vector Group)	- Yzn5
Impedance voltage at rated current	- %4
Resistance	- ohm
Type of cooling	- ONAN
Total mass	- kg
Total mass of core and windings	- kg
Volume of oil	- Liter
Connection diagram	-
Table giving tapping voltages of the tap positions	-
Ambient temperature	- ºC
Purchase order no.	-
TAVANIR stock number (Customer item code)	-

5.0 TESTING

5.1 Routine Tests:

Routine tests shall be carried out on all transformers, and shall be free of charge. The manufacturer shall carry out the tests in accordance with IEC-60076 and a test certificate should be provided along with each transformer.
The results of the tests shall be recorded on a routine test certificate, and two copies of this shall be sent to SBEPDC immediately after the tests.

The following routine tests shall be carried out:

Measurement of winding resistance.
Voltage ratio measurement and check of polarity or vector group symbol at All tap positions. Bushing positions must have permanent marking sat this stage of production.
Measurement of impedance voltage.
Measurement of load loss.
Measurement of no-load loss and no-load current.
Induced overvoltage withstand test.
Separate source voltage withstand tests on HV and LV windings.
Oil leakage test.

SBEPDC may carry out routine test sin its laboratory on random basis on 20% of each batch delivered to SBEPDC stores. If one transformer fails, SBEPDC can decide to reject the batch, if pass SBEPDC can decide to test any number of transformers of the same batch and the supplier shall replace any failed transformer.

5.2 Type Tests:

Type tests shall be carried out on individual transformers at an independent testing laboratory and be witnessed by representative acceptable to SBEPDC.

The transformers offered shall meet any or all (as per SBEPDC option) of the type test requirements of the standards listed below:

Test of temperature rise	IEC 60076
Impulse voltage withstand tests	IEC 60076
Noise level measurement	IEC 60551
Radio influence voltage measurement	IEC 60437
Winding insulation requirement	ASTM-D-202
Tests on bushings	IEC 60507

6.0 INSPECTION:

SBEPDC may wish to witness tests or to visit factory during manufacture of any or all items covered in this specification. Accordingly the supplier shall give advance notice to SBEPDC of the manufacturing and test schedule.

7.0 PACKING AND SHIPPING:

Packing and shipping shall generally be as per SBEPDC General Requirements including the following:

i. The transformer shall be delivered ready for service.
ii. Supplier shall contact Materials Department of SBEPDC for additional packing, handling, and shipment instructions as applicable.
iii. Packing crates shall be marked with the following:

- Manufacturer's name
- Country of origin
- SBEPDC purchase order number
- SBEPDC item number
- Gross weight in kilograms
- Handling instructions
- Final destination store

8.0 GUARANTEE

The supplier shall guarantee the transformers against all defects arising out of faulty design or workmanship, or defective material for a period of one year from the date of commissioning or two years from date of delivery SBEPDC certificates for date of commissioning or delivery shall be accepted.

9.0 SUBMITTALS

Submittals required with tender:
The supplier shall complete and return one copy of Data Schedule given by SBEPDC the following drawings shall be provided with quotation for each transformer rating offered:

- Outline of transformer showing position of fittings and attachments.
- Details of HV and LV terminals.
- Mounting arrangements. Lifting arrangements.
- Details of filling and draining valves. Details of cable clamps.
- Type test certificates for transformers of identical design.

10.0 LITERATURE

Maintenance and Operation Booklets shall be provided in English and Persian languages.

TENDER NO……

DATA SCHEDULE **Sheet 1 of 5**

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDERS DATA
GENERAL DATA:				
1	Manufacturer			
2	Applicable Standard		IEC– 60076	
3	Type of Designation		Pole mounted	
4	Number of phases	No.	3	
5	Number of Windings	No.	2	
6	Frequency	Hz	50	
7	Primary Voltage	kV	20	
8	Max. system Medium Voltage	kV	24	
9	Secondary voltage	V	400/230	
10	Higher system Voltage (LW)	kV	1.1	
11	Configuration	Core/shell	Core type	
12	Over excitation ability	%	5%	
INSULATION LEVEL:				
Insulation type : mono form				
13	Impulse withstand voltages (BIL):			
	a) MV winding	kVp	125	
	b) LV winding	kVp		
14	Separate-source power frequency test voltage:		Two times rated voltage	
	a) MV winding	kVrms	50	
	b) LV winding	kVrms	3	
15	Induced overvoltage withstand test:			
	a) MV winding	kVrms		
	b) LV winding	kVrms		
	c) Test frequency	Hz		
CONSTRUCTIONALFEATURES:				
16	Flux density at rated voltage and frequency	T		
17	Specific loss in core laminations	Wt/Kg		
18	Insulation of core laminations			
19	Winding conductor material (Cu. or Al.):			
	a) MV winding			
	b) LV winding			
20	Winding conductor shape			
	a) MV winding			
	b) LV winding			
21	Winding resistance at 20℃ per phase at principal tap:	Ohm		
	a) MV winding	Ohm		
	b) LV winding			
22	Maximum current densities in windings at normal rating and principal tap:			

TENDER NO……..

DATA SCHEDULE **Sheet 2 of 5**

	a) MV b) LV	A/mm² A/mm²		
23	Material of winding insulation:			
24	Grade and type of core			
RATINGS:				
1	Nominal transformer rating at principal tapping	KVA		
2	Normal rated current: a)MV b) LV	A A		
3	Design continuous ambient temperature	℃		
LOSSES:				
1	Core loss (No-Load loss)	KW(Max.)		
2	Winding loss (Load loss) at 75° C: a) Principal tapping b) Tapping having highest losses	 KW(Max.) KW(Max.)		
3	Magnetizing current	A		
4	No-load Current c) Exaction at rated voltage d) Exaction at 1.05 rated voltage	A		
EMERGENCYLOADING:				
	Maximumdurationofoverloadat30℃: a) 133% b) 150%	 Minutes Minutes		
COOLING:			ONAN	
OIL:				
1	Producer			
2	Type and trade mark		uninhibited mineral oil	
3	Applicable standard specs. (ref. No. & date of issue).		IES 60296	
4	Minimum flashpoint	℃		
5	Pour Point	℃		
6	Viscosity: at20℃	m²/s		
7	Maximum dielectric strength for 1 min	KV		
8	Dielectric factor			
9	Acidity(neutralization value): - Inorganic - Organic - Specification value (maximum)	 mg/KOH/g mg/KOH/g mg/KOH/g		
10	Maximum sludge formation	%		
11	Maximum acidity development in sludge	mg/KOH/g		
12	Moisture content	ppm	Max.30	

TENDER NO……

DATA SCHEDULE **Sheet 3 of 5**

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDERS DATA
TAP CHANGER:				
1	Type			
2	Make			
3	Rated current			
4	Rated step voltage			
5	Voltage class		CFVV	
6	Taps (off-load) on MV:			
	a) Total range	±%	5	
	b) Number of taps	No.	5	
	c) Plus steps	%	+ 2.5, + 5	
	d) Minus steps	%	- 2.5 - 5	
VECTOR GROUP SYMBOL			Yzn5	
IMPEDANCE VOLTAGE		%	4	
TEMPERATURE RISE:				
1	Max. top oil temperature rise	℃	45	
2	Max. average winding temperature rise	℃	50	
3	Max. hot spot temperature rise	℃	98	
4	Temperature rise due to short circuit current Above hot tests pot (3s) after full load.	℃	250	
NOISE LEVEL:		dB	48	
SHORT CIRCUIT LEVEL FOR 2seconds:		KA		
DEGREE OF PROTECTION:		IP		
DIMENSIONS and MASSES:				
1	Overall dimensions of complete transformer in service:			
	a) Width	mm		
	b) Depth	mm		
	c) Height	mm		
2	Masses:			
	a) Mass of core and winding	Kg		
	b) Mass of tank	Kg		
	c) Mass of oil	Kg		
	d) Total mass of transformer ready for service	Kg		
	e) Shipping mass			

TENDER NO……..

DATA SCHEDULE **Sheet 4 of 5**

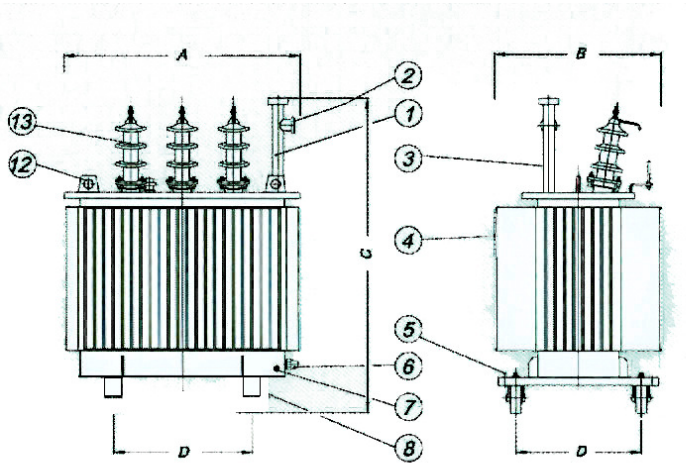
NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDERS DATA
TANKS:				
1	Tank construction			
2	Top oil temperature for internal pressure of 30kN/m²	ºC		
3	Steady load at 40ºC ambient at oil temperaturegivenin2	KVA		
4	Steadyloadat40ºCambientby Considering effect of solar radiation	KVA		
5	Maximum with stand pressure of the tank for 24 hours without leakage	kN/m²		
6	Tank steel thickness	mm		
7	Radiator steel thickness	mm		
MV BUSHING:				
1	Manufacturer			
2	Material / color			
3	Rated current	A		
4	Rated thermal current a)1sec	KA		
	b) 3 sec	KA		
5	Impulse withstand voltage	KVp		
6	Impulse flashover voltage	KVp		
7	Power frequency withstand voltage			
	a) Dry	KVrms		
	b) Wet	KVrms		
8	Power frequency flashover voltage			
	a) Dry	KVrms		
	b) Wet	KVrms		
9	Puncture voltage	KV		
10	Maximum withstand salinity	kg/m³		
11	Maximum withstand voltage at 224 kg/m³ salinity at 20ºC	KV		
12	Total creep age distance	mm²		
✓	:IT IS POSIBEL TO CHANGE MV BUSHING WITH SAME VOLTAGE WITH TO GETHER			
LV BUSHING:				
1	Manufacturer			
2	Material / color			
3	Rated current	A		
4	Rated thermal current a)1sec	KA		
	b) 3 sec	KA		
5	Impulse withstand voltage	KVp		

TENDER NO……

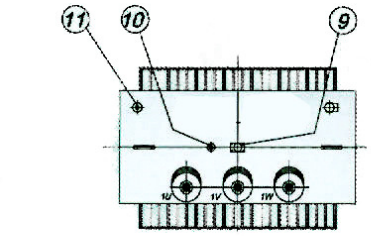
DATA SCHEDULE **Sheet 5 of 5**

NO	DESCRIPTION	UNIT	SEC REQUIREMENTS	BIDDERS DATA
6	Power frequency withstand voltage			
	a) Dry	KVrms		
	b) Wet	KVrms		
7	Total creep age distance	mm²		
SUPPLEMENTARY FITTINGS:				
1	Is transformer fitted with all accessories Require din this specification		Yes	
2	Type and make of accessories:			
	a) Temperature indicator			
	b) Pressure relief vent			
	c) Oil level indicator			
ACCESSORISE				
1	Cover for surge arrester horn	Yes/no	Yes	
2	Oil level indicator	Yes/no	Yes	
LIST OF DEVIATION:				

Fig. (1) Traditional **Dimensions** of Iran Transformer



1) filing pipe
2) Visual oil level eye indicator
3) Surge arrester horn
4)Rating plate
5)putting Lug
6)Oil drain valve & Sampling valve
7)Earthing screw
8)Holding rail
9)Terrminal plate
10)Tapping switch with indicator & drive
11)Thermometer Packet R1"
12)Lifting lugs for complete Trans & active part
13)H.V. Bushing



Hermetically sealed (oil filled)
Technical Specification according to Table 1 (20/0.4 kV)

POWER	25 kVA	50 kVA
A(mm)	804	834
B(mm)	728	738
C(mm)	1338	1368
D(mm)	520	520
W_T(Kg)	473	500

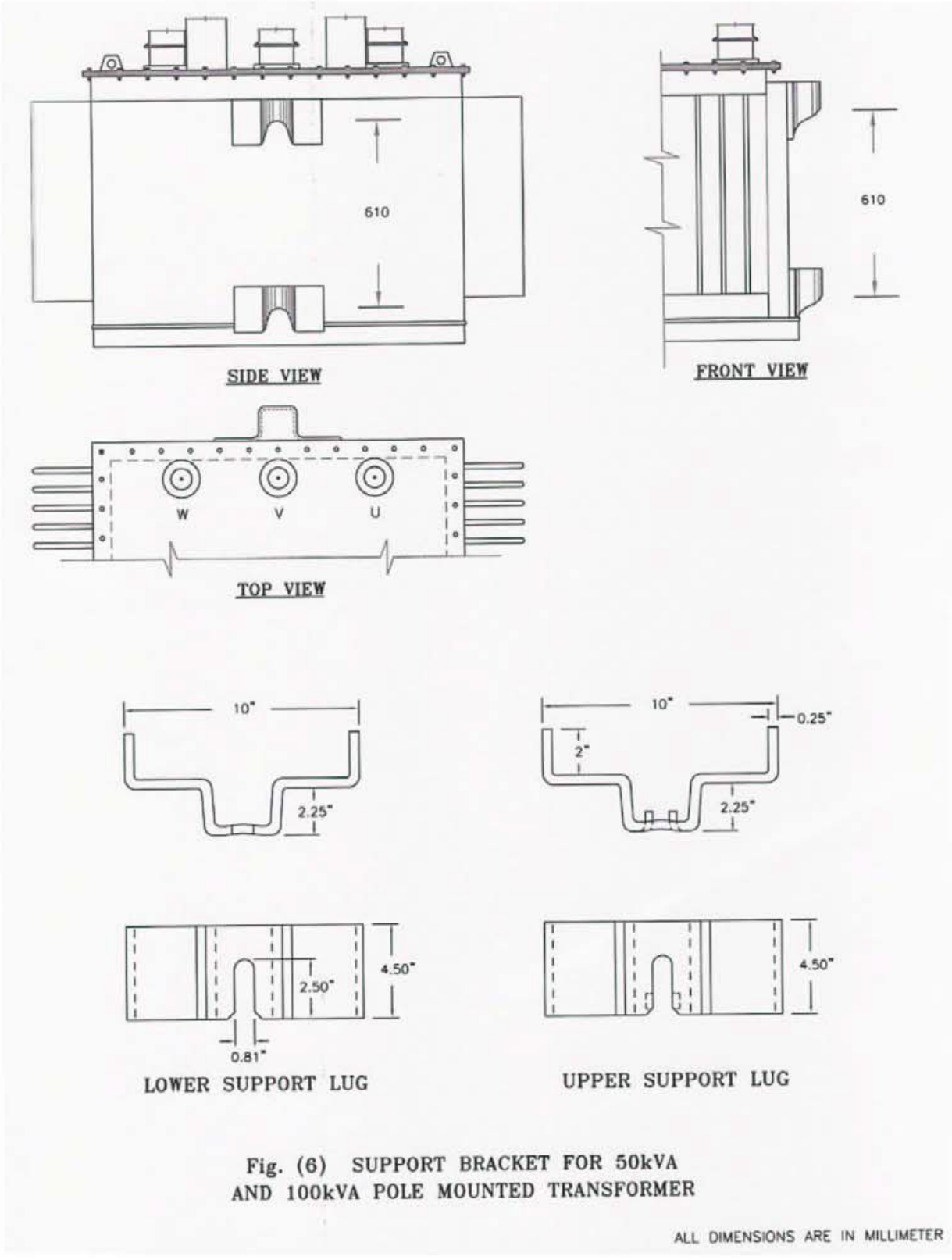


Fig. (6) SUPPORT BRACKET FOR 50kVA AND 100kVA POLE MOUNTED TRANSFORMER

ALL DIMENSIONS ARE IN MILLIMETER