OPERATION & MAINTENANCE MANUAL FOR DRY TRANSFORMERS



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Contents

1 INTRODUCTION:

1.1 GENERAL:

- **RRPL** make transformers are designed, manufactured, and tested to high standard of practice and are reputed for their quality and reliability in service. With proper installation, commissioning, protection and timely maintenance during operation, the users shall definitely receive a high-quality standard of service.
- The purpose of this Instruction Manual is to provide guidance on the installation, commissioning, and maintenance of Dry Type transformers. This guide is necessarily general in nature. In the event of any doubt, query arises or need for any further information or any irregularity / deviation from IEC / IS / Equivalent Standard, observed, please refer to the manufacturer for clarification and possible assistance.
- The transformer along with all its accessories / fittings should be installed, commissioned, operated and maintained under the supervision of a competent electrical engineer in accordance with relevant statuary requirements and good engineering practices, including Code of Practice, where applicable, and properly used within the terms of specification.
- For the Domestic/International Standards & Codes of Practice, reference should also be made to the current edition / publication of IEC / IS / Equivalent standards. A list of Standards & Codes of Practice for selection, construction, application & operation of various transformers will be furnished on request.
- All products have been designed, tested and supplied as per the specification and standards quoted, order acknowledged and subsequent modification as approved.
- Some accessories / fittings / components referred in this manual are supplied only when specified and may not be incorporated into all the transformers supplied. The equipment supplied may differ in minor details from the data given herein.
- For information about the transformer actually supplied, ALWAYS refer to the Drawings, Technical Specification Sheet, Manufacturer's Instruction / Product Catalogue of the Accessories / Fittings and such documents furnished with the hand-over documents.
- Transformer Enclosure is suitably designed to allow the safe lifting & transportation of the complete unit without over-straining the joints / clamps that are supporting the core coil assembly. All floor mounted transformers are provided with skid type under-base with pulling eyes or axle holes suitable for handling with roller bars. Wherever required, foundation / mounting holes are provided in the under-base.
- A Marshaling Box, if required, is provided to marshal all the transformer auxiliary wiring for convenience of external connection.
- In addition to the standard Fittings / Accessories, the other optional / additional items as required by customer's specification are provided. All the items are listed in the Approved Drawing furnished with the handing-over documents.

1.2 CAUTION:

- No transformer should have rated service voltage applied to it until ALL preliminary work (Clause No. 3) and pre- commissioning tests (Clause No. 4.02) and checks have been satisfactorily completed.
- A transformer which has been removed /stored from service for a long period of time should be rechecked prior to re-energizing and placing the transformer back into service.
- No high voltage tests should be applied to any transformer without making reference to the manufacturer.
- For an anticipated variation appearing in the supply voltage, the secondary side supply voltage is maintained within prescribed limits by the use of an Off-Circuit Tap Links (OCTL) mounted integrally within the transformer or Off Circuit Tap Switch (OCTS), whichever is provided.

	The OCTL/OCTS should be changed/operated ONLY when the transformer is `Off-Circuit' i.e. totally isolated from the power supply, otherwise this can lead to severe accident causing heavy arcing at tap connections which may cause a fire / explosion hazard.

1.3 HEALTH AND SAFETY:

- Materials or components that are liable to be exposed or handled in normal operation & maintenance and which present any hazard to health are covered here under.
- During design of an electrical distribution system including a transformer, care shall be taken with the following aspects;

a) Selection of transformer installation site having adequate ventilation, normal operating temperature, protection against fire, moisture, explosion, etc.

b) Selection of electrical protection at both primary & secondary side against over-load, short-circuit, earth-fault, etc.

c) Provision for regular inspection & maintenance.

- In addition to the instruction given in this manual, IS / IEC / equivalent standards and local regulation should also be referred for other details regarding the design, materials and performance.

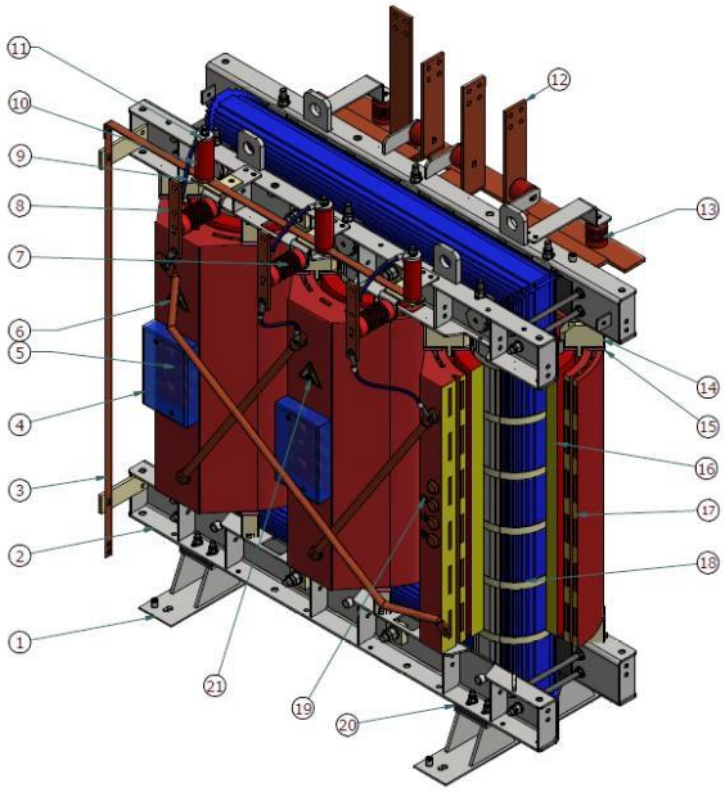
1.4 MAJOR APPLICABLE STANDARDS:

- IEC 60076 – Part 11, Part 12, Part 3, IS 2026, IS11171, IEC 61378 & IS 10028

1.5 A STANDARD FITTINGS: CRT

 As per IS / IEC standards the 'Standard Fittings' as listed below, are the minimum requirements for the safe & correct operation of a transformer.

1	BASE FEET
2	YOKE CLAMP
3	CU FLAT FOR ARRESTER EARTHING
4	TERMINAL COVER
5	TAP LINK
6	DELTA TUBE `U, V & W' PHASE
7	HV INSULATOR
8	HV TERMINAL BUSBAR
9	CABLE
10	SURGE ARRESTER
11	LUGS
12	LV TERMINAL BUSBAR
13	LV INSULATOR
14	FG SUPPORT BLOCK
15	RUBBER PAD
16	LV COIL
17	HV COIL
18	POLYGLASS TAPE
19	STICKER FOR TAP LINKS
20	ANTI VIBRATION PAD
21	DANGER SIGN PLATE



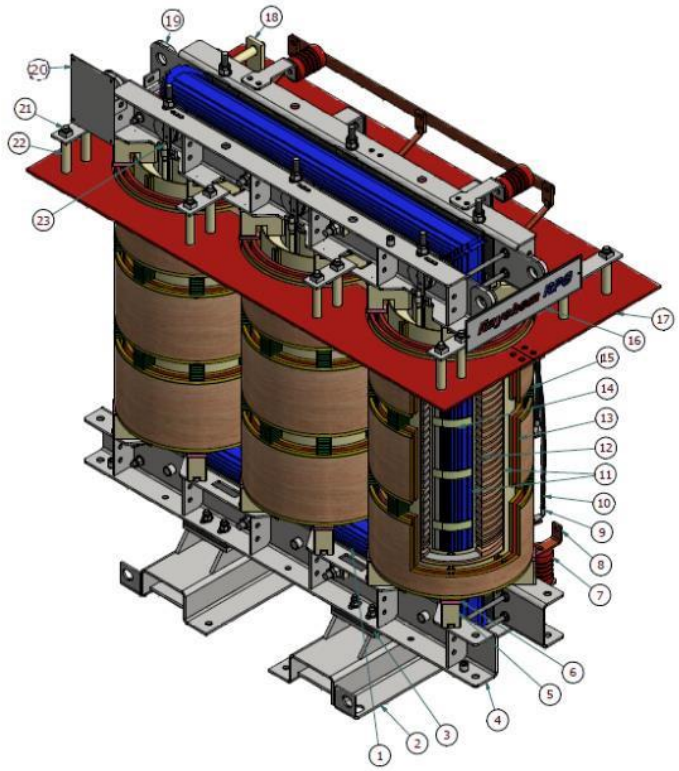
- Apart from above PT 100 sensor and Temperature Scanner will be provided.

 Space heaters will be provided for transformers with enclosure.

1.5 B STANDARD FITTINGS: VPI

- As per IS / IEC standards the 'Standard Fittings' as listed below, are the minimum requirements for the safe & correct operation of a transformer.

1	CORE ASSY. & INSULATION ASSY.
2	BASE FEET
3	ANTI-VIBRATION PADS
4	YOKE CLAMP
5	FG SUPPORT BLOCK
6	RUBBER PAD
7	HV INSULATOR
8	HV TERMINAL BUSBAR
9	LUGS
10	CABLE
11	FG CYLINDER
12	HV COIL
13	LV COIL
14	CORE BINDING
15	FG SPACER
16	MONOGRAM PLATE MGT PLATE
17	GLASTIC SHEET
18	FG SUPPORT
19	LIFTING LUG
20	R&D PLATE MOUNTING PLATE
21	FG STUD & FG NUT
22	FG TUBE



- Apart from above PT 100 sensor and Temperature Scanner will be provided.
- Space heaters will be provided for transformers with enclosure.
- Glastic sheet will be provided based on the applicability.

2 TRANSPORT, RECEIPT, HANDLING & STORAGE:

2.1 ARRANGEMENT FOR TRANSPORTATION:

- Each transformer is dispatched in clean & dry condition from Factory. (Suitably covered)
- Parts that are liable to get damaged during transit are detached and dispatched in separate cases along with the transformer. Accessories like Cable Boxes, rollers, support insulators etc., might be detached before dispatch.
- In Case of IP 00 transformers, the Core Coil Assembly is dispatched by fixing in the locking structure to avoid damage and the same is wrapped in packing bags to avoid water & dust ingress in the CCA during transit.
- The parts removed for transport are generally indicated in Packing List furnished along with the unit during delivery / handing-over of the equipment. Re-assembly of these parts should be carried in controlled environmental conditions (Free from dust, water droplets, rain etc.)
- Loading /unloading/ handling of the transformer must be done through transformer lifting lugs at the top cover or through Jacking pads at underbase of the transformer.
- Transformers supplied as IP-00 (Only Core- Coil Assembly) which are integrated with customer panel to be ensured for positive locking of Core-Coil assembly at base feet & top yoke clamps to avoid movement & damage during transit.

2.2 RECOMMENDED INSPECTION AFTER RECEIPT:

- Transformers are properly packed & dispatched by suitable transport up to destination. All consignment should be checked thoroughly after receipt at site. Post inspection; the transformer should be packed in the similar fashion to avoid ingress of water/dust.
- Immediately on arrival at site, transformer should be examined for any physical damage in transit with particular attention to;

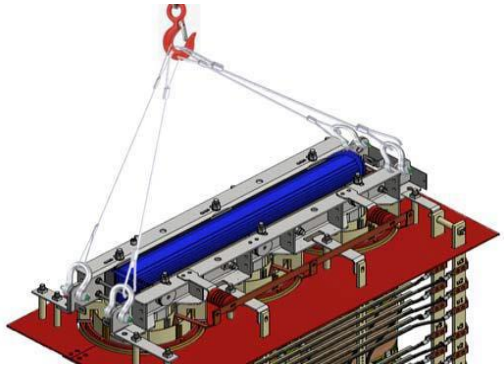
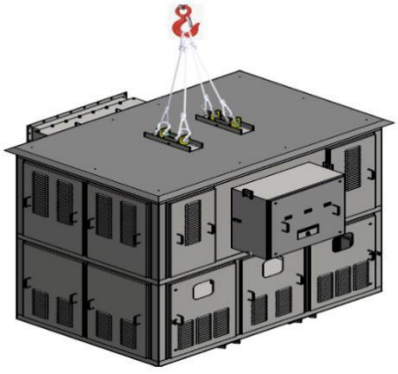
1) Damages to external packing.
2) Dents / cracks on side-walls, covers etc. of the enclosure.
3) Damage to protruding fitting such as bushings, insulators, sight glasses of marshaling box if any.
4) Loose bolts / screws / clamps / coil supporting blocks / OLTC mounting connections (FG nuts & OLTC mounting arrangement).
5) HV & LV Terminals & connections.
6) Presence of scratches/Cracks on the windings and centering of the windings.
7) Presence of impurities, dirt, moisture/water or any foreign material.
8) Damage to the Louvers etc.

SHORTAGE/ DAMAGE TO BE IMMEDIATELY REPORTED WITHIN ONE WEEK OF TRANSFORMER RECEIPT

- Unless there is reason to suspect internal damage, the enclosure cover should not be opened and no attempt to lift Core Coils Assembly (CCA) should be made. Internal inspection should be carried out to the maximum possible extent only via doors provided.
- Above inspection process should be repeated if the unit is moved or stored before it is installed or put in service.

2.3 UNLOADING & HANDLING OF TRANSFORMER AT SITE:

- The transformer should be unloaded by means of a crane or suitable lifting device of sufficient capacity (For weight details, please refer the Rating & Diagram Plate). Always use lifting mechanisms, crane, chain pulleys, etc. of adequate capacity. Use of any under capacity lifting mechanism or accessories could result in severe damage to the transformer, lifting equipment and possibly personnel involved in handling the transformer.

CORE COIL ASSEMBLY ONLY (IP 00 TYPE)	TRANSFORMERS WITH ENCLOSURE
	
Make use of all 4 lifting lugs for lifting	**Make use of all 4 lifting hooks on top of enclosure for lifting**

2.4 STORAGE:

- After receipt at site, it is desirable to erect and commission the transformer with minimum delay. In case this is not possible, all items including main unit & Accessories / Fittings dispatched separately from main consignment as received should be stored in a dry and covered place provided there are no signs of damage or rough handling. Main unit should be stored on an elevated platform high enough, so that water should not enter the enclosure during rains.
- Indoor type transformer must be protected from the weather. Outdoor units may be stored outside, in a dry covered area, if possible, protected from the prevailing weather.
- Heaters for marshaling box, enclosure etc., should preferably be kept energized to avoid possible internal condensation / deterioration of the internal components.
- It is recommended that as much of the original manufacturing packaging should be kept in place as possible during storage.

CARE SHOULD BE TAKEN WHILE UNPACKING OF THE ACCESSORIES FROM THE WOODEN BOXES TO AVOID DAMAGE

2.5 UNLOADING/UNPACKING/STORAGE INSTRUCTIONS FOR IP 00 TRANSFORMRS

- Park the vehicle in company premises under Covered shade for unloading.
- Untie the lashing and remove outer tarpaulin/covering provided over the vehicle.
- Remove wooden battens provided for locking/choking the base of structure.
- Check physical condition of locking structure/packing for any transit related damages.
- Check for accumulation of rain water/dew over the package prior to removal of first layer of
- HDPE bag. If any rainwater/dew accumulation is found, same to be cleaned.
- Do not cut the HDPE bag from top side as it may cause the accumulated water to enter in the Core Coil Assembly parts.
- Remove the second layer of HDPE bag and stretch film wrap.
- Lift the job with lifting rope by providing suitable J hooks or D shackle at lifting hooks.
- Shift the transformer to storage area. (Storage area should be such that there is no scope of direct water/dust ingress/entry over the transformer from any side)
- Unwrap the final layer of stretch film wrapped over the transformer
- If the Transformer needs to be stored for longer period of time (more than 48 Hrs.), repacking to be done to avoid ingress of moisture, water & dust.

In case any discrepancy is observed please inform to RRPL representative immediately within 24 Hrs.

Logistics at 9765410438 (Mr. Sachin Patankar), Services at 9765410171 (Mr. Kedar Mokal).
Please take & submit photos of discrepancies to RRPL authorities.

3 INSTALLATION:

The Electrical installation compiles with the following points:

a) The latest Indian Electricity Act.
b) Local utility rules & regulations.
c) IEC60076-11 -2018, Annex A
d) IS 100288: Code of practice for Selection, Installation & Maintenance of Transformer.
e) The electrical installation should be carried out by authorized persons competent to undertake such work.
f) Check for Core Coil assembly locking with enclosure.

3.1 PRECAUTIONS:

- All accessories / fittings / components dispatched separately should be thoroughly cleaned inside and outside before being fitted. Same should be fixed in their respective places according to the relevant drawings. If rusting is observed in any part of the transformer, same to be cleaned and touch up paint should be applied.
- Clean the air-cooling ducts between the windings and between the low Voltage coils and the magnetic core. Due care should be taken while cleaning to avoid falling of any foreign material inside transformer which may lead to failure of transformer after commissioning.
- Once in final position ensure that the transformer is secured by locking the Rollers.
- It is essential to fix the rollers provided with the transformers for proper air circulation. It will also avoid direct ingress of water inside the enclosure.
- Sufficient height should be provided below active part in order to provide adequate ventilation.

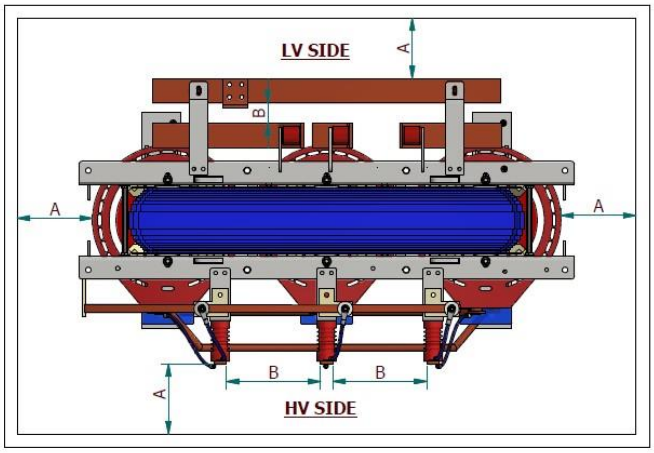
3.2 LOCATION AND SITE PREPARATION:

- The installation site should be such that there is easy accessibility for inspection. The transformer should be positioned in a way that the winding temperature indicator, rating and diagram plate, etc. can be safely examined when the transformer is energized. It should also be possible to have access to Tap changing links or the operating mechanism of the on load tap changer/off circuit tap switch, marshaling box etc.
- Consideration must also be given to the Efficient cooling of the transformer. The following conditions are important:

a) Keep the ambient temperature in the transformer room within specified limits.
b) Avoid stagnation of hot air above the transformer, which could impede the convective cooling process.
c) Try to obtain a diagonal airflow through the transformer bay or housing. The fresh air should enter by lower part and the hot air should exit from the upper part of the bay. The air inside room / Hall should get replaced min. 3 times per hour.
d) Any transformer should always be separated from other transformers, reactors and any other such heat generating equipment.
e) In order to limit the noise level of the transformer it is advisable to install it as far as possible from the walls of the bay as reflections can add to the noise from the transformer.

- Adequate electrical clearances are also to be provided from various exposed live parts of the unit to any earth point. (Ref.: Statutory & Regulatory Requirement on Electrical Clearance in Air.)
- External power conductors, power cables, control cables, earthing conductors, etc., shall be so positioned / supported such that no pressure is exerted on the transformer bushing terminals / cable box.
- Suitable provision shall be made for all non-current carrying metal parts used for the transformer support / base such that they can be earthed, preferably at two points.

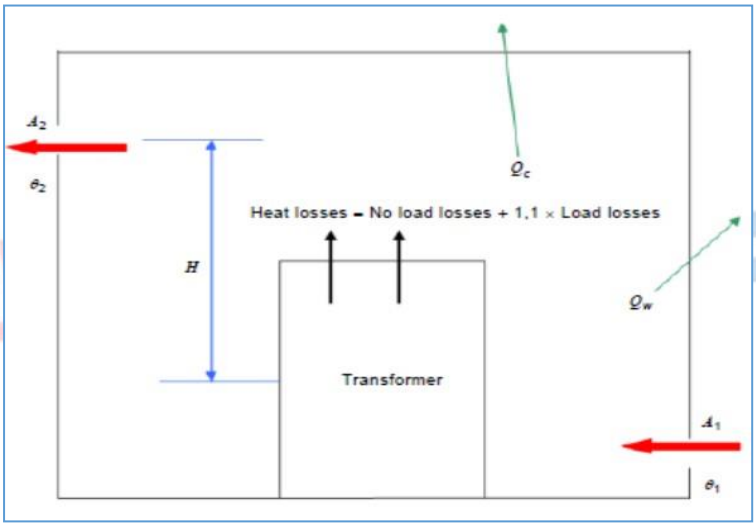
3.3 POSITIONING OF CCA IN THE PANEL/ENCLOSURE:



kV	BARE PARTS		INSULATED PARTS	
	A (mm) Phase - Earth	B (mm) Phase - Phase	A (mm) Phase - Earth	B (mm) Phase - Phase
1.1	25	25	20	20
3.6	60	60	40	40
7.2	90	90	70	70
12	120	120	100	100
17.5	160	160	140	140
24	220	220	200	200
36	320	320	300	300

3.4 POSITIONING OF COMPLETE TRANSFORMER ASSEMBLY (WITH CCA)

- Cooling of transformer in naturally ventilated room should be maintained according to IEC60076-11-2018, Annex C



A_1 is the air inlet effective cross section (m^2)

A_2 is the air outlet effective cross section (m^2)

θ_1, θ_2 are the air temperatures of inlet and outlet (°C)

H is the difference in height between mid-outlet surface and mid-height of transformer (m)

Q_c, Q_w are losses dissipated respectively through the ceiling and the walls (kW)

Fig: All Dimensions are in Meters. Minimum recommended spacing between the walls & Transformer periphery & the preferred ventilation scheme.

3.5 GROUNDING:

- The enclosure and core and coil assembly of transformers should be adequately grounded. Make sure that the flexible grounding jumper between the core and coil assembly and enclosure is intact, or that the core and coil assembly is directly grounded from the core clamp through a flexible lead. Ensure that grounding or bonding meets relevant standards.

3.6 CONNECTIONS:

- Cable termination/Connection points are clearly labeled on both high voltage (HV) and low voltage (LV) side of the transformer.
- Make only those connections specified by the nameplate or connection diagram, check all tap connections for proper location and tightness, and re-tighten all cable retaining bolts.
- Improper connection will cause heating and arcing which may result in connection failure. When connecting bus bars, make sure the joints are properly aligned prior bolting, to prevent excessive strain on the insulators.
- Bi-metallic lugs should be used in case of Aluminum cables and Copper bus-bars.
- Sufficient clearances should be maintained between the user/termination cables and coils and top clamps.
- Always use two wrenches (with proper torque set) while tightening or loosening bolted connections to prevent damage.
- The cables should be supported separately to ensure that no-undue strain is exerted on the bushing terminals in the cable box.
- Cables should be terminated on bus-bars provided in a cable box and termination should not exceed the number of holes provided. In other words NO extra holes should be made in bus-bar at site.
- The cable should be clamped / supported by suitable cable glands. Care should be taken to ensure minimal stress on the bus-bar.
- Adequate support should be provided for Cables and Cable Box as per site requirements/arrangements.

3.7 PRIMARY VOLTAGE & TAP CONNECTION VERIFICATION:

	**WARNING: Failure to de-energize and ground the transformer to change taps could result in serious personal injury and death.**

- Check line voltage before attempting connection of transformer to the power supply lines. When line input voltage is higher or lower than transformer nominal voltage, the Off Circuit Taps Links (OCTL) must be shifted to compensate for the difference between nominal and tested voltage. (This activity to be carried strictly when Transformer is in de-energized condition)
- The transformer is normally shipped with the tap connections made for the nominal voltage. They are marked with Numbers. The tap arrangement is shown on the nameplate.
- Tap connections should be changed only when the transformer is totally de-energized.
- Two tap terminals are connected together electrically by solid link. Ensure that the tap connections are tight and all coils must have same tap connections.

3.8 CURRENT TRANSFORMERS (IF SUPPLIED):

- Before energizing the transformer, secondary circuit of any CT fitted MUST always be short-circuited or connected with the load circuit. When CT primary is energized with secondary winding open, excessive voltage will develop across the secondary circuit and damage the CT or become a safety hazard if touched.

3.9 TORQUE TIGHTENING:

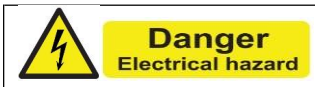
- It is recommended to use torque wrenches while tightening fasteners for electrical & mechanical connections. This result in better symmetry of the tension forces on the fasteners & overstressing can be avoided.
- All the fasteners should be tightened by using suitable Torque wrench w.r.t the following torque chart.

	SCREW JOINT FOR ELECTRICAL APPLICATIONS			SCREW JOINT FOR MECHANICAL APPLICATIONS		
	MAY CARRY CURRENT	MAY CARRY CURRENT		WELDED BOLTS		
WHEN USING SCREWS OF MIN. GRADE	>/=5.5 OR >/=Ax-70	>/=5.8 OR >/=Ax-70	>/=8.8 OR >/=Ax-80	>/=5.8 OR >/=Ax-70	>/=8.8 OR >/=Ax-80	>/=4.8 OR >/=A2-50
	SOFT MATERIALS (Cu, Al, Cu, Zn. SCREW JOINT, INSERTS, EPOXY RESIN, SPACERS WITH STEEL SOCKET INSERTS)	SOFT MATERIALS (Cu, Al, Cu, Zn. SCREW JOINT, INSERTS, EPOXY RESIN, SPACERS WITH STEEL SOCKET INSERTS WELDED NUTS)	HARD MATERIALS (STEEL, CONTACT WASHER)	SOFT MATERIALS e.g.: LAMINATED AND PRESSED MATERIALS. ALUMINUM ,PLASTIC WELDED NUTS, BLIND RIVETS ,NUT INSERT,SHEET METAL)	HARD MATERIALS (STEEL)	FIXING OF COMPONENTS OF LOW WEIGHT OR LOWER ORDER RISK GROUP (NO PNEUMATIC SCREW DRIVERS TO BE USED)
M3	0.8 NM	0.8 NM	1.3 NM	0.8 NM	1.3 NM	0.8 NM
M4	1.9 NM	1.9 NM	3 NM	1.9 NM	3 NM	1.9 NM
M5	3.7 NM	3.7 NM	6 NM	3.7 NM	6 NM	3.7 NM
M6	6.5 NM	6.5 NM	10 NM	6.5 NM	10 NM	6.5 NM
M8	15 NM	15 NM	25 NM	15 NM	25 NM	-
M10	31 NM	31 NM	50 NM	31 NM	50 NM	-
M12	50 NM	50 NM	88 NM	50 NM	88 NM	-
M16	130 NM	130 NM	215 NM	130 NM	215 NM	-

4. COMMISSIONING:

4.1 PURPOSE:

- After the satisfactory completion of installation, the following pre-commissioning checks and tests on Transformer & instruments must be performed before putting the transformer into service.
- Only qualified personnel should perform these tests.

	**WARNING: Improper testing by unqualified persons could result in serious injury or death.**

4.2 COMMISSIONING TESTS:

- During testing, external power lines / cables, lightning arresters, neutral earthing, etc., should not be in the power circuit.
- Ensure that transformer is completely isolated at HV & LV sides and all non-current carrying conductors are earthed.
- Before starting this test all the power terminal bushings should be thoroughly cleaned with a dry & clean piece of cloth.
- All system protections & transformer protection settings through relays to be verified from site before charging activities.

4.2.1 VOLTAGE RATIO TEST:

- Apply 3-Phase, Low voltage AC supply on the HV side and the Voltage Ratio at all tap positions can be derived using suitable precision voltmeter connected to the LV side. A ratio meter, if available can be used for a more accurate measurement.
- The Ratio values obtained should be similar to those indicated in the manufacturers' test report, furnished with the handing-over documents.

Tap No.	Voltage Applied (HV Side)			Voltage Measured (LV Side)			Ratio Obtained			Calculated Ratio from R & D Plate
	U-V	V-W	W-U	U-V	V-W	W-U	U-V	V-W	W-U	
First										
N										
Last										

4.2.2 MAGNETIC BALANCE TEST:

- Apply 230 Volts AC between each HV phase, keeping LV open. Measure HV Voltage for other remaining phases & record. A matrix will be formed as follows:

Applied voltage	U-V		V-W		W-U	
1	230		XX		xx	
2	XX		230		XX	
3	xx		XX		230	

- The “X, x” denotes the place to record measured readings. Measure the current and record separately for each phase.

4.2.3 MEASUREMENT OF MAGNETIZING CURRENT TESTS:

- Apply 400 V from HV Side and check current per phase in milliamps. (This test is applicable only for Distribution type of Transformer)

Phase	Voltage Applied (V)	Current Measured (m Amps)	Remarks
U-V			
V-W			
W-U			

4.2.4 INSULATION RESISTANCE (IR) TEST:

- IR values of windings to earth & between windings shall be measured with designated insulation resistance tester of suitable ratings and readings should be noted.
- HV-Earth
- HV-LV
- LV-Earth
- Control wiring – Earth
- As a safe general rule the following values may be considered as satisfactory.

Rated Voltage (kV)	Minimum safe I.R. in **MΩ** at Ambient Temp.	DC Voltage of IR Tester (V)	IR Measured in **MΩ**
22 OR 33	500	2500	
11 or 6.6	250	1000	
0.433	250	1000	

- IR values obtained should be similar to those indicated in the manufacturers' test report, furnished with the handing-over documents. In humid weather, IR values obtained may be lower due to condensation on the terminal bushings.
- If IR values are very low and unacceptable, then it may be necessary to dry-out the winding assembly till the insulation reaches satisfactory values. This should be done in consultation with the Manufacturer.
- In case of transformer with OLTC, the HV side Insulation resistance includes combined Insulation resistance for OLTC & Transformer. Minimum Safe value is similar as mentioned in the table above.

4.2.5 WINDING RESISTANCE MEASUREMENT TEST:

- Winding Resistance between phase windings should be measured using suitable DC Resistive Bridge or similar.
- Winding Resistance values obtained should be similar to those indicated in the manufacturers' test report, furnished with the handing-over documents.

Winding	Tap No.	1U- 1V/ 1U-N	1V- 1W/ 1V-N	1W- 1U/ 1W-N	Temp.	Remark
Primary Winding	First					
	N					
	Last					
Secondary Winding 1	Tap No.	2u- 2v/ 2u-n	2v- 2w/ 2v-n	2w- 2u/ 2w-n	Temp.	Remark
	-					
Secondary Winding 2	Tap No.	3u- 3v/ 3u-n	3v- 3w/ 3v-n	3w- 3u/ 3w-n	Temp.	Remark
	-					

4.2.6 MARSHALING BOX WIRING SCHEME CHECK (IF SUPPLIED):

- All the auxiliary wiring from various accessories to marshaling box should be checked with marshaling box scheme drawing furnished with the handing-over documents.
- During testing of accessories like Scanner etc., operation (Alarm & Trip settings) should be checked at marshaling box terminal blocks ensuring both operation and wiring are correct.

4.2.7 TEMPERATURE INDICATORS & SETTINGS (IF SUPPLIED):

- For a self-cooled (AN) transformer having a guaranteed temperature rise at rated KVA for applicable class of insulation - by average winding rise by measurement of resistance, the recommended setting of the alarm and trip contacts of the Winding temperature scanner is as follows:

	Fan (In case of AN /AF)	**Alarm**	**Trip**	**Class of Insulation**
WTI	**120 ˚C**	**130 ˚C**	**140 ˚C**	**F(155) – 90**
WTI	**140 ˚C**	**155 ˚C**	**165 ˚C**	**H(180) – 115**
WTI	**170 ˚C**	**185 ˚C**	**195 ˚C**	**R/C(220) - 145**

- The above settings are only indicative. However depending upon ambient temperature and loading conditions these settings can be changed by consulting manufacturer.
- For forced air cooled (ANAF) transformers, the recommended setting of WTI for control of cooling fans and the setting of the alarm and trip contact of the WTI, will be indicated in the transformer test certificate.
- The control wiring should be done using suitable multi core PVC copper control cables.

4.2.8 RECOMMENDED ADDITIONAL CHECKS PRIOR PUTTING TRANSFORMER IN OPERATION:

Electrical Checks,

- Connections are tight and secure.
- Accessories are operational (WTI, scanner, fans, space heaters, limit switches, etc.)
- Identical tap positions in all three windings.
- Solid neutral & ground connection of enclosure, neutral bushing, marshaling box, control gear box, cable box etc.
- Fans (if supplied) are operational
- Proper clearance is maintained from high voltage and low voltage bus to terminal equipment.
- Windings are free from unintended grounds or earth parts.
- Continuity in all windings
- All CT secondary circuits are closed.
- Surge arrester is separately earthed.
- Door interlock with breaker for tripping operation.

Physical Checks,

- No dust, dirt, or foreign material on the core and coils.
- No visible moisture on or inside the core and coils or enclosure.
- No visible damage to or shifting of core and coil assembly.
- All plastic wrappings are removed from the core and coils.
- All shipping members have been removed.
- There are no obstructions in or near the openings for ventilation.
- No tools or other articles are left inside or on top of the core and coils or enclosure.
- All protective covers are closed and bolted tightly.

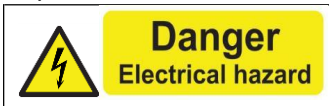
4.3 : CHARGING:

- It is recommended that the transformer should be initially energized at NO-LOAD and checked for any abnormalities for next 6 to 8 hours.
- After Switching on No-load, if the Primary Side Circuit Breaker is tripped, investigate the cause thoroughly and re-energize the transformer ONLY AFTER ensuring that the fault is properly cleared.
- If satisfactory (transformer on No-Load) then apply load gradually and observe for any abnormalities for the next 6 to 8 hours.

5 MAINTENANCE:

5.1 GENERAL:

- Main objective of any preventive maintenance activity is to preserve the original properties of the materials in good condition. If a transformer is to give long and trouble-free service, it should receive a reasonable amount of maintenance, which consists of regular inspection, testing and reconditioning when necessary. Records should be kept giving details of any abnormalities during service and also of any periodic test results taken. This demonstrates compliance with the general requirements of ISO: 9000.

	**WARNING: Maintenance work should be done on the transformer, with all the external circuits disconnected / made dead and all the windings are solidly earthed.**

5.2 EXTERNAL — OUTDOOR / INDOOR TERMINAL BUSHINGS:

- Outdoor bushings and rain sheds should be cleaned at regular intervals. Scrubbers can be used effectively to remove dirt / stains.
- During cleaning, the outdoor porcelain bushings should be examined for cracks or other defects and defective ones should be replaced.

5.3 CABLE BOXES (if supplied):

- It is advisable to check regularly for cleanliness, damages of bushings, tightness of terminal connections, etc.

5.4 BOLT, NUTS & FASTENERS:

- All bolts, nuts, fasteners, etc., should be thoroughly checked for proper tightness.

5.6 PAINT-WORK:

- During storage and service, the external paint-work should be inspected once a year, especially at the welded seams / joints, and where necessary, painting or retouching should be carried out. If the metal surface is exposed and becomes dirty, rusty or greasy because of delay in repairing the external painting, the surface must be thoroughly cleaned with a wire-brush or similar abrasives, before repainting to ensure a good bond between metal and paint. If paints recommended by supplier are not available, any good quality alkyd resin-based paint may be used.

6 A RECOMMENDED MAINTENANCE SCHEDULE FOR TRANSFORMER: CRT

Sr. No.	Frequency of Inspection	Items to be Inspected	Inspection Notes	Action required for unsatisfactory conditions
1	**Hourly / Daily**	Ambient Temp.	For reference	-
2		Winding Temperature	Check that Temperature rise is within the limit	For any abnormal Temperature rise/trip, investigate the cause.
3		Load, Voltage & Current	Check against the rated figures	For any abnormal tripping, investigate the cause.
4	**Quarterly**	Cable Box / Terminal Bushings	Check for tightness / dirt / damage	Tighten/ Clean thoroughly, if needed, take remedial measures.
5		OCTL/OCTS/OLTC	Check for tightness / dirt / damage	Tighten/ Clean thoroughly, if needed, take remedial measures.
6	**Half Yearly**	Core Coil Assembly	Check for cleanliness/ dirt/ dust	Clean thoroughly
7		Earthing Terminals	Check tightness & Earth Resistance	Take remedial action if earth resistance is high
8		Accessories / Auxiliary Circuits/ Space heater	Check operation & switching contacts.	Clean the components, if necessary, replace the item.
9	**Yearly**	Insulation Resistance	Check IR values	If low investigate & take action to restore insulation
10		Fastening Bolts / Screws / Clamps	Check for tightness	Replace the defective fasteners
11		Paint-work	Check for peelings / rusting/ damage	Repaint, as required.
12	**3-5 Years**	Overall paint-Work	Check for deterioration	Consider full repaint to original specification
13		Core & Windings	Check for tightness / cleanliness	Replace / Repair defective components as necessary

* Apart from above table, respective accessories manuals should be referred for maintenance schedule

* For cleaning, use of electric air blower / compressed air is strictly prohibited, only vacuum cleaning is recommended.

6 B RECOMMENDED MAINTENANCE SCHEDULE FOR TRANSFORMER: VPI

Sr. No.	Frequency of Inspection	Items to be Inspected	Inspection Notes	Action required for unsatisfactory conditions
1	**Hourly / Daily**	Ambient Temp.	For reference	-
2		Winding Temperature	Check that Temperature rise is within the limit	For any abnormal Temperature rise/trip, investigate the cause.
3		Load, Voltage & Current	Check against the rated figures	For any abnormal tripping, investigate the cause.
4	**Quarterly**	Cable Box / Terminal Bushings	Check for tightness / dirt / damage	Tighten/ Clean thoroughly, if needed, take remedial measures.
5		OCTL/OCTS/OLTC	Check for tightness / dirt / damage	Tighten/ Clean thoroughly, if needed, take remedial measures.
6		Core Coil Assembly	Check for cleanliness/ dirt/ dust	Clean thoroughly
7	**Half Yearly**	Earthing Terminals	Check tightness & Earth Resistance	Take remedial action if earth resistance is high
8		Accessories / Auxiliary Circuits/ Space heater	Check operation & switching contacts.	Clean the components, if necessary, replace the item.
9	**Yearly**	Insulation Resistance	Check IR values	If low investigate & take action to restore insulation
10		Fastening Bolts / Screws / Clamps	Check for tightness	Replace the defective fasteners
11		Paint-work	Check for peelings / rusting/ damage	Repaint, as required.
12	**3-5 Years**	Overall paint-Work	Check for deterioration	Consider full repaint to original specification
13		Core & Windings	Check for tightness / cleanliness	Replace / Repair defective components as necessary

* Apart from above table, respective accessories manuals should be referred for maintenance schedule.

* For cleaning, use of electric air blower / compressed air is strictly prohibited, only vacuum cleaning is recommended.

7 DETAILS TO BE FURNISHED BY THE CUSTOMER IN CASE OF TRANSFORMER FAILURE

#	Details Required	Remarks
1	Transformer Sr. No.	
2	Date & Time of Failure	
3	Failure occurred at the time of -	
3.1	i. Charging	
3.2	ii. Operation	
3.3	iii. Switching	
4	Date of Installation	
5	Date of Commissioning/Charging	
6	Load condition on Transformer at the time of failure	
6.1	i. No Load	
6.2	ii. Part Load	
6.3	iii. Full load	
6.4	iv. Over Load	
7	Transformer Test report at the time of commissioning	
8	Environmental conditions at Site	
8.1	i. Humid	
8.2	ii. Dusty	
9	Single line diagram (SLD) of transformer feeder	
10	Details of Preventive maintenance	
11	Abnormality records (if any) in the past history based on Log book	
12	Tripping record at time of transformer charging (if any)	
13	Transformer protection system details	
14	Breaker details -	
15	CT details in breaker	
15.1	HV	
15.2	LV	
16	RC circuit or Snubber circuit	
17	Relay details	
17.1	Relay Settings in HV (CT multiplier - Overcurrent, Instantaneous, Time delay settings - Overcurrent I>, Instantaneous I>>)	
17.2	Relay Settings in LV (CT multiplier - Overcurrent, Instantaneous, Time delay settings - Overcurrent I>, Instantaneous I>>)	
18	Installation room photos with transformer	
19	Visual flash marks over the transformer(if any), Photographs	
20	Failure details of any other equipment in the system	

8 DISPOSAL:

- All steel components, CRGO & Copper are to be disposed through authorized re-cyclers.
- Casted coils should be disposed through authorized waste disposal agencies to avoid any environmental hazards.
- For further details and guidance on waste disposal customer may contact RRPL.

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Warranty Terms & Conditions

Raychem RPG Pvt. Limited. ("Raychem RPG") provides the following warranty with respect to Transformer. Transformer will be free from defects in material and workmanship for a period of 12 (twelve) months from the date of Installation & 18 (Eighteen) from the date of invoice whichever is earlier. Extended Warranty can be provided to customer only if they agree to pay the warranty costs as highlighted at the time of order finalization. The requirements of warranty must be brought out to notice of Raychem RPG at the time of order finalization. Under no circumstances, the warranty of supplied transformers shall be extended after final issue of PO/contract signing. Raychem RPG, in its sole discretion will repair the transformer that Raychem RPG and Buyer mutually agree contains a defect in material and workmanship.
Raychem RPG's warranty obligations shall be subject to and contingent upon the following:

- The transformer shall be installed in accordance with Raychem RPG's instructions, in accordance with any other applicable instructions (to the extent not in conflict with Raychem RPG's instructions), and in accordance with good industry practice.
- Customer must buy the service of "Supervision of Erection Testing & commissioning of transformers" at site & set of recommended spares at advised by Raychem RPG
- Buyer must store & maintain the recommended spare parts / spare transformers at the site under appropriate storage conditions at their own cost.
- The transformers must be operated & maintained as per Raychem RPG's instructions. Under no circumstances, the maintenance of transformers at site shall not be a part of the warranty.
- Transit damage should be reported to Raychem RPG within one day from transformer received at site (as per PO incoterms of delivery), otherwise the product is deemed to be delivered in good condition & no claim if any transit damage / defect shall be accepted & Customer has to inform/ share charging date and pre-commissioning / commissioning test / observation reports with Raychem RPG Pvt. Ltd.
- In event of any claim pursuant to this warranty, buyer must submit a formal Non-Conformity Report through email (in format as specified by Raychem RPG) with proper photographic evidence of the issue, job no., site conditions, and any /all data as required by Raychem for technical analysis. Post submission of this report Raychem RPG, shall within 24-72 hours, assess the issue and provide solution through emails / telephone calls. If required, Raychem RPG shall be provided an opportunity to inspect such transformer as installed, and Raychem RPG shall have the right for Inspection and Testing of the Transformer at site or at its premises, as required.
- The warranty is expressly excluded for and / or defect of the transformer arising from or consisting in:
  a. Any repair, alteration and/or modification not authorized in writing by Raychem RPG
  b. Normal wear and tear of the material or of the singles components;
  c. Improper use and/or application of the transformer
  d. Excessive thermal, electrical or mechanical stress, although when occasional, beyond the limits of performance of the transformers;
  e. Failure due to dust, metallic duct, moisture or foreign material or particle.
  f. Defect and/or mistakes in the technical specifications, if any supplied by the client or by third parties entrusted by the client;
  g. Negligent maintenance of the transformer; Installation not in compliance with Raychem RPG instructions;
  h. In case of Earth pit resistance > 1 ohm.
  i. Failure to comply with any functional and environment parameter indicated by Raychem RPG for the correct functioning of the transformer;
  j. In case of IP 00 supplied transformer failure due to dust, metallic duct, moisture or foreign material or particle
  k. In case of defects in the electrical instrument E.g. : Cooling fan, Bushing , Buchholz relay, WTI , OTI, MOG, PRV, All Valve, Heater, Thermostats, Sensors, Contactor, Indicators, fuses, Lamps, Switches, OCTC, OLTC & RTCC warranty will be applicable only for a period of 12 (twelve) months from the date of Installation & 18 (Eighteen) from the date of invoice.
  l. Any uptime power guarantee at site.
  m. Shifting / re-installation of transformers or installation of spare transformers at site due to any reason and expenses associated with the same.
- In the event of failure of any transformer at site under the warranty, Raychem RPG's liability shall be limited to technical analysis of the root cause of the failure. The buyer must provide all the suitable technical data, site incidence reports etc. as required for the analysis.
- In any case the aggregate Raychem RPG's liability for damages arising out of vices and/or defect of the transformer under contract shall not exceed their aggregate price/total contract value.
- Except as provided in the preceding paragraphs, Raychem RPG makes no warranties of any kind whatsoever either express or implied, including without purpose. Raychem RPG's sole liability to buyer shall be for a repair of transformer, and in no event will Raychem RPG be liable for expenses, liabilities or losses associated with the Installation or removal of transformer, or the Installation for loss of profits, loss of use, or incidental expenses, interest, consequential or special damages of any kind.

GENERAL NOTES:

- It is essential to keep a record of observations made regarding operating condition, any test parameters & test results obtained.
- In case of any abnormality occurring during service, advice from the suppliers should be obtained, giving them name-plate particulars and complete details as to the nature & the extent of occurrence.
- Customers are hereby advised to contact us by letter/ fax/ e-mail / phone in case of any doubt before doing something wrong at the time of installation / commissioning to avoid any damage to the transformer.
- We value our customer feedback which can help us serve better.

Issue No. 3
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