



**INSTALLATION, COMMISSIONING,  
OPERATION & MAINTENANCE INSTRUCTIONS FOR  
OIL FILLED DISTRIBUTION TRANSFORMERS**

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- 1) Liability of Raychem RPG (P) Ltd. Is only limited to the product supplied (transformers).
- 2) **Failure to observe safety precautions, Indian Electricity rules and unauthorised operation or operation by untrained people may result in death or serious injury. Our liability does not cover such damage** and also any created consequential damage/loss. Our liability is only for product and that too during guarantees/ warranty period.
- 3) During rectification period any liability for hiring/production loss etc are not in Raychem RPG scope.
- 4) Our liability does not cover any production loss or any expenses incurred by customer for hiring/buying any equipment or apparatus or any consequential expenses during repair/rectification period.

**1) Introduction:**

This **O & M Manual** gives guidance for **installation, operation and Maintenance** of oil immersed distribution and power transformers including transformers for the **special application**.

**2) Applicable Standards:** IS 2026, IEC 60076 & BS 171, ANSI C 57, AS 2374

**2.1) Inspections & Un-Loading**

The unloading of the Transformer should be done with crane of capacity more than transformer weight. Please refer Rating & Diagram plate drawing for total weight.

Shortage/damage to be immediately reported in 24 hrs of transformer receipt, to our works.

The following points to be checked at site at the time of receipt of the transformer & should be reported to our works.

- a) Any damage to oil sight glass, Explosion vent diaphragm
- b) Condition of Bushings (Any crack or brokage)
- c) Any damage to Radiators, tank & other fittings
- d) Leakage of Oil

Lifting should be done using all lifting lugs located on transformer e.g. transformer having 4 lugs shall not be lifted on Two Lugs".

Dragging shall be avoided. If necessary, where rollers are fitted suitable rails or tracks should be used and the wheels should be locked to prevent accidental movement of the transformer

**2.2) Storage:**

The transformer has to be stored in a place, free from fire and explosion hazards.

Drums of transformer oil should never be stored outside, if it can be avoided. Where drums cannot be stored in indoors, they should be stored on side with bungs horizontal so that the bungs will always have the weight of oil against them. This will prevent breathing of drums during extreme changes of weather.

The oil level in main tank to be noted. Seal of Drums to be checked, any abnormality to be reported.

**2.3) Installation:**

The Electrical installation compiles with the following points:

- a) The latest Indian Electricity Act.
- b) Local utility rules & regulations
- c) IS 10028: Code of practice for Selection, Installation & Maintenance of Transformer.
- d) IS 1866: Code for practice for maintenance of Insulating oil.
- e) The electrical installation should be carried out by Govt. approved/Licensed persons competent to undertake such work. Details of agency with certificate shall be sent to us for the validity of warranty and guarantee.
- f) Before start of pre-commissioning test, please ensure to open locking screws on Dial of Oil temperature indicator & Winding Temperature Indicator & Buchholz Relay, MOG, OSR, and PRV. (If fitted.)

**2.4) Location of Transformer:**

The transformer installation position should be such that the breather, oil level indicator, rating and diagram plate, dial thermometer, etc., can be safely examined with the transformer energized. It should also be possible to have access to the operating mechanism of the on load tap changer/off circuit tap switch, marshalling box etc.

**2.5) Foundation:**

Special foundation is not required for the installation of a transformer, expect a level floor strong enough to support the weight and to prevent accumulation of the water. The transformer foundation should be provided with adequate oil soak pits and drains.

**2.6) Protection of Distribution Transformers:**

Transformers shall be provided with protection scheme as per Latest Indian Electricity Rules and CBIP guidelines, not less than below.

Transformer Rating	Protection		
	Primary	Secondary	Additional
16KVA - 200KVA	Fuse Dropout/Horn gap/HRC, with isolator	MCCB for each Feeder	-
315KVA - 990KVA	Fuse Dropout/Horn gap/HRC, with isolator	MCCB/ACB for each Feeder	-
1000KVA & Above	Circuit Breaker with IDMT type overcurrent & earth fault relay	MCCB/ACB for each Feeder	Oil temperature Indicator and Buchholz relay, with alarm & trip contact

**3) Transformer Oil :**

The transformer oil is a hydrocarbon mineral oil, clean and sufficiently free from moisture and other foreign matter and conforming to the requirement of the latest issue of IS: 335 for insulating oil. It must be ensure that for topping up or refilling, only new oil complying in all respect with the requirements of the above specification is used.

**4) OTI & WTI Setting:**

For a self cooled (ONAN) transformer having a guaranteed temperature rise at rated KVA of 50°C as measured in top oil by thermometer and 55°C average winding rise by measurement of resistance, the recommended setting of the alarm and trip contacts of the oil temperature indicator (OTI) and winding temperature indicator (WTI), are as follows:

	ALARM	TRIP
OTI	70 <sup>o</sup> C	80 <sup>o</sup> C
WTI	75 <sup>o</sup> C	85 <sup>o</sup> C

The above settings are based on a weighted average annual ambient temperature of 32°C as per IS:6600 "Guide for loading of oil immersed transformers". At other ambient, the temperature setting will have to be correspondingly changed. For forced air cooled (ONAF) transformers, the recommended setting of the contacts of the WTI for control of cooling fans and the setting of the alarm and trip contact of the OTI, shall be obtained from plant.

**5) Ordering of Spares:**

When ordering a spares please provide full name plate details of transformer with detailed description of spares.

**6) Format for reporting site failure:**

The following information to be provided along with photographs during any failure of transformer

- |                                  |   |   |
|----------------------------------|---|---|
| a) KVA                           | f) Date of supply   | k) Accessories / Instruments damage details |
| b) Voltage ratio                 | g) IR Values  | l) Log book record                          |
| c) Serial No. of the Transformer | h) Tap Links / OLTC failure: OLTC Name plate details required | m) Breaker tripping details                 |
| d) Date of Commissioning         | i) HV/LV Bushing cracked or damaged                           | n) Data logger's details                    |
| e) Oil Leakage Details           | j) Oil BDV  |   |

**7) Records:**

Record the transformer rating, serial number, Insulation Resistance values & date of installation

**8) Insulation Resistance:**

For **Class A insulation** the Insulation Resistance gets halved for every 10-15 Degree Centigrade. As a safe general rule the values as given in the table may be considered as satisfactory.

Rated Voltage kV	Minimum safe I.R. in Mega Ohms at 30°C	Voltage of megger (V)
33 / 22	500	2500
11 / 6.6	250	1000

**9) Recommended Maintenance Schedule for Transformers:**

Sr. No.	Inspection Frequency	Item to be inspected	Inspection notes	Action required, if inspection finds unsatisfactory conditions
1	<b>Hourly</b> (For Special & Industrial Transformers)	Ambient & oil Temperature Load (Amp)&Voltage	Check the temp.rise Check against rated figures.	Shut down the transformer & investigate if it is persistently higher than normal
2	<b>Daily</b>	1) Inspect general condition, see if there is any unusual noise 2) Oil level in transformer tank	Check against transformer oil level and oil leakages ifrom bushings, gaskets, welds if any	If low, top up with dry oil, after attending leakages
3	<b>Quarterly</b>	1) Bushings & Lighting arresters of PMT 2) Oil in Transformer 3) Indoor Transformer	Examine for cracks & dirt deposits Check for dielectric strength and water content Ventilation	Clean or replace Take suitable action to maintain quality of oil.
4	<b>Yearly</b>	1) Oil in Transformer 2) Winding 3) Earth resistance 4) Painting	Check for acidity & sludge, issolve Gas Analysis. Check for insulation value Overall painting.	Filter or replace Filter the oil & ensure proper megger value Take suitable action, if earth resistance is high To be done at site by our engineer.
5	<b>Three Years</b>		Servicing	To be done at site by our engineer.

**10) LV/HV Connections**

All External Connections must be tight & mechanically secure. It is recommended to use torque wrenches for better symmetry to avoid overstressing tightening torque for brass or copper hardware should be as per shown in table.

Size	Torque in NM
M8	10
M12	13
M20	30
M30 X 2	70

11) Trouble shooting chart for transformer:

Trouble	Cause	Remedy
<b>Rise in temperature</b> High temperature	Over Fluxing Over Current  Lower oil level slugged oil Short circuited core Defects in the calibration or contact of the thermometer	Check voltage and frequency to avoid over excitation.  If possible, reduce the load. Improving the power factor of load can often reduce heating. Check parallel circuits for circulating currents, which may be caused by improper ratios or impedances. Use filter press to wash off core coils. Filter oil to remove sludge.  Test for exciting current & no load loss, if high, inspect core & repair.  Examine & set right the defects.  Calibrarte the thermometer.
<b>Electrical Troubles:</b> Winding failure	Lightening, short circuit, overload, entry of foreign matter, ageing of insulation, and loose contact in jumpers tap, switches or bushings.    Sudden overload due to external fault.	Usually, when a transformer winding fails the transformer is automatically disconnected from the power source by opening the supply bracket or fuse.  When there is any such evidence of a winding failure, the transformer should not be re-energized at full voltage, because this might result in additional internal damage, also it would introduce a fire hazard in transformer, after disconnection from both source and load, the following observations and tests are recommended: a) External b) Mechanical or electrical damage to bushing leads, disconnect-ing switches or other accessories. c) Level of insulation liquid in all compartments. d) Temperature of insulating liquid wherever it can be measured. e) Evidence of leakage of insulating liquid. Maintain all protective systems in healthy conditions so that the transformer is isolated in case of sudden overload. Check up the insulation co-ordination gaps and do the needful.
<b>Core failure</b>  <b>High exciting current</b>	Core insulation break-down (core, clamps, or between laminations) Switching surges. Short circuited core  Open core joints	Test core loss .if high, it is probably due to a short-circuited core. Test core insulation. Repair if damaged.  Core loss test will show no appreciable increase re-tighten clamping structure.
<b>Audible internal arc</b>    <b>Bushing flashover</b> <b>Moisture condensation</b>	Isolated metallic part  Loose connection Low liquid level exposed live parts Lighting Dirty bushings Improper or insufficient ventilators	The source should be immediately determined. Make certain that all normally grounded parts, such as clamps and cores are grounded intact.  Same as above. Tighten all connections.  Maintain proper liquid level.  Provide adequate lighting protection  Clean bushing porcelains.  Make sure that all ventilator openings are free.
<b>Audio noise:</b> Fractured metal or porcelain parts of bushings.	Accessories and external transformer parts are set into resonant vibration giving rise to noise.  Unusual strain on terminal connections.	In some cases, parts may be stressed into resonance. Releasing pressure and shimming will remedy this connection.  Cables & bus bars attached to transformer terminal should be adequately supported. In the case of heavy loads. Flexible connections should be provided to remove strain on the terminal and bushing porcelain
<b>Oil Troubles</b> Badly dis-coloured oil	Carbonised due to switching or winding / core failure.	Recondition by filtration
<b>Oxidation</b> (Sludge & acidity)	Exposure to air  High operating temperatures.	Wash down core-coil and tank. Filter & reclaim or replace oil.  Same as above. Either reduce load or improve cooling.
<b>Other Troubles:</b> H.T. Fuses blowing off (if applicable)	a. Internal defect b. Jumper defects c. External fault not cleared by protective switch gear. d. Size of the fuse inadequate. e. Overload f. Excessive motor starting current.	Examine and rectify the defect.  Replace the fuse with suitable size. Reduce the overload. Check motor circuit and check fuse characteristics.

## 12) DO'S AND DON'T'S:

### Don'ts for Transformer:

- 1) Do not leave off-circuit tap switch handle unlocked.
- 2) Do not operate off-circuit tap switch when the transformer is energised.
- 3) Do not energise transformer without conducting pre-commissioning checks.
- 4) Do not energise without through investigation of the transformer whenever any alarm of protection has operated.
- 5) Do not re-energise the transformer unless the bushings relay is analysed.
- 6) Do not allow WTI/OTI temperature to exceed 60 degree centigrade during dry out of transformer & filter machine temperature beyond 70 degree centigrade.
- 7) Do not parallel transformer, which do not fulfil the paralleling condition.
- 8) Do not overload the transformer other than the specific limits as per IS: 6600
- 9) Do not leave any connection loose.
- 10) Do not allow conservator oil level  $\frac{1}{4}$  level.
- 11) Do not allow unauthorised entry near the transformer.
- 12) Not mix the oil unless it confirms fully to IS: 335 / or IEC: 600296
- 13) Do not continue with pink silica gel. This should immediately be changed or regenerated.
- 14) Do not leave secondary terminal of an unloaded CT open.
- 15) Do not top up oil from conservator with air cell bag inside.
- 16) Do not touch any live terminal. If some testing has to be done, switch off the Transformer, earth Terminals. Then work on it.

### Do's for Transformer:

- 1) Check the oil in the transformer & OLTC for di-electric strength & moisture content & take suitable action for restoring the quality.
- 2) Ensure all locking screws of Instrument Dial (OTI, WTI, Buchholz Relay) are open.
- 3) Check the oil level in oil cup & ensure air passages are free in the breather.
- 4) Check the oil for acidity & sludge as per IS: 1866
- 5) Check the protection circuit periodically
- 6) Open the equalising valve between tank & OLTC, wherever provided at the time of filling the oil in the tank.
- 7) Check the door seals of marshalling box. Change the rubber lining if required.
- 8) Inspect the painting and if necessary retouching should be done.
- 9) Check the buchholz / OSR relay and readjust the floats, switches etc.
- 10) Check the pointer of all gauges for their free movement.
- 11) Check & clean the relay and alarm contacts. Check also their operation and accuracy and if required, change the setting.
- 12) If inspection covers are opened or any gasket joint is to be tightened, then tighten the bolts evenly to avoid uneven pressure.
- 13) Check and thoroughly investigate the transformer whenever any alarm or protection is operated.
- 14) Check air cell in conservator if provided.
- 15) Attend the leakages on the bushings immediately.
- 16) Examine the bushing for dirt deposits on coats and clean them periodically.
- 16) Transformer Re - Painting to be done after 3 years.
- 17) Oil DGA to be done on yearly basis, after doing it at the time of Commissioning. (It will be bench mark)
- 18) Oil leakage if any on monthly / quarterly basis to be checked & reported.
- 19) Check that, all connections are properly tightened and there is no oxidation at contact points.

## 13) Oil Filling Instructions For Transformer with Air Cell: -

- a. Close & blank the Buchholz relay valve to isolate the conservator from main tank. Fill the oil in transformer under vacuum up to tank rim through bottom filter valve.
- b. After filling the oil in transformer break the vacuum through silica gel breather by connecting it to valve provided on cover.
- c. Remove the inspection cover provided on the side of the conservator and check the air cell ensuring that it is inflated. The air cell must remain sinfully inflated condition during oil filling operation. If the air cell is found deflated fit the inspection cover and inflate the air cell with dry air/nitrogen gas to 0.07 kg/sq.cm max. through connection. A Gauge E is be put by removing plug at top. After achieving the pressure close valve wait for 24 hours to check leakage in air cell by monitoring the air pressure.
- d. Remove the air release plug provided on top of the conservator and open valve.
- e. Slowly pump the oil through the main transformer temporarily stop filling operation when oil starts coming out from opening. after ensuring that no air bubbles come out through these air release holes fit the two air release plugs.
- f. Continue oil filling till oil starts coming out from opening. Stop oil filling ensuring that no air bubbles come out through these air release holes fit the two air release plugs.
- g. Now release the air pressure held in the air cell by opening valve and continue oil fillings until oil gauges indicates 30 degree centigrade level.
- h. Remove the breather and its connecting pipe-closing valve and refit breather in to connecting pipe.
- i. Finally remove pressure gauge & blank the opening with plug.

**14) Final commissioning & checks of Transformers:**

- a) Silica gel Breather: Ensure that the colour of the silica is blue .if it is pink then either it should be changed or heated at 100 deg. C. until the original blue colour is regained. The pink colour of the silica is due to absorption of moisture. Ensure that oil cup of breather is filled with oil at required level two air vents are provided on the oil cup. Remove tape from the air vent and make it open for air entry.
- b) Valve for correct closing & opening: Check all valves are in open position.
- c) Oil in the conservator should be checked before commissioning.
- d) Check that all radiators are filled with oil.
- e) Checking of different accessories: check all accessories as per manufacturers catalogues.

**15) Pre-Commissioning Tests (Also refer our Pre-Commissioning checklist):**

- 1) Insulation Resistance Test:
  - a) Control wiring E
  - b) HV-E
  - c) HV-LV
  - d) LV-E
- 2) Voltage Ratio Test: Ratio at all taps is to be checked. start the tap changer from lowest tap and then go on increasing tap instead of starting from normal tap.

Tap no.	Voltage Applied			Voltage Measured			Ratio Obtained			Cal. Ratio from R & D Plate
	U-V	V-W	W-U	U-V	V-W	W-U	U-V	V-W	W-U	
1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
to	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
16	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

3) Continuity test: Continuity between line and neutral (For neutral end) or line to line (for line end) with millimeter on all taps and phases to be confirmed.

4) Measurement of Winding resistance

Winding	Tap no.	Phase - U	Phase - V	Phase -W	Temp.	Remark
-----	1	-----	-----	-----	-----	-----
-----	to	-----	-----	-----	-----	-----
-----	16	-----	-----	-----	-----	-----

- 5) Magnetization Tests:  
Apply 400V from HV Side and check current per phase in milliamps.
- 6) Magnetic Balance Test:  
Apply 230 Volts AC between each HV phase, keeping LV open. Measure HV Voltage for other remaining phases & record. For voltage >= 22KV, it is recommended to do the test at higher voltages.

A matrix will be formed as follows:

Applied voltage	U-V	V-W	W-U
	230	xxx	xxx
	xxx	230	xxx
	xxx	xxx	230

The "XXX" denotes the place to record measured readings.Current to be recorded separately for each phase.

- 7) The Oil BDV to be recorded as per IS: 335. The minimum value to be 40KV For Distribution Transformers & 60 KV for Power Transformers.
- 8) Checks for operation of temperature sensor to be done.
- 9) Other Testing: (Please refer Fitting & accessories manufacturers catalogues)
  - a) OTI: Check alarm & trip. Setting.
  - b) WTI: Check alarm & trip. Setting.
  - c) PRV: Check alarm & trip function
  - d) OLTC Oil Surge: Trip function
  - e) Buchholz relay: Check alarm & trip. Setting.
  - f) Magnetic Oil Level Gauge: Check low-level alarm.

**16) Disposal:**

All material soaked in Oil is hazardous in nature and is to be disposed through authorized hazardous waste disposal agencies.  
All steel components, CRGO & Copper is to be disposed through authorized re cyclers.  
Used transformer Oil is hazardous in nature and to be disposed through authorized re cycles.



Chakan



Nalagarh

ISO:9001-2008

ISO:14001- 2004

OHSAS:18001-2007



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Note : Due to constant improvement in the product, Raychem RPG (P) Limited reserves the right to change specification and details mentioned this brochure

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