



**INSTRUCTIONS MANUAL FOR LIQUID DIELECTRIC DISTRIBUTION
TRANSFORMERS**

TRANSFORMER NR 47330

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INSTRUCTIONS MANUAL FOR LIQUID DIELECTRIC TRANSFORMERS

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1.- DESIGN, FABRICATION AND TESTS

The following tests are carried out in order to verify the above stated conditions:

1.1.- Individual or routine tests.

	STANDARD
- Winding resistance measurement	IEC 60076-1
- Transformer turns ratio measurement and check up of vector group	IEC 60076-1
- Measurement of losses on-load and short circuit voltage at main line input connection	IEC 60076-1
- Losses and no-load current measurement	IEC 60076-1
- Industrial frequency voltage test	IEC 60076-1
- Induced voltage test*.	
* As a function of insulation level at maximum H.V.	IEC 60076-1

2.- COMPANY REGISTRY CERTIFICATE

Company Registry Certificate (ER-0227 / 1996) issued by AENOR, on May 5th, 1996, certifies our Quality Assurance System, from design stage through manufacturing processes up to after sales services, establishing management criteria as well as procedures and processes that guarantee the delivery of defect free transformers, this scheme including the suppliers, taking advantage of knowledge and practice derived from research, type and special tests, that allow guaranteeing consistent product component design, fabrication and testing procedures, personnel training and non-stop improvement of the whole process.

3.- TEST PROTOCOL

All information regarding transformer tests is recorded in the Test Protocol enclosed with transformer documentation.

4.- RELIABILITY

Backed up by tests, transformers leave the factory free from defects and ready for service during their working life.

For achieving this reliability level, transformers must be maintained through a proper handling, storage, transportation, commissioning with adequate checks, provision of protections set up by the Requirements of H.V. Electrical Installations (**Reglamentos de A.T.**) and keeping the maintenance rules stated in the manual.

Also, action must be taken for the protection of regular or casual personnel working in the transformer vicinity avoiding the proximity of any unauthorized personnel.

5.- CONSTRUCTION DETAILS

5.1.- Dielectric liquid expansion and preservation

Transformers can be provided with an expansion system consisting of:

- 1) *Transformers with conservator.* An external expansion tank with dehydrating breather for transformers above 1.000 kVA.
- 2) *Hermetically sealed transformers.* One air chamber under sealed cover.
- 3) *Completely filled transformers.* A flexible tank adapts to temperature dependent oil volume

The various systems to accommodate dielectric expansion are able to accept 100 K temperature change.

6.- TRANSPORTATION AND HANDLING, DELIVERY AND STORAGE

6.1.- Inspection at arrival

Transformers are supplied fully mounted and ready for connection to H.V. and M.V. lines. Some items such as thermometers and similar parts could be delivered loose.

Upon arrival, at the client warehouse or at the client site, the following checks must be thoroughly carried out:

- Check that transformer data on nameplate coincide with Test Protocol data and these at the same time coincide with purchase order data.
- Check machine general condition
- Check for knocks specially on cooling elements and H.V. and L.V. bushing insulators.
- Check paint condition looking for chippings, scratches, etc.
- Check all transformer accessories (wheels, thermometers, etc.). Should any of the accessories be missing or damaged during transportation, report immediately the haulage company and the manufacturer in order to allocate responsibilities and appraise the costs involved.

IMPORTANT:

- **Specifically check if transformer seals are intact. A worked on or broken seal voids transformer guarantees and manufacturer responsibilities.**
- **In case any anomaly is found, report the manufacturer immediately. If no anomalies or defects are reported to the manufacturer within a 15 day period, it will be construed that the transformer is in perfect condition, and the manufacturer will not be held responsible for what might occur to the transformer and the possible consequences.**

6.2.- Transportation and handling

The tank allows for safe transformer movement in any direction, with adequate means, it being robust enough for lifting the transformer with no need for accessory removal: This can be done by means of slings hooked to the lifting lugs on the cover or on the walls, forming an angle of 50-70°.

- Slings must be prevented from rubbing or damaging bushings or other accessories.

Selection of lifting elements must be based on the transformer weight shown on the nameplate.

- Hook hole has a minimum diameter of 40 mm.
- Four tying points for transportation with a minimum diameter of 24 mm have been provided on transformer corners
- Transformer base and cooling elements are designed so that transformers can be moved by means of a lever without preventing the operation; nevertheless, pushing against transformer cooling fins must be avoided. In case of using levers, the provision of wooden stops is recommended.

6.3.- Storage

If commissioning is not immediate, transformers must be stored following the recommendations below:

- 6.3.1) The storage place must be dry and clean.
- 6.3.2) Regarding lifting and transportation, all points stated on par. 6.2 must be taken into account.
- 6.3.3) For transportation and handling, all points stated on par. 6.2 must be taken into account. Pushing on cooling elements and bushings as well as impairing the paint must be avoided.
- 6.3.4) In case of transformer lifting and moving by means of fork lifts, get the fingers through the underside of wheel coupling section, protecting the cooling elements from possible damage against the fork lift structure.
- 6.3.5) If transformers are equipped with plug-in bushings, make sure the taper protector provided for keeping bushing contacts clean and intact is in place.

7.- INSTALLATION

The manufacturer is not responsible for transformer installation. It has to be carried out in accordance with the applicable legislation in force.

The following transformer features must be taken into account:

Transformer are filled with dielectric liquid that could be lost by leakage of transformer tank as a consequence of aging gaskets, broken parts due to knocks etc. A dielectric liquid collecting system must be provided at the installation site.

Electric current flow through windings and magnetic circuit field produce electric losses that turn into heat. In order to prevent heat building up in the transformer and the inherent hazards, transformers are provided with cooling elements that limit the temperature of transformer parts to the values given by the standards; but adequate ventilation must be provided in the installation site, whether outside or indoors, to allow the cooling elements to do their duty.

Transformers are designed and fabricated to withstand abnormal over voltage and over current conditions, even secondary short circuit currents; but limiting their duration and magnitude with adequate devices is required.

7.1.- Installation site and protection of personnel

Transformer installation site conditions and design, regarding technical reasons as well as personnel and goods protection and safety, are defined in the Requirements of H.V. Electrical Installations (“**Reglamento de Alta Tension**” of Spanish legislation) and Local Government Regulations (**Normativa de las C.C.A.A.**) in force at that date.

Also, the instructions of the Power Supply Company, which also knows the specific features of the system the transformer is connected to, must be taken into account.

A horizontal base must be prepared for the transformer, designed to withstand the transformer weight without distortion. Total transformer weight is shown on the nameplate.

Also, wheels must be locked with the purpose of preventing any displacement during operation.

7.2.- Transformer protections

Although the Requirements of H.V. Electrical Installations state compulsory protections, basic protections for transformer and operation reliability are given below:

7.2.1.- Over current an overheating protection

Protection of transformer against thermal and dynamic effects as a consequence of over current and over voltage, is required.

For this purpose, a circuit breaker or fuse designed to withstand calculated overloads and calibrated for breaking at currents above 1,5 or 2 times rated current (see nameplate) must be provided.

7.2.2.- Transformer cubicle ventilation

As stated before, adequate ventilation must be allowed to limit transformer heating above the limits stated on the standards.

If the transformer is mounted inside a cubicle, proper ventilation with a proper design of air inlets and outlets must be provided.

Also, the transformer must be placed at a minimum distance from the walls of the cubicle, bushings keeping their safety distance from walls and top as a function of the voltage.

Avoid:

Ambient air exceeding the conditions stated in the standards.

Placing transformers inside confined spaces with metallic shutters exposed to direct sun radiation.

Taking in and out cooling air in the same transformer enclosure.

Placing transformers in enclosures destined to other uses; specifically rooms where devices operating at elevated temperatures such as boilers, steam generators, etc. are present.

If transformers cannot be placed in rooms with natural ventilation, forced ventilation must be provided.

7.2.3.- Dielectric liquid containment and fire fighting system

Transformers shall be placed over Spillage Containment Systems for dielectric containment in case of spillage, as per the Requirements of H.V. Electrical Installations (**Reglamentos de A.T**) and **Fire Fighting Systems** in accordance with the same shall be provided.

7.2.4.- Over voltage protection

For industrial and atmospheric induced frequency over voltage protection, variable resistance lightning arresters shall be provided, their characteristics being a function of transformer Insulation Level and mains characteristics, with a suitable earthing connection in accordance with the Requirements of H.V. Electrical Installations (**Reglamento de A.T.**)

Regarding this point, collaboration with the Power Supply Company which system the transformer is connected to is essential.

8.- INSPECTION BEFORE COMMISSIONING

Transformers are supplied completely assembled and ready for installation (except thermometers and temperature switches that must be properly mounted into their housing their proper operation test being required). Thermometers are calibrated for alarm and trip actions.

Nevertheless, they must be subject to the following checks prior to connecting to the line.

8.1.- Inspection of dielectric liquid and preservation system

8.1.2.- Transformers with conservator.

- If transformers are provided with an expansion device with dehydrating breather, the plug on the lower part of the air dryer shall be removed checking whether the silica gel has a dark blue colour. Otherwise, the silica gel shall be dried out in a stove until it recovers the blue colour.

- Make sure, looking through the sight glass, that the Buchholz relay is completely filled with insulating liquid. Otherwise, proceed with purging until air is completely eliminated.
- Check that dielectric liquid level is correct.

8.1.3.- Hermetically sealed transformers

Check that transformer seals are intact. Removed, broken or manipulated seals void transformer guarantees and manufacturer responsibilities as mentioned before.

In any case, dielectric liquid level shall be checked.

9.- CONNECTIONS

9.1.- Coupling

Transformers must be connected to H.V and L.V. circuits by means of connections fastened such that said connections do not exert any forces over bushings, and have enough cross sectional area as to avoid excessive heating and, at the same time, allow for expansion. Make sure that tap position is correct and, if a multi-voltage transformer is involved, the H.V. winding is connected for operating voltage. **Tap changer must always be operated under no voltage.**

- Also, check by means of a multi meter, for all tap positions, the continuity of the circuit the actuator being properly locked in working position.

- Transformer tank shall be earthed in a permanent and positive way by means of earthing bolts located on the bottom right corner of both largest tank sides. The earth lead must be sized as per the Requirements of H.V. Electrical Installations (**Reglamento de A.T.**) and as a function of transformer characteristics.

9.1.1.- Transformer inspection prior to loading

After having connected the transformer to the H.V. line:

- Voltage shall be applied, under no-load, checking for anomalies during this period.
- Voltage between L.V. bushings shall be measured for checking correct connection and regulation.
- After this, load shall be progressively applied, until rated power is reached, monitoring the temperature.

9.1.2.- Parallel coupling

If transformer must be coupled in parallel with other transformers, compatibility conditions required by Standards regarding voltage, tap changer position, short circuit voltage and vector group must be complied with.

10.- NOISE PREVENTION

- When connecting the transformer to the H.V. line, tap changer position and H.V. winding connection, as applicable, match the working voltage. Otherwise saturation of the magnetic circuit might occur thus increasing noise significantly.
- Check that all four transformer wheels are positively resting on the floor.

Do not place gratings or protections against transformer metallic walls.

11.- MAINTENANCE

11.1.- Frequency

General.

Monthly

- Tightness
- Temperature
- Noise

Yearly

- Insulator cleaning
- Connection tightening
- Accessory inspection
- Paint condition

Hermetically sealed transformers.

Monthly

- Dielectric liquid level

Yearly

Transformers with conservator

Monthly

- Dehydrating breather inspection
- Dielectric liquid level

Yearly

- Relay operation test

Completely filled transformers.

Checking dielectric liquid level is the only thing required in case of leakage.

Performing the above stated operations does not discharge the user from compliance with transformer station Legislation in force with the purpose of:

Protecting personnel and goods integrity and functionality that might be affected by the installations.

- This inspection must be carried out on all transformers, and transformers with less than ten year operation since their fabrication, in liaison with the manufacturer who must know the outcome of the inspection in order to recommend corrective actions if applicable.

11.2.- Precautions

Actions required by legislation in force must be taken. Among these actions, the most important are stated below.

Prior to proceeding with the inspection or maintenance of the transformer:

- H.V. and L.V. switches shall be disconnected taking the transformer out of operation.
- Transformer bushings shall be earthed using an insulated pole to make sure no static electricity remains on the same.
- After this, bushings shall be short-circuited and earthed.

11.3.- Inspection of dielectric liquid and winding condition

- Resistance of insulation between windings and between windings and earth shall be measured.

Transformers with conservator and hermetically sealed transformers:

- Check that dielectric liquid level is correct.
- If transformer is provided with air dryer, silica gel colour shall be checked. If colour is not dark blue, proceed to drying the silica gel.
A sample of dielectric liquid from the bottom of the transformer, as per IEC standard in force, shall be taken for dielectric strength measurement.
- In case transformer needs replenishment with dielectric liquid, oil added shall be dry as per IEC Standard in force and shall be compatible with remaining oil. The fact that oil filling at the factory is done at atmospheric pressure and 20°C shall be taken as a reference.
- *Completely filled transformers.* Dielectric liquid not being in direct contact with the air, this analysis will not be required. If for unusual reasons taking a sample or liquid replenishment should be required, this operation shall not be done without seeking manufacturer advise who will give proper instructions or recommend an Approved Shop for this operation.
- Transformer load and dielectric liquid temperature must be periodically checked.
- Also, check for leaks through bushings, valves, etc.

11.4.- Bushings and external connections

- Bushing porcelain insulators shall be thoroughly cleaned to guarantee their dielectric strength.
- Check and tighten bolts and connections.

11.5.- Paint condition

Check for chippings, scratches and corrosion spots. Should any of these defects exist, sandpaper the affected area until reaching white metal, followed by applying antioxidant primer and standard paint finish coats.

11.6.- Temperature checking

Temperature shall be checked as a function of transformer load.
For trouble shooting, refer to the tables at the end of this manual.

12.- REPAIRS

12.1) If anomalies occur during transformer operation, these shall be reported to the manufacturer who will give the applicable instructions.

12.2) If after transformer inspection, repairs or modifications should be required, these must be carried out by the manufacturer.

Important note:

If these instructions are not complied with, the native manufacturer will cease to be responsible for transformer operation and reliability that will be transferred to the repairer.

13.- ACCESSORIES

Transformers are provided with following accessories as per IEC Standard in force.

- 13.1- Nameplate
- 13.2- Two earth terminals
- 13.3- Filling device
- 13.4- Draining and sample taking devices
- 13.5- Temperature sensor mounted in housing.

Hermetically sealed transformers and transformers with conservator.

- 13.6- One or two air chamber pressure relief valves if the transformer is hermetically sealed.
- 13.7- Gas detection relay
- 13.8- Two dielectric liquid level indicators located on both largest walls for transformers without conservator, or on both flat faces of the expansion tank for transformers with conservator.

14.- TROUBLE SHOOTING

Symptom	Affected elements Probable cause	Recommended action
Low insulation resistance	Dielectric Water in dielectric Insulators Aging Internal connections Element out of place	Drying process Contact the manufacturer Contact the manufacturer
Silica gel pink colour	Ambient air Humid air Drier Lack of dielectric in the siphon, if provided	Replace silica gel Replenish filling tank with dielectric
Dielectric liquid bleeding	Plug or drain valve and several gaskets. Poor tightening. Defective gaskets Gas relays Poor tightening of gaskets. Misplaced purge valve. Plug-in bushings. Poor tightening	Correct or tighten Contact the manufacturer Correct tightness Check position Correct or tighten
Circuit breaker trips when connecting the transformer	Gas relay Gas presence Defective windings. Wrong calibration of contact thermometers. Temperature switch wrongly connected	Purge. Check whether collected gas is flammable or not. If it is flammable, contact the manufacturer avoiding trying to put the transformer into operation. Contact the manufacturer Adjust calibration Check wiring diagram
Circuit breaker trips when connecting the transformer (continued)	Tap changer. Primary voltage not matching tap position. Fuses. Wrong size Protection relays Wrong timing calibration	Check tap position. Change size Contact the manufacturer

<p>Abnormal secondary voltage. - No voltage</p>	<p>Primary voltage. No primary voltage.</p> <p>Windings. Lack of continuity in windings.</p> <p>Tape changer. Wrong position.</p> <p>Primary voltage. Very low.</p> <p>Primary voltage. Very high.</p> <p>Tape changer. Wrong position. Unbalanced voltage.</p>	<p>Check installation and contact the Power Supply Company.</p> <p>Contact the manufacturer.</p> <p>Change position.</p> <p>Check installation and contact the Power Supply Company</p> <p>Check installation and contact the Power Supply Company.</p> <p>Check installation and contact the Power Supply Company</p>
<p>- Abnormal working temperature</p>	<p>Fuse. Blown out</p> <p>Windings. No continuity in windings.</p> <p>L.V. installation Load unbalance. Wrong coupling.</p> <p>Transformer enclosure. Poor ventilation. High ambient temperature.</p> <p>Low dielectric level. Defective active part cooling.</p> <p>L.V. circuit Overload.</p>	<p>Change fuse.</p> <p>Contact the manufacturer</p> <p>Check L.V. installation. Check L.V. connections</p> <p>Check enclosure ventilation.</p> <p>Check level at 20 °C. Check installation and contact the manufacturer.</p> <p>Check for possible power increase and reduce transformer load.</p>

NOTES: