"I.G." TRANSFORMERS

Instructions for Transformers of the Pad mounted Type, Distributed for Underground Use

Cía. Manufacturera de Artefactos Eléctricos, S. A. de C. V.

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1 Introduction and range of application

First of all, **Cía. Manufacturera de Artefactos Eléctricos, S. A. de C. V.** thanks you for having acquired an **"I.G."** Transformer, which has been designed and carefully manufactured in conformance with national standards and/or the client's specifications, to thereby provide the final user with a product that will satisfy his needs and expectations.

With this manual we are providing the user with a guide containing the instructions for the use, handling, and safety precautions for the transformer, as well as the most usual warnings and precautions that must be taken into account with the acquisition of this transformer, since its nature dictates that it must be installed correctly and used in an appropriate manner, with a maintenance and testing program that will prolong its useful life.

Therefore, before receiving, installing or mounting your **I.G.** Transformer, you should carefully read these instructions, in order to ensure that it will be used and handled safely, to thereby avoid its loss or damage. You must also ensure that the installation, startup and maintenance of your transformer are carried out only by experienced personnel with the necessary technical knowledge. Otherwise, you will incur unnecessary risks that could lead to the damaging of your transformer and the invalidation of your guarantee.

This instruction manual is for pad mounted-type transformers for underground installation, which are manufactured in conformance with the NOM-002-SEDE/ENER-2014 and NMX-J-287-ANCE standards and/or specifications of the client or final user. It covers transformers of the following capacities and classes:

Single phase:	from 25 to 167 kVA and from 1.2 to 25 kV
Three phase:	from 30 to 2500 kVA and from de 1.2 to 25 kV

2 Reception

I.G. Transformers are minutely inspected and tested before they leave the plant, to ensure that they meet the standards and specifications established by the client or final user. Nevertheless, when you receive your transformer, you must follow the recommendations indicated below, in order to verify the state or condition in which you are receiving your transformer. Use the list on *page 24* to record this verification.

- **a.** Check that your transformer has been delivered on a wooden pallet, which protects it during its transportation, handling and storage before its installation. Keep it on the pallet until its arrival at the place where it will be installed (see *figure 1*).
- **b.** Check the capacity and series of the transformer against the data on its ID tag and its documents.
- **c.** Check to ensure that neither the medium voltage nor low voltage bushings have cracks or fissures.
- **d.** Check to ensure that none of the accessories such as valves, operating levers, tap changers, etc., are damaged or are leaking oil.
- **e.** The cover and tank joints, middle and low voltage bushing seats, connectors, shunt switches, disconnectors, etc. must be free of oil stains, which could be an indication of leaks.

3 Handling

I.G. Transformers are fitted with hoisting hooks or ears for their handling. Instead of chains or steel cables you should preferably use woven fiber straps, to avoid a deterioration of the coating on the hoisting hooks (see figure 2). If chains or metallic straps are used, you should protect the area that comes into contact with them, to avoid deterioration of the coating.

Also, ensure that the chains or straps used do not come into contact with the radiators, since this could cause leaks in them.

The wooden pallet on which the transformer is shipped can be used to move it with a front loader. We recommend that the said pallet be kept until the transformer arrives at the point where it will be installed. If the pallet is removed sooner, the transformer could incur damage to its anticorrosive coating. Avoid dragging your transformer directly over the floor, since this could deform the cabinet or damage the coating, and thereby begin the process of corrosion of the transformer.

As an alternative, if it is not possible to move the transformer with a crane or front loader, it can be moved over rollers. In this case, use the base of the transformer itself, since the said base has been designed to slide your transformer in both directions parallel to its axes. Take care not to tip it excessively.

In the case of three-phase transformers, these have been reinforced to allow the use of levers or jacks for their handling. Use these devices to move the transformer to its installation site, avoiding an improper use of the said devices to prevent damage to the cabinet.

The transformer should not be pulled, jerked, or moved by placing leverage on the cabinet. Nor should the lever be used on the radiators or as a lifting tool, since this can cause deformation that obstructs the circulation of the oil, or cause oil leaks (see *figure 3*).

4 Storage

All **I.G. Transformers** are hermetically sealed against leaks and the penetration of moisture, and they can therefore be stored under a roof or in the open air. In either case, always store your transformer on a pallet and on a solid level floor with no pooling of water. Also, keep the transformer under lock and key, to keep it safe against vandalism or other physical damage.

5 Installation / Mounting

Before the installation, mounting and/or startup of your **I.G. Transformer,** you must realize and check the following in the verification lists of *pages 24 and 25:*

5.1 The features of your transformer must correspond to the required operating conditions (the line voltage and capacity requested). This can be verified in the data tag.

5.2 Verify that the transformation ratio is correct in all the phases and positions of the tap changer. Ensure that your transformer is not in short circuit or that one of its windings is open.

5.3 Verify the resistance of the insulation and ensure that the windings are not in short circuit with each other or grounded or with a low resistance (less than 1 000 mega ohms/kVa 20 °C / 1 minute). If your transformer is of a star-star connection, the internal bridge must be disconnected, for which an authorization from the manufacturing plant must be requested.

5.4 Verify the resistance of the ground system of the installation site.

5.5 Be sure to connect your transformer to the ground, for which you will need to verify the resistance directly from the cable that is connected to the transformer tank. If you energize your transformer and it is not solidly connected to the ground you can damage it and thereby invalidate the warranty.

5.6 Verify that your transformer does not have leaks or the indication of leaks or damaged bushings or accessories. Also, make sure it is leveled, so that there will not be any live point in the interior above the oil level.

5.7 Ensure that the protections or accessories not included in your transformer are the appropriate ones, according to the technical or coordination specifications required.

5.8 Verify that the disconnecting switch or switches can operate freely in every position.

5.9 If the transformer is installed in the interior of a closed locale, make sure that the necessary provisions have been made for the flow of air for its adequate ventilation.

NOTE: The **I.G. transformers** are shipped with the internal connections specified by the client, or with those described in the NMX-J-285-ANCE standard, which are indicated in the data tag.

6 Operation

Your **I.G transformer** is an electrical unit that has been designed and built with the highest standards of quality. By its nature, it does not have moving parts. It operates practically on its own, and its possibilities of failure are minimal. Nevertheless, in order to avoid failures, damage, and a reduction in the useful life of your transformer, as well as to guarantee a reliable, safe and continuous supply of electricity, we recommend that you take the following aspects into account:

6.1 Install your transformer appropriately, in conformance with the indications in *point 5*, and in conformance with other practices that your technician considers advisable.

6.2 Before placing your transformer into operation with a load, you should first connect it without a load, to ensure that it is energized in a normal manner. Towards this effect, you must proceed according to the following indications:

- **a.** The verification should be with the low voltage terminals totally free (without connecting the cables). If your transformer has a low voltage switch make sure it is in the **"C"** position (see the operation of the switch in *point 6.2 of section II*).
- **b.** When raising the taps, it must be done rapidly, to avoid arcing or overvoltage that could cause damage to the transformer.
- **c.** Once the transformer has been energized you should not hear a strident sound, abnormal buzzing or vibration. If you do, disconnect the feed to your transformer immediately and examine the ground system again, as well as the connections and protections. Also, go over the recommendations once more. Verify that the transformer is level and that the oil level is not low. If the protections are operating properly, proceed in conformance with the recommendations indicated here.
- **d.** Once you have energized your transformer check the voltage of the secondary winding (phase-phase and phase-neutral). If the voltage measured differs by more than ± 2.5% from the nominal or expected voltage, ensure that the tap changer is in the correct position. If its position needs to be changed, disconnect the transformer and do the calculation to determine the correct position or "tap" to be used in order to obtain the voltage that is closest to the nominal or desired voltage.

> NOTE: **I.G. transformers** are shipped with the internal connections established in the Mexican standard NMX-J-285-ANCE or with the connections specified by the client, which will be indicated on the data tag. If you wish to change the connection of your transformer, ask the manufacturer to do it and avoid having it done by unqualified persons or unauthorized shops, since this carries the risk of an unsafe condition and the invalidation of the warranty.

6.3 Try to balance the load as closely as possible in each phase. Avoid overloading any of the phases more than another.

6 Operation

6.4 Always operate your transformer under normal conditions and with the adequate protections. Do not overload it, because if you do this frequently and/or for prolonged periods the overheating will cause a diminution of its insulation properties (accelerated aging), which can cause a failure. Also, verify that the tap changer is in the position corresponding to the nominal voltage of the secondary winding or the closest one to it.

6.5 To prolong the useful life of your transformer, make sure that its installation and its protections are appropriate. After you place it into service keep it always under normal operating conditions without exceeding its capacity or operating it without the adequate protections.

6.6 Do not forget that your transformer must undergo an efficient preventive maintenance, together with its protections and its installation site in order to detect or avoid failures and damage.

7 Maintenance

In the maintenance tables *1, 2 and 3 of point 10* of this instruction manual, inspections, tests and specifications for the general preventive maintenance that must be provided , as a minimum, to the **I.G. Transformer**. Additionally, however, it is recommended that the verifications and necessary actions indicated by your maintenance expert be carried out, including the transformer's protections and its installation site, as well as those indicated below. Make sure your transformer is disconnected before realizing any maintenance task.

Periodic verification:

7.1 Low Voltage Bushings
Check them for deformities, breakage or cracks. If you find these defects, replace them. In the case of oil leaks, tighten the fastening bolts lightly, taking care not to break the bushing.

7.2 Middle Voltage Bushings
Check them for oil leaks. If you find leaks, tighten the fastening bolts lightly. Verify that there are no indications of leaking current, such as carbon encrustations or trails. If any are found, replace the bushing. This operation should be carried out by an authorized shop.

7.3 Tap Changer
Check the joints to ensure there are no oil leaks. If there are, tighten the changer bolt lightly. If the leak persists, change the gasket, for which you will have to remove the principal cover or inspection hole cover and lower the oil level to gain access to the changer. Do this in a closed place, clean and free of moisture. After the repair, replace the oil to the "oil level" mark.

7 Maintenance

7.4 If you realize any repairs on your transformer, you should request that the dielectric voltage rupture and oil power factor tests be carried out, as well as the measurement of the insulation resistance and the airtightness test. This is for the purpose of verifying that your transformer and the oil are in good condition, free of humidity and tightly sealed. The results of these tests must be in accordance with *Table 3* of this manual. If these values are not met, take your transformer out of service and subject the windings to a drying treatment and a change of oil. The short circuit method or oven-drying treatment is recommended.

> **NOTE:** If your transformer is still under warranty, request its repair by a shop authorized by C.M.A.E.

7.5 Anticorrosive Coating

The tank and cabinet of the pad mounted-type transformers distributed by **I.G.** are protected by a high quality coating, to provide the best protection against the most aggressive environments. However, if damage occurs in which the metal is exposed, the coating must be repaired in order to inhibit the corrosion process.

To repair the coating, prepare the surface to be repaired in an adequate manner and apply a coat of a zinc epoxy-polyamide (CFE-P9) organic primer of 50 to 75 µm (2 to 3 mils) in thickness (when dry). After it is dry, apply a coat of high solids vinyl finish (CFE-A5) with a thickness of 75 to 100 µm (3 to 4 mils).The color in which the pad mounted-type transformers are normally supplied is dark green 12, in accordance with the CFE L0000-15 specification.

Before repairing the coating, examine the welds and the accessories carefully. In the event of oil leaks in welds, they can be repaired by welding them with zinc, annealed wire or tin, applied with a torch. The use of electric welding is recommended only if the point to be welded is located below the oil level

8 General Recommendations

a. Do not energize the transformer if the oil level is below the respective mark indicated in the inside of the tank.

For single phase transformers of up to 167 kVA, remove the cap found in these transformers and verify that the oil drips. If it does not, fill the oil to the “oil level” mark.

For three phase transformers of 225 kVA and greater, check the oil level in the dial-type indicator.

8 General Recommendations

NOTE: The above must be done with the transformer installed on a level floor.

b. Do not open the inspection hole (if the transformer has one) or the transformer's principal cover in a humid environment. When closing them, take special care in placing the gaskets in their correct position and ensure that they are air tight. Removing these covers shall be at the risk and responsibility of the person who does it, unless it has been expressly authorized by I.G.

c. Do not go near the disconnected transformer (on the line) without first ensuring that the tank, cabinet and low voltage are grounded and you are sure that it is disconnected. Connect the primary side to the ground before carrying out any operation.

d. Never operate the tap changer with the transformer energized. Once it is in the corresponding operation tap, ensure that it will stay correctly in its position and place the safety block or lock, to prevent its accidental operation.

e. Do not operate the transformer if it shows signs of internal failure, such as a bulging tank, oil leaks through the cover or bushings, a leak in the overpressure valve, damaged expulsion fuses, etc.

f. Whenever you find a damaged bushing, replace it immediately.

g. All repairs of the I.G. transformers that are under warranty must be carried out under C.M.A.E., and by authorized shops.

h. All claims must be made directly to your distributor. **Any repair that has not been authorized by C.M.A.E. will invalidate the warranty.**

9 Expected useful life and the warranty

The **I.G. transformers** are designed and manufactured to reach an expected useful life of at least 20 years, under the conditions and provisions established herein.

When you acquire your **I.G. transformer** make sure you receive the warranty policy, in which the terms and conditions under which you can claim your warranty are established. In order to claim your warranty the terms and conditions established in the policy and in these instructions must be observed and followed. Additionally, in accordance with the stipulations established in the **NOM-002-SEDE/ENER-2014** standard, the following shall be cause for the invalidation of the warranty:

a. When the transformer has been installed by unqualified personnel.
b. When there is no evidence of the satisfactory results of the tests realized before the energization of the transformer (see the list in *Section III*).
c. For adverse environmental or meteorological conditions.
d. When the transformer has not been protected against overloads or overvoltage.

10 Figures

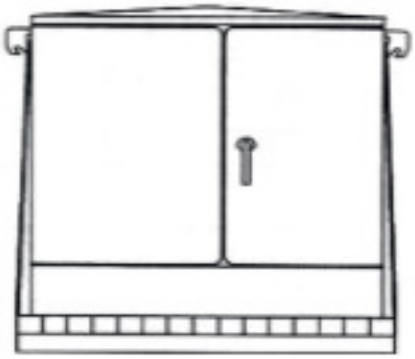

Figure No. 1

Figure No. 2

NO

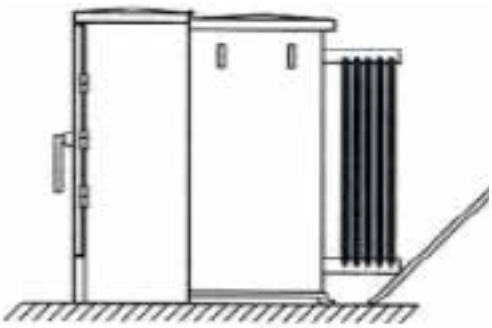

Figure No. 3

10 Figures

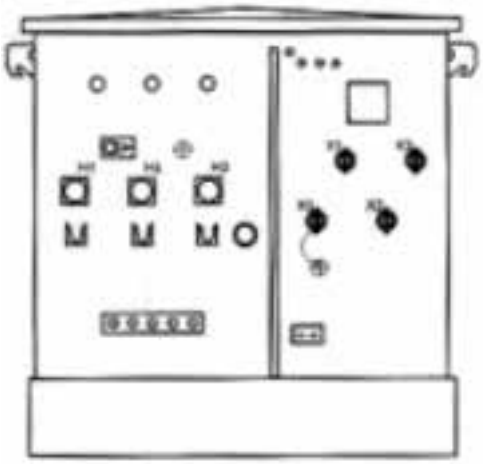

Figure No. 4
Radial Operation Transformer

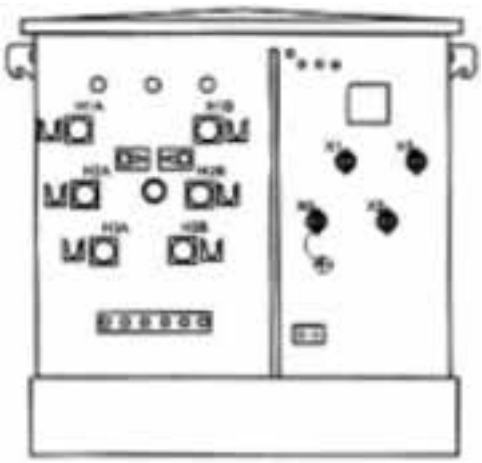

Figure No. 5
Ring Operation Transformer

Figure No. 6
Positions of the Radial Disconnector

Figure No. 7
Positions of the Ring Disconnector
(two positions each)

11 Maintenance Tables

Table 1 Critical Maintenance	
Inspection points	**Frequency**
1. Middle and low voltage bushings	Every 2 years
2. Accessories in general	Every 2 years
3. Airtightness	Every 2 years
4. Tank (coating)	Every 2 years
5. Ground connections	Every 2 years

Table 2 Maintenance Tests	
Test	**Frequency**
1. Isolating oil: **a.** a. Dielectric tension **b.** b. Power factor at 25°C **c.** c. ASTM D-1500 color	Every 2 or 3 years
2. Insulation resistance @ 20°C	Every 2 or 3 years
3. Ohm resistance of the windings @ 75 or 85°C	Every 2 or 3 years
4. Power factor of the windings @ 20°C	Every 2 or 3 years

Table 3 Acceptance Limits of the Insulation Oil			
Test (*)	**Satisfactory**	**Filter**	**Change**
1. Dielectric Tension	Flat electrodes: 30 kV minimum	25 to 29 kV	Less than 25 kV
	Semi-spherical: 28 kV minimum	22 to 27 kV	Less than 22 kV
2. Power Factor @ 25°C	0.05% Maximum	0.05 to 0.06%	More than 0.06%
3. Neutralization Number	0.3 Maximum	0.4 to 0.9	More than 0.9
4. Color	0.5 M	More than 1	

Acceptance Limits of the Windings		
Test	**Satisfactory**	**Investigate**
1. Insulation Resistance @ 60 s	More than 1000 MΩ per kV	Less than 1000 MΩ per kV
2. Absorption Index	1 to 1.2%	Less than 1%
3. Power Factor @ 20°C	1.5% Maximum	More than 1.5%

(*) Testing method in conformance with Mexican standard NMX-J-123-ANCE

II Instructions for the principal accessories and devices

1 Definitions

a. **Pad mounted-Type Transformer:** A transformer with an integrated cabinet holding accessories that will be connected to underground distribution systems, with its live parts of the dead front type at middle voltage, and designed for mounting on a pad mounted and for outdoor service.

b. **Transformer for Radial Operation Systems:** A transformer equipped with a middle voltage terminal per phase.

c. **Transformer for Ring Operation Systems:** A transformer equipped with two middle voltage terminals per phase.

2 Introduction

A pad mounted-type transformer is equipped with protection accessories and devices such as an expulsion fuse, a current limiting fuse, and, as may be requested by the customer or final user, a thermal or thermal-magnetic switch for the low voltage and failure indicator.

Additionally, in the case of three phase pad mounted-type transformers, they are supplied with a middle voltage disconnector, which is a mechanical device operated manually, capable of interrupting or reestablishing the feed to a transformer from one line or another (**A** or **B**).

The following points contain a description of the functions, instructions, precautions and recommendations of the principal accessories and devices integrated into the pad mounted-type transformers distributed for underground service.

3 Disconnection Switches

In the three phase transformers these devices are submerged in oil and they are found in the middle voltage section. In single phase transformers the disconnection must be carried out by means of separate isolated switches of the elbow type, operated with electricity.

In the three phase transformers the disconnection switches are of electrical operation. Depending on their function, they are of two types:

a. **Radial switch:** This switch has two positions (**open-closed**) and it can be used only to turn the transformer on or off (see *figure 6*).

b. **Ring operation disconnection switch:** This switch can have four positions or it can be composed of 2 switches with 2 positions each and independent levers (see *figure 7*).

   This switch is utilized to interrupt or continue the feed line to which 2 or more transformers are connected (ring). It can also disconnect each transformer of the ring in the case of failures in the transformer or in the feed cables, or for maintenance or replacement.

Following below are the instructions for the operation of the switches.

3 Disconnection Switches

3.1 Ring operation Transformers: The disconnection switches of these units have a metal tag indicating the "**open-closed**" position in line "**A**" and in line "**B**", as well as the turning direction of the operating knobs.

The ring operation transformers have 2 bushings for each middle voltage phase (see *figure 5*). For example, the three phase transformers have 3 bushings in line "**A**", identified as H1A, H2A and H3A, and 3 bushings in line "**B**", identified as H1B, H2B and H3B. Therefore, the switch can have the following positions:

Position 1.- Line **A** and line **B** in the "**closed**" position. This position allows the ring feeding of current to adjacent transformers.

Position 2.- Line **A** in the "**closed**" position and line **B** in the "**open**" position. In this position only line **A** of the ring is connected to the transformer's windings.

Position 3.- Line **A** in the "**open**" position and line **B** in the "**closed**" position. In this position only line **B** of the ring is connected to the transformer's windings.

Position 4.- Line **A** and line **B** in the "**open**" position. In this position both sides of the ring (line **A** and line **B**) are disconnected, and therefore the transformer's windings are isolated and disconnected from the current.

As was mentioned above, the switching can also be made with 2 switches of 2 positions each, and their operation is similar to the above, but differing in the direction of their turn.

The 4 positions switch turns only clockwise, while the 2 position switches can be turned in both directions.

3.2 Radial Operation Transformers: In these transformers a single switch of 2 positions, "**open-closed**", is used to turn the transformer on and off, respectively.

WARNING: These devices are designed to interrupt load currents only. They are not appropriate for interrupting failure currents. Do not exceed the voltage and current limits specified in the data tag.

4 Fuses

The pad mounted-type single phase and three phase transformers of up to 150 kVA for underground use, are equipped with an expulsion fuse and a current limiting fuse of partial coverage in each phase, connected in series and duly coordinated with each other in such a manner that the current limiting fuse will only function if there is an internal failure in its transformer or high current in the primary winding. Three phase transformers of from 225 to 750 kVA are supplied with only a current limiting fuse of complete coverage per phase, when requested by the customer or final user, removable from the outside. In this case, the expulsion fuse is not required.

4.1 Expulsion fuse: This element functions in the event of an internal low current failure, and/or a complete failure in the low voltage network.

If your transformer is not provided with an interrupter in the secondary winding, it will have an integrated internally operating double element fuse of the bayonet type. If your transformer is provided with an interrupter in the secondary winding, then it has an integrated single element fuse.

If the expulsion fuse is activated, take the following steps for its replacement (see *figure 8*).

a. De-energize the transformer, opening the cabinet doors and flip the switches to the "**open**" position with a lever.

b. Release the transformer's internal pressure by pulling the ring on the overpressure valve that is located in the low voltage section.

c. Free the bayonet ring by using the shotgun-type lever

d. Release the bayonet safety by pushing the ring bolt downward and turning it 90° clockwise.

e. Withdraw the bayonet fitting a little (about 10 or 15 cm), allowing sufficient time for the oil to flow downward and preventing it from dripping over the rest of the accessories.

f. Withdraw the bayonet fitting slowly, to avoid extracting more oil from the transformer. Hold the lower end of the bayonet fitting with a rag to prevent the residual oil from dripping over the other accessories.

g. Extract the damaged fuse, unscrewing the ends of the fuse holder. If the Teflon tube is not burned, you will have to straighten the tabs at the end of the fuse in order to extract it.

h. Inspect the fuse cartridge to ensure that it is clean.

i. Insert the new fuse inside the fuse holder. Screw the fuse holder or cartridge onto the bayonet fitting so that the tabs on the fuse will be at the end of the bayonet fitting.

j. Insert the bayonet fitting with the new fuse into its place and turn the ring bolt 90° in a counterclockwise direction by means of the lever with which the safety is activated.

4 Fuses

4.1

WARNING: Determine the cause of the activation and damage of the fuse that was replaced. Once the expulsion fuse has been replaced carry out tests to ensure that the transformer was not damaged, since the operation of the fuse indicates the existence of a possible failure.

4.2 **Current limiting fuse:** This is a fuse with a high interruption capacity, and it can be of partial or complete coverage, depending on its specification. It is activated in the event of an internal failure of the transformer or in the high currents in the primary winding to protect the distribution or feed system.

This fuse limits the time of interruption under nominal voltage conditions to an interval of time equal to or less than the duration of the first middle cycle of the failure current, limiting the peak leakage current to a value less than the peak current that would circulate if it were a solid conductor of the same impedance.

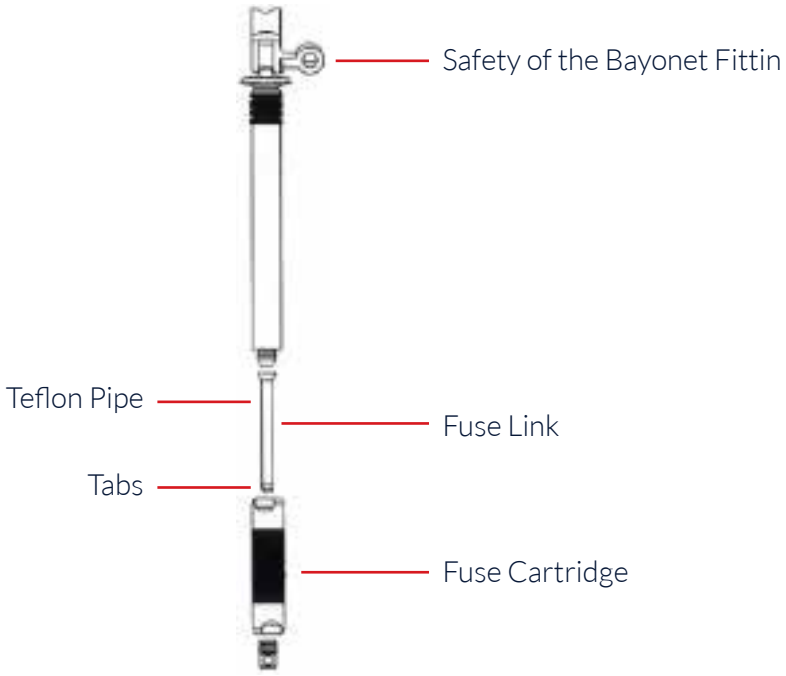

Figure No. 8

4 Fuses

4.2 The partial coverage fuse is located in the interior of the transformer and it can be replaced through the hand hole or through the principal cover. The complete coverage fuse, on the other hand, can be of the bayonet type, in which case it can be removed from the outside of the transformer. In this case, it has a mechanism to prevent the fuse from being removed until transformer's radial disconnector is opened. To remove it, proceed as follows:

a. Place the radial switch in the "**open**" position, to thereby disconnect the transformer and unblock the current limiting fuse holder.

b. Activate the relief valve in order to release the tank's internal pressure.

c. Hook the fuse holder ring bolt with a shotgun stick.

d. Pull it swiftly to completely extract the fuse.

e. Replace the fuse.

f. Insert the fuse by pushing it in firmly. Ensure that it is in the correct position.

WARNING: Determine the cause for the activation of the fuse and carry out the necessary tests to verify that the transformer was not damaged.

5 Failure indicator

This accessory is supplied at the customer's or final user's request. Its dial or indicator, for each phase, is located on the front in the upper left corner on the cabinet door, and the status of the indicator is therefore visible without having to open the cabinet door.

6 Secondary Winding Interrupter

This device is utilized to protect your transformer against overloads and instantaneous tripping and for external short circuit protection. It can be thermal or thermo-magnetic, submerged in the isolating liquid, and it is connected internally through the transformer's secondary or low voltage winding.

It functions by means of temperature-sensitive bimetallic sheets, which upon becoming heated from the combined effect of the current and the temperature of the oil will flex in a manner proportional to the temperature. This flexion activates a lever and a luminous signal is turned on, releasing the energy stored in the springs of the mechanism, tripping the shot.

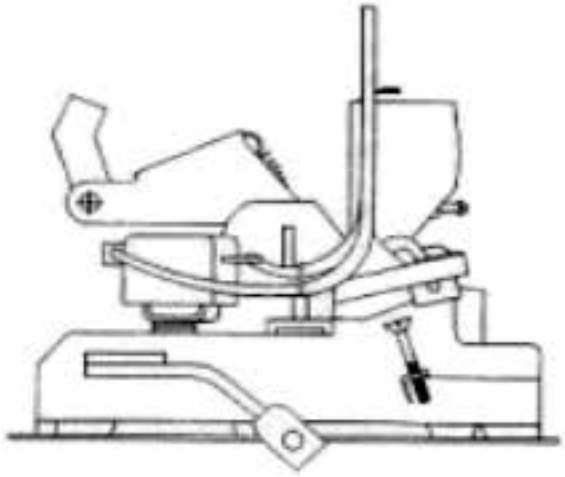

Figure No. 9

Each interrupter includes the following elements:

6.1 Signal lamp (red light): It is located over the lever that operates the interrupter and it operates with the load at the same precision as the interrupter when the temperature of the oil increases from the excessive demand of the load or from unbalanced loads that exceed the thermal capacity of the interrupter.

The lamp's light goes on, indicating that the transformer is overloaded and very close to tripping. The lamp stays on after the opening as long as the interrupter is not restored.

The signal lamp's connection diagram and the diagram of the interrupter are shown in *figure 10*.

6 Interrupter of the Secondary Winding

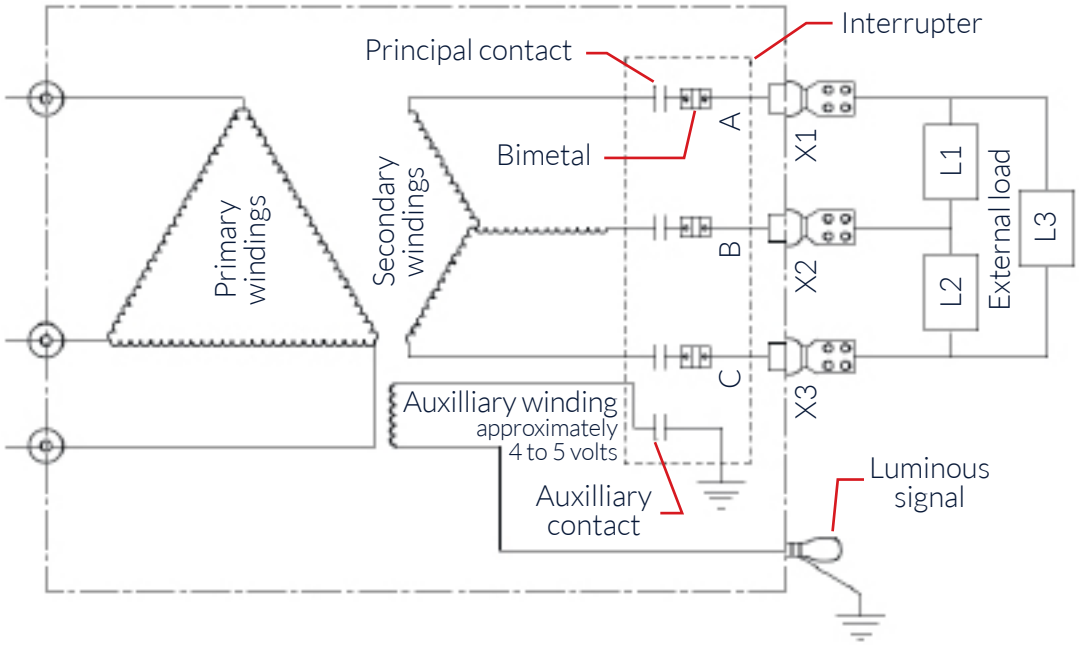

Figure No. 10

6.2 **Emergency overload device:** This device allows the transformer to be operated under loads that are beyond its nominal capacity without tripping the interrupter (see figure 11). This element consists of a lever that allows the operation of the transformer with overloads of approximately 10% above its capacity. The service can be restored even if the bimetals are at their tripping temperature.

The permanent use of this device shall be at the user's cost and risk, since the operation of the transformer under these service conditions degrades the insulation more rapidly, with the consequent reduction in the useful life of the transformer.

6.3 **Operating lever (see *figure 11*):** This device is located in the low voltage section and is used to manually "open" and "close" the interrupter. It can be operated even when the transformer is under a load.

Following below are the instructions for each of the functions of this lever or handle:

a. **To test the functionality of the signal light:** This test is carried out with the transformer energized. Turn the operating handle – by means of a pole – until the arrow or mark is in the "**L**" position. The lamp should then go on. After this operation return the lever to the "**C**" position, and the light should go out.

To operate or trip the interrupter automatically: In this case first take the lever or handle to the "**R**" (Restore) position and then return it to the "**C**" position. Do not attempt to take the lever directly to the "**C**" **position without having first restored, since this could damage or misadjust the interrupter's mechanism.**

6 Secondary winding Interrupter

6.3 b. Manual opening: Just move the lever from the "**C**" position to the "**O**" position, and if you wish to close the circuit you can return the lever directly to the "**C**" position. It is not necessary to Restore in this case. The Restore is only necessary when the interrupter is activated or tripped automatically.

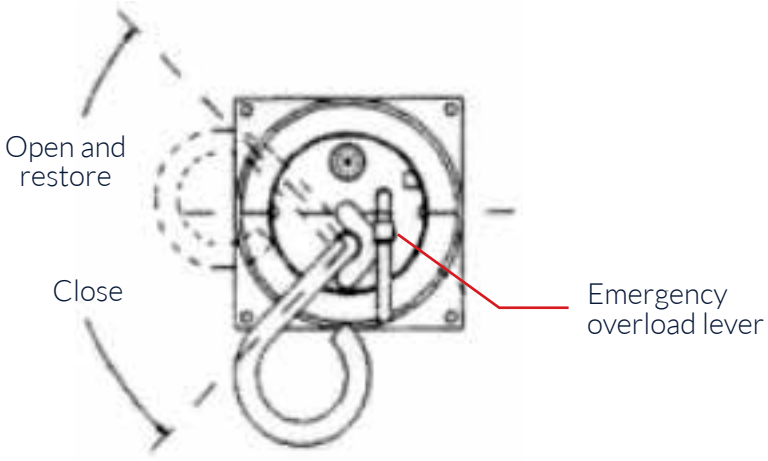

Figure No. 11

6.3 c. When there are overloads move the emergency overloads lever upwards. Return it to its original position as soon as the transformer once more has it nominal load.

7 Tap Changer

This device allows you to select the most appropriate tap from the primary winding in order to obtain the secondary voltage desired. The transformers are normally supplied with 2 taps above and 2 taps below the nominal voltage, with a difference in voltage between adjacent taps of 2.5% of the nominal voltage. The changer has a knob for its external operation, but only when the transformer is disconnected. If you wish to change its position make sure that the transformer is disconnected.

8 Overpressure Relief Valve

This is a mechanical operation device that allows the manual release of the tank's internal pressure by means of a spring and a gasket, by pulling the ring bolt of the valve from the outside, or automatically when the pressure rises gradually to a pressure between 0.5 and 0.7 kg/cm^2.
It is not a protective device against a sudden rise in pressure.

WARNING: Before effecting any operation, activate the valve manually to release the internal pressure. After activating the valve, make sure it returns to its position and is tightly sealed, to prevent the penetration of moisture.

III Verification Lists

List for verification during the reception
Location:
Date:
Transformer description:
Transformer type:
Series number:

No.	Element for Revision	Good / Yes	Bad / No
1	Stencil of capacity (kVA)		
2	Data Plate		
3	Identification of nozzles (M. T. and B. T.)		
4	Eye connectors and bolts (M. T. and B. T.)		
5	Broken or cracked nozzles (M. T. and B. T.)		
6	Nozzle leaks (M.T. and B. T.)		
7	Taps changer lever		
8	Lever for the operation of the low voltage interrupter		
9	Operation of disconnection switches		
10	Expulsion fuses		
11	Thermometer		
12	Oil level indicator		
13	Bar and/or ground connections		
14	Lock and lock holder		
15	Overpressure relief valve		
16	Drainage-sampling valve		
17	Leaks in the principal cover or hand hole cover		
18	Leaks in welded joints or gaskets		
19	Radiators in good condition		
20	Coating in good condition		

OBSERVATIONS: _____

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_____

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INSPECTED BY: _____

Checklist to be verified before installation or startup into service	
Location:	Date:
Assigned installer:	

No.	Inspection Realized				
1	Description of Transformer:				
	Type of Transformer:				
	Series No.:				
	Middle and low voltage connection:				
2	Transformation ratio:	**Pos.**	**Phase A**	**Phase B**	**Phase C**
		1			
		2			
		3			
		4			
		5			
3	Insulation Resistance (mega ohms):		**Temperature: °C**		
			H-XT	X-HT	H-X
4	Ground Resistance(ohms):		**Temperature: °C**		
			1	2	3
5	Ohm Resistance – Middle Voltage(1) (ohms):		**Temperature: °C**		
			H1-H2	H1-H3	H2-H3
6	Ohm Resistance – Low Voltage(1) (ohms):		**Temperature: °C**		
			X1-X2	X1-X3	X2-X3
7	Other (specify):				

OBSERVATIONS: _____

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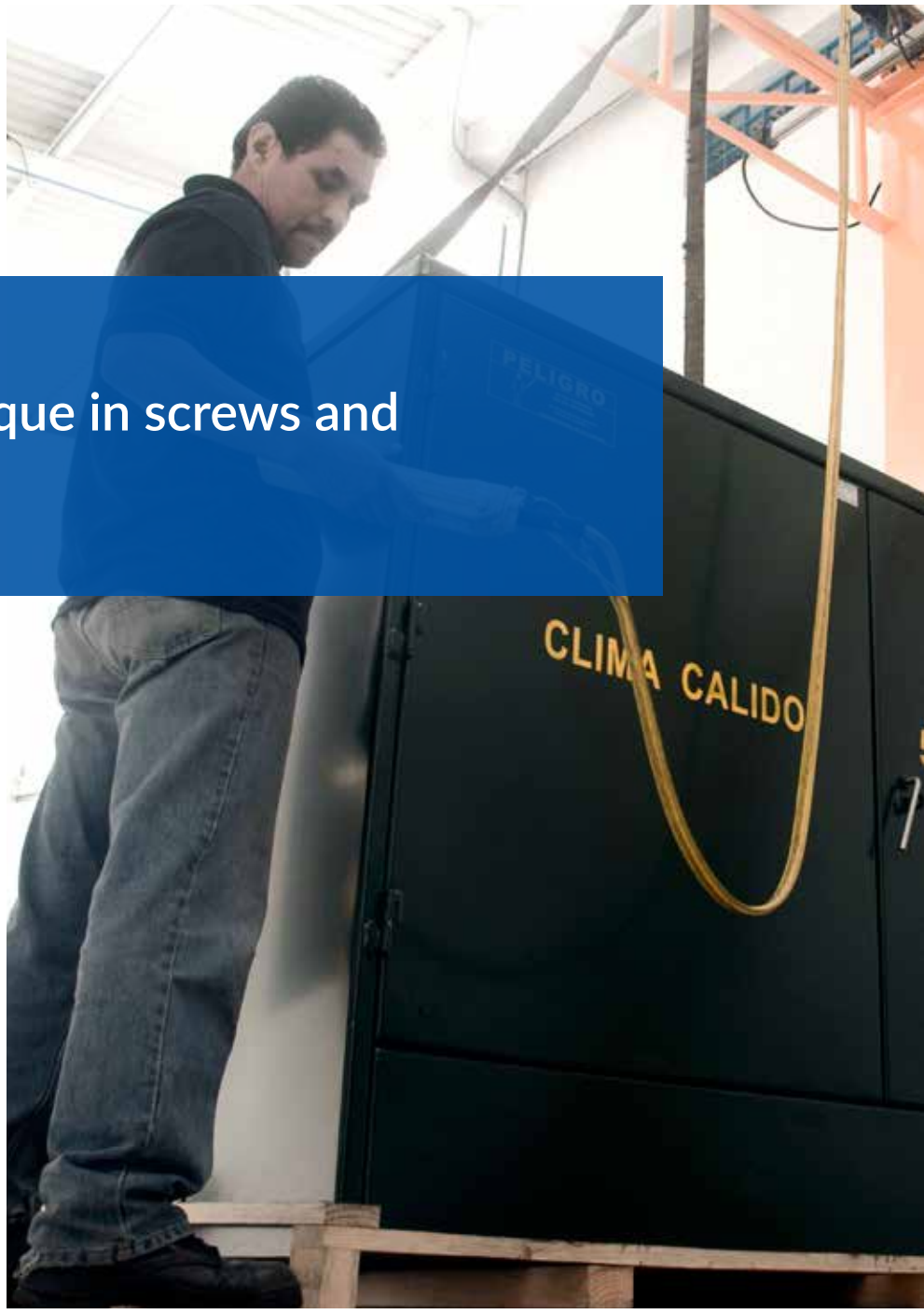
_____

_____

(1) For future reference.

IV Tightening torque in screws and accessories



Tightening torque in screws and accessories				
Description		Minimum torque	Maximum torque	Die for its measurement
M10 screws utilized in the vices to hold the middle voltage bushings		10,17 N·m	11,30 N·m	17 mm
M10 screws utilized in the principal cover		13,56 N·m	15,82 N·m	17 mm
M10 Lug nuts utilized to externally hold the low voltage bushings		9 N·m	11,3 N·m	17 mm
M10 lug nuts utilized for the covers of inspection holes		7,9 N·m	10,17 N·m	17 mm
Nuts for M10 rods utilized in fittings of low voltage bushings		14,7 N·m	16,95 N·m	17 mm
Nuts for M12 rods used in bushing fittings		22,6 N·m	26 N·m	19 mm
Nuts for M20 and greater rods uses in low voltage bushing fittings		16,95 N·m	20,34 N·m	30 mm
Torque nut used in external operation changers	Orto	10,1 N·m	12,4 N·m	NA
	Abb	11,3 N·m	13,5 N·m	NA
	Cooper	9 N·m	13,5 N·m	NA
	Moloney	6,7 N·m	6,7 N·m	NA
	Termomanufacturing	10,8 N·m	10,8 N·m	NA
Torque nut used in the signal pilot light		5,65 N·m	9 N·m	NA
Torque nut used in the operation lever of the low voltage interrupter		16,95 N·m	20,34 N·m	NA
Nut for the bayonet- type expulsion fuse holder		11,3 N·m	13,6 N·m	NA

V Customer Support

Customer Support

The following information is provided so that you can contact us in case of any doubt or for any care or service that you may require:

General Offices:

Isabel La Católica No. 626, Sector Independencia,
36559 Irapuato, Gto.

Telephones: (01 462) 626 62 62; 626 21 91 y 626 21 94 ó
LADA free call: 01 800 714 16 62

Webpage: **www.ig.com.mx**
e-mail: **cmaesa@ig.com.mx**

Likewise, we are at your disposal through our branches or our distributors that are indicated in our web page.

Thank you for your preference