



Installation manual

Low-voltage transformers

Pólux[®]



Congratulations!

You have purchased a low-voltage dry-type transformer developed and manufactured by Pólux Indústria Eletromecânica LTDA.

To ensure optimal performance and equipment lifespan, carefully read the instructions in this manual. Following the guidelines presented here contributes to the safe operation of the transformer and helps prevent wear or damage resulting from improper installation, operation, or maintenance.

It is also recommended to consult the standards and requirements for electrical installations established by local utility companies.

This manual aims to provide all the necessary information for the installation, operation, preservation, and maintenance of Pólux low-voltage dry-type transformers. Each piece of equipment is designed and manufactured to meet the specific application needs of our customers, guaranteeing quality, safety, and reliability. If you have any questions or require technical support, please contact our team. We will be happy to assist you!



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1. Introduction

This manual aims to provide necessary instructions for users handling, transporting, storing, installing, and maintaining Pólux dry-type transformers. Following these instructions will ensure optimal transformer performance and guarantee the electrical characteristics for which it was designed and specified by the customer. The manual covers both single-phase and three-phase transformers installed with and without enclosures.

These instructions establish the limiting factors for optimal transformer performance. The information contained herein describes the inspection, proper installation, and maintenance of dry-type transformers. Pólux transformers are designed and manufactured in strict accordance with the mandatory standards in effect at the time of their construction.

For further clarification, we recommend reading the following regulations:

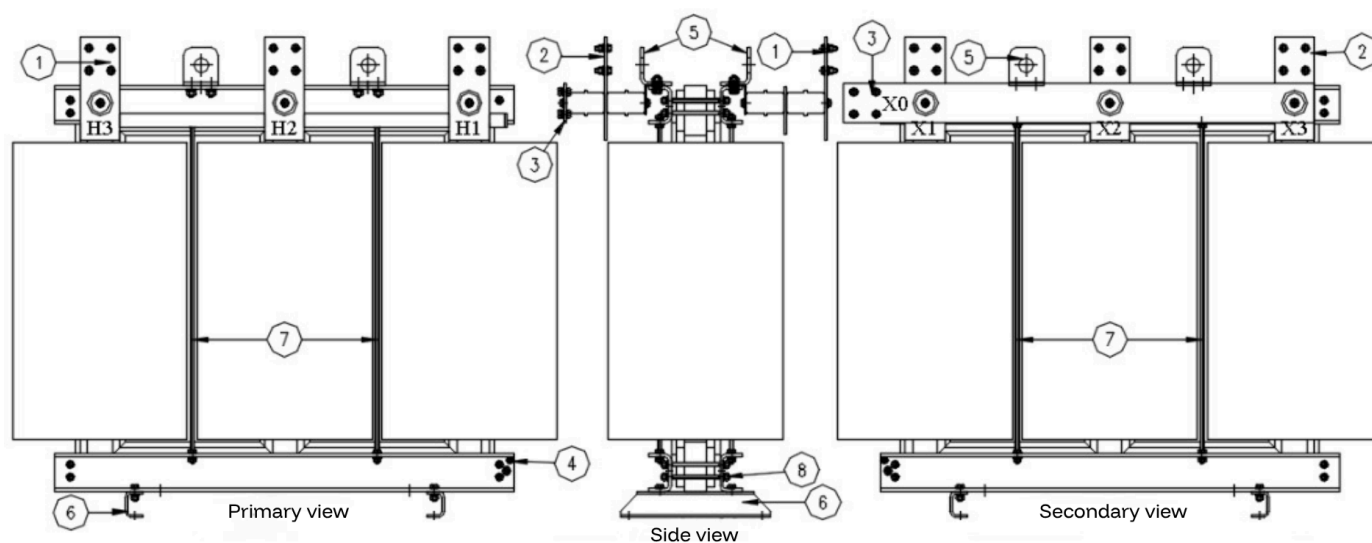
- NBR 5416: Application of Loads in Power Transformers;
- NBR 13297: Receiving, installing and maintaining dry-type power transformers;
- NBR 5356: Power Transformers – Dry-type Transformers – Specification.

To ensure the correct installation and operation of the transformer, it is essential that the procedures described in this manual and in the aforementioned standards be carried out by a qualified professional with knowledge of the applicable technical and safety standards, ensuring a proper and safe installation.

1.1 Identification of the main components of the transformer

To facilitate and guide the installation, the description of the main components of the Pólux three-phase and single-phase transformers is shown in figures 1, 2 and 3 below.

Figure 1 – General identification of a three-phase transformer.



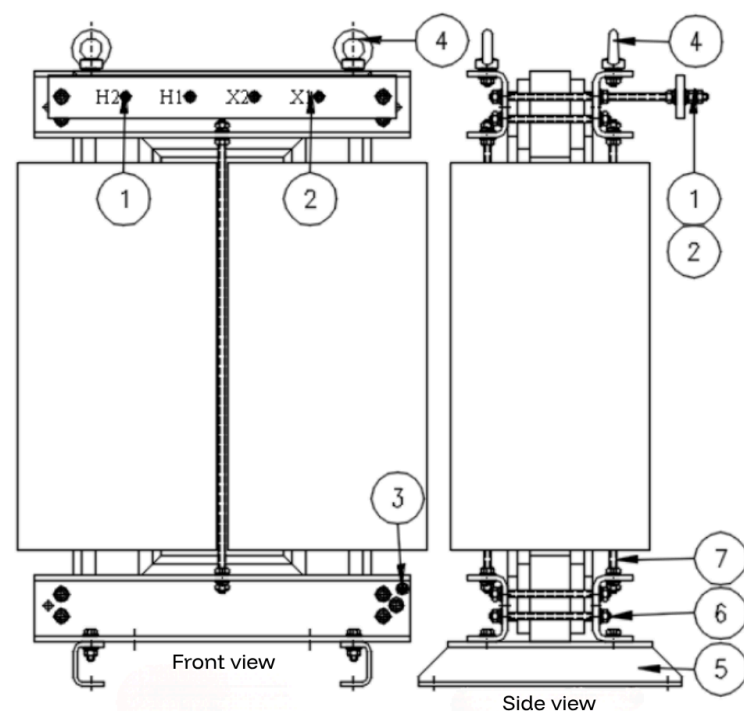
Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Primary terminals (H3-H2-H1): Retighten all electrical connections;
2. Secondary terminals (X3-X2-X1): Retighten all electrical connections;
3. Neutral Terminal (X0): Retighten all electrical connections;
4. Ground screw;
5. Eyelets for transformer suspension: Use all eyelets when moving the transformer;
6. Transformer support base: Used to secure the transformer in the installation. It can be supplied with casters or a drag base, when requested in the specification or during the document approval process by the client;

7. Vertical fastening straps: Before operating, retighten all mechanical connections;
8. Horizontal fastening straps: Before operating, retighten all mechanical connections.

Figure 2 – General identification of a single-phase transformer.



Source: Pólux Indústria Eletromecânica Ltda

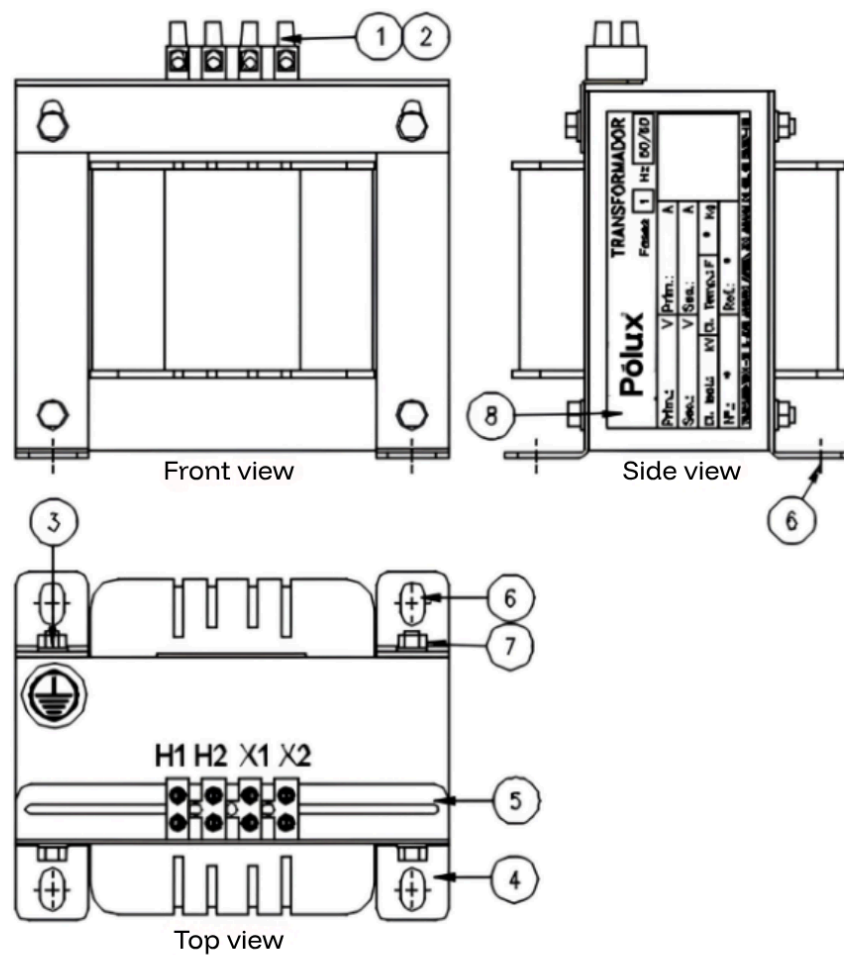
Legenda:

1. Primary terminals (H2-H1): Retighten all electrical connections;
2. Secondary terminals (X2-X1): Retighten all electrical connections;
3. Ground screw;
4. Eyelets for transformer suspension: Use all eyelets when moving the transformer;
5. Transformer support base: Used to secure the transformer in the installation. It can be supplied with casters or a drag base, when

requested in the specification or during the document approval process by the customer;

6. Horizontal fastening straps: Before operating, retighten all mechanical connections;
7. Vertical fastening straps: Before operating, retighten all mechanical connections.

8. Figure 3 – General identification of a control transformer.



Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Primary terminals (H2-H1): Retighten all electrical connections;
2. Secondary terminals (X2-X1): Retighten all electrical connections;
3. Grounding tab for grounding the installation;
4. Tabs for securing the core and fixing the transformer in its application (installation);
5. Support for securing the electrical connection: Primary and secondary connections can be provided on opposite sides;
6. Transformer mount: Used to secure the transformer in the installation;
7. Horizontal fastening screws: Before operating, retighten all mechanical connections;
8. Nameplate: Verify all information before powering on.

2. Receipt

Upon receiving the transformers, a visual inspection must be carried out to identify any damage that may have occurred during transport. If any problem or damage is identified, the transport company and Pólux must be notified immediately before authorizing the unloading of the material. The packaging is provided in a manner suitable for transport to prevent any accidents with the product.

To allow for the lifting and moving of products weighing more than a human can support, these devices can be equipped with lifting lugs. To avoid excessive stress on any of the devices, it is recommended that all available lifting lugs on the transformer be used during lifting. Casters can also be provided to facilitate movement. Transformers should never be moved by their live parts or connection terminals, as excessive stress in incorrect locations can cause irreversible damage to the equipment.

The product should only be lifted by a forklift using the pallet at the bottom of the enclosure (when applicable) or by a crane using the internal lifting eyes fixed to the upper structure of the core and coil assembly, ensuring even load distribution. Transformers are heavy and have a relatively high center of gravity, therefore careful handling and slow movement are necessary to avoid falls.

2.1. Unloading and handling

Handling transformers requires specific procedures to ensure the safety and integrity of the equipment; therefore, all unloading, lifting, and moving operations must be performed by qualified and experienced personnel. Furthermore, the transformer must be protected from moisture and impacts during all stages of handling.

Lifting must be carried out exclusively from the anchor points indicated in the technical drawing, using appropriate lifting equipment, such as load slings, with sufficient load capacity and in perfect condition.

When moving a transformer by dragging it, it must be done using appropriate support devices, such as wheels or drag bases, ensuring the equipment's stability and preventing the risk of tipping. Moving the transformer with a forklift is only permitted when the transformer has a pallet compatible with the operation. During forklift handling, the transformer must not be exposed to an angle of inclination greater than 10°, due to the risk of tipping, and a forklift compatible with the transformer's weight and dimensions must be used. Attention must be paid to the transformer's positioning in relation to the forklift to avoid damaging the product.

Important: When lifting transformers equipped with protective enclosures, the following precautions must be taken:

1. The cover on the roof of the enclosure must be removed, and the transformer must always be lifted by the eyelets on the upper beams of the transformer (inside the protective enclosure). If necessary, the entire roof of the enclosure may be removed.
2. Prevent fasteners, tools, particles, or debris from falling onto the live part of the transformer, as this could cause irreversible damage.
3. The process of removing the covers to access the lifting lugs and then replacing them must be done carefully to avoid damage to the enclosure sheets.

Figure 4 - Demonstration of transformer lifting operations.



Source: Pólux Indústria Eletromecânica Ltda

Note: The protective enclosure is of utmost importance for the operation of the transformer; therefore, after moving the item to its final location, the top cover must be replaced.

In some cases, the protective box will have eyelets on the front and back. These eyelets are for exclusive use during the transport of the item, as they are used to increase the stability of the transformer during transit. These eyelets must never be used to lift the item, as this poses a risk of tipping and damage. Figure 5 highlights these eyelets.

If the transformer is damaged during lifting by the transport eyelets, Pólux will not provide a warranty, as this confirms misuse of the equipment.

Figure 5 - Detail of the eyelets used only for transport.



Source: Pólux Indústria Eletromecânica Ltda

2.2. Place of receipt

It is advisable to unload the transformer at its final installation location to avoid impacts or even displacement of the live parts, which could cause highly critical accidents.

2.3. Receiving inspection

Upon receipt, it is important to verify that the physical product matches the product invoiced on the sales invoice. A visual inspection should also be carried out to check the external condition of the transformer, its accessories, and any possible damage caused during transport. The inspection should be done before removing it from the truck, and if there is any obvious damage or any indication of rough handling, a complaint should be filed immediately with the carrier and the manufacturer should be notified.

Subsequently, the covers or panels must be removed and an internal inspection must be carried out for damage or displacement of parts, loose or broken connections, dirt or foreign material, and the presence of water or moisture (for supplies with enclosures). In the case of IP00, cover removal is not necessary. Check the information on the nameplate installed on the equipment; this must correspond to the specifications to ensure the transformer installation.

If the transformer has been stored prior to installation, this inspection must be repeated before putting it into service.

2.4. Storage

If storage is necessary, the transformer must be placed in a clean, dry room where a uniform temperature is maintained. Air circulation through the transformer enclosure must be allowed. The relative humidity to which the insulating materials will be exposed must be kept as low as possible, and the

floor where the transformer will be stored must not allow moisture to enter from the air. Precautions must be taken to protect against water ingress from any source, such as roofs, leaks, water or steam lines, windows, etc.

In cases where the relative humidity during storage is high or unknown, electric resistance heaters should be used inside the enclosure.



During storage, the packaging supplied with the transformer should not be removed.

3. Installation and assembly

3.1. General considerations

Pólux dry-type low-voltage transformers are designed and manufactured to operate at a maximum ambient temperature of 40°C and a maximum altitude of 1000 meters. When the customer has special application requirements, these must be communicated in advance during the technical/commercial proposal process so that the non-standard conditions can be evaluated by the product engineering team. The installation environment must provide adequate ventilation for the correct operation of the transformer, as temperatures exceeding the design temperature may reduce its power output. Therefore, it is important that the air inlets are located at the bottom and the outlets on the opposite wall at the top, with sufficient openings to allow for the circulation of approximately 2.5 m³ of air per minute/kW of loss.

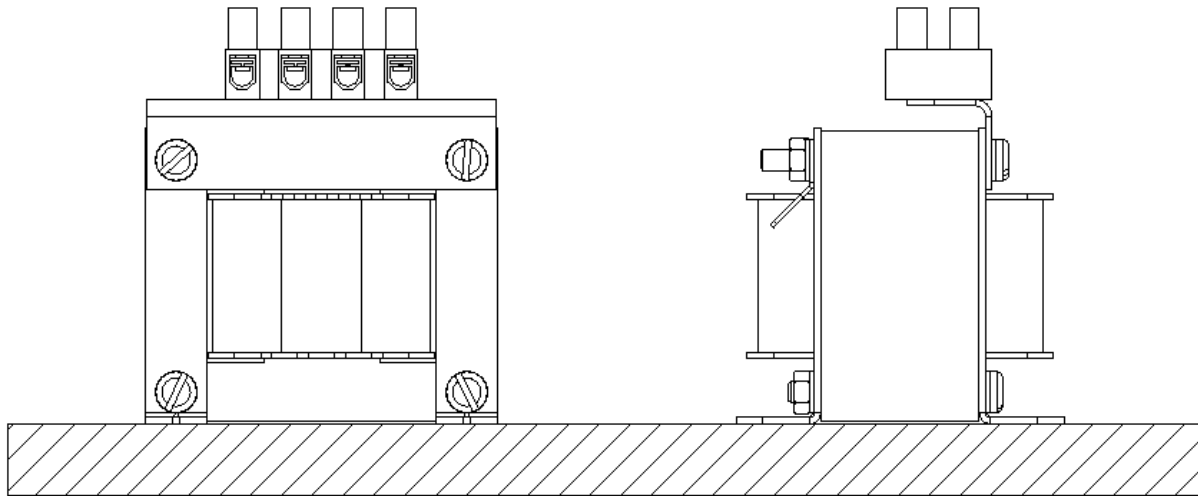
Before installing the transformer, the availability of appropriate tools and equipment, as well as qualified professionals to perform the procedure in accordance with NR 10 - Safety in Electrical Installations and Services and NBR 13297 - Receiving, installation and maintenance of dry-type power transformers, must be verified.

The following factors must be carefully considered when installing transformers:

- Avoid installation on rainy days;
- Perform a visual inspection of the assembly, especially the terminals, connectors, and accessories, to identify any damage resulting from handling and transporting the transformer;
- Verify that the data on the nameplate is consistent with the system in which the transformer will be installed and the correct position (selection) of the voltage switch (when this condition exists);
- Do not connect the neutral wire from the mains (installation) to the neutral terminal of the transformer; use it only for load (output). Pólux transformers have a device on their underside, identified with the grounding symbol, specifically designed for this purpose.
- All Pólux transformers should only be energized after the mains power has stabilized and when the circuit is unloaded, in order to avoid problems with voltage and overload;
- Remove the enclosure covers (unless it has an IP00 protection rating) and retighten all electrical (primary and secondary winding terminations) and mechanical connections;
- When it is necessary to lift the transformer, the cables used must be attached to the lifting lugs that are provided for this purpose;
- Maintain a minimum distance of 0.5 meters between walls, buildings, and other transformers to allow for air circulation.

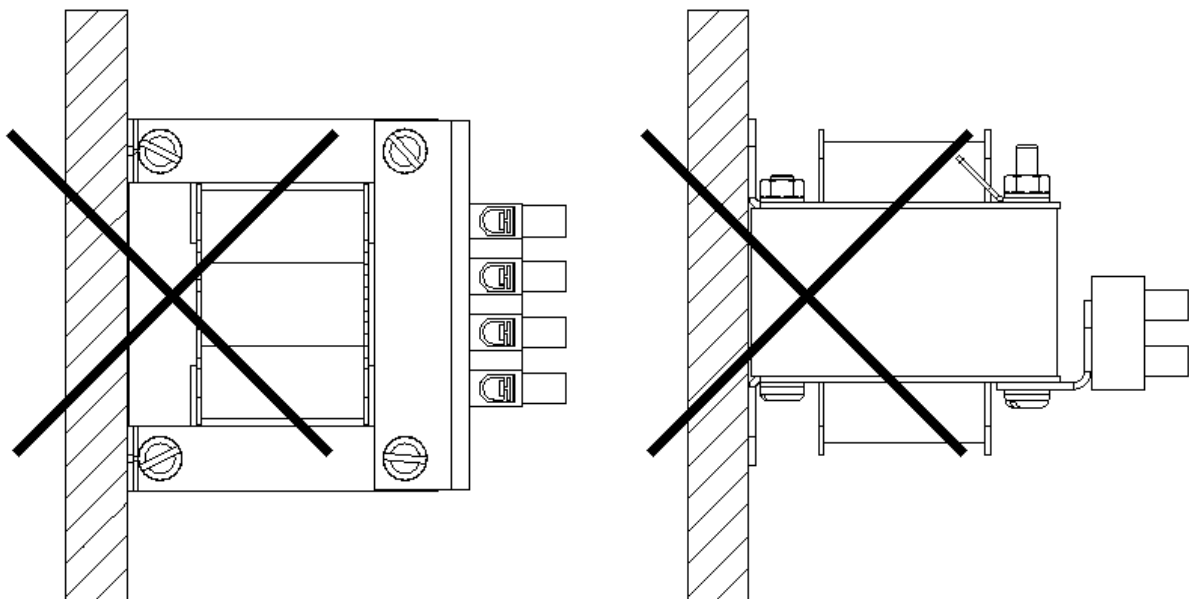
The transformer should ideally be mounted vertically to allow for proper heat dissipation.

Figure 6 – Recommended mounting position.



Source: Pólux Indústria Eletromecânica Ltda

Figure 7 – Prohibited mounting positions



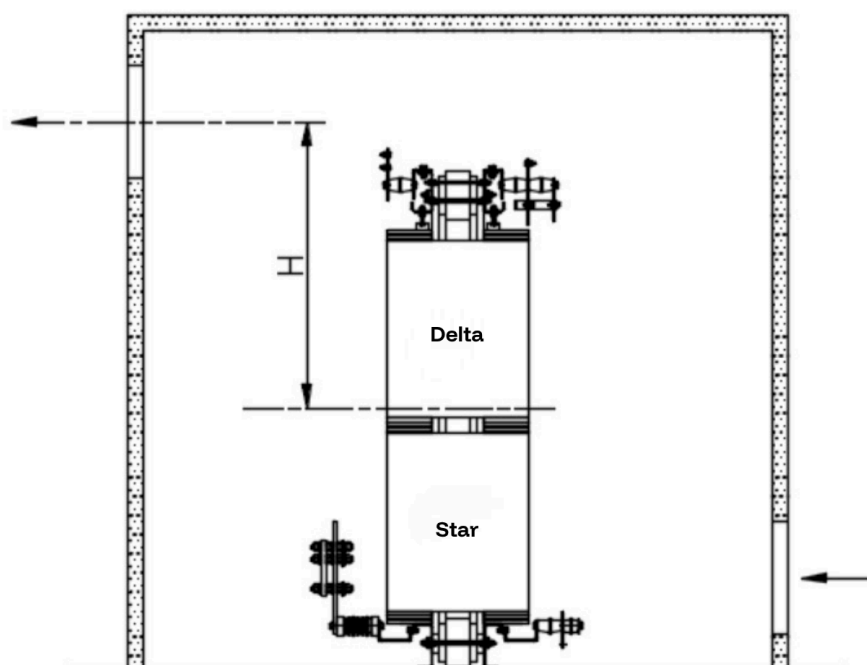
Source: Pólux Indústria Eletromecânica Ltda

Proper transformer installation is crucial for its proper functioning and system safety. Failure to follow installation instructions, including choosing the correct location, can result in problems such as overheating, reduced lifespan,

and even equipment failure. Pólux will not be held responsible for any damage caused by improper transformer installation.

If air conditioning is installed in the electrical room where the transformer is located, do not point the air conditioning equipment directly at the transformer to avoid water condensation. This contact with water can cause serious problems and lead to the transformer burning out.

Figure 8 – Adequate ventilation.



Source: Pólux Indústria Eletromecânica Ltda

3.2. Transformer operating altitude

Pólux low-voltage transformers are designed and manufactured according to applicable standards for installations up to 1000 meters above sea level. At higher altitudes, the transformer will experience reduced operating capacity due to the decreased dielectric strength of the air. A correction factor is required, as per the following table:

Table 1 - Air dielectric strength corrections for altitudes above 1000 meters.

Altitude (meters)	Correction factor
1000	1.00
1200	0.98
1500	0.95
1800	0.92
2100	0.89
2400	0.86
2700	0.83
3000	0.80
3600	0.75
4200	0.70
4500	0.67

Source: NBR ABNT 5356-11

3.3. Connections

It is necessary to follow the wiring diagrams illustrated on the nameplate to verify the transformer information and installation requirements.

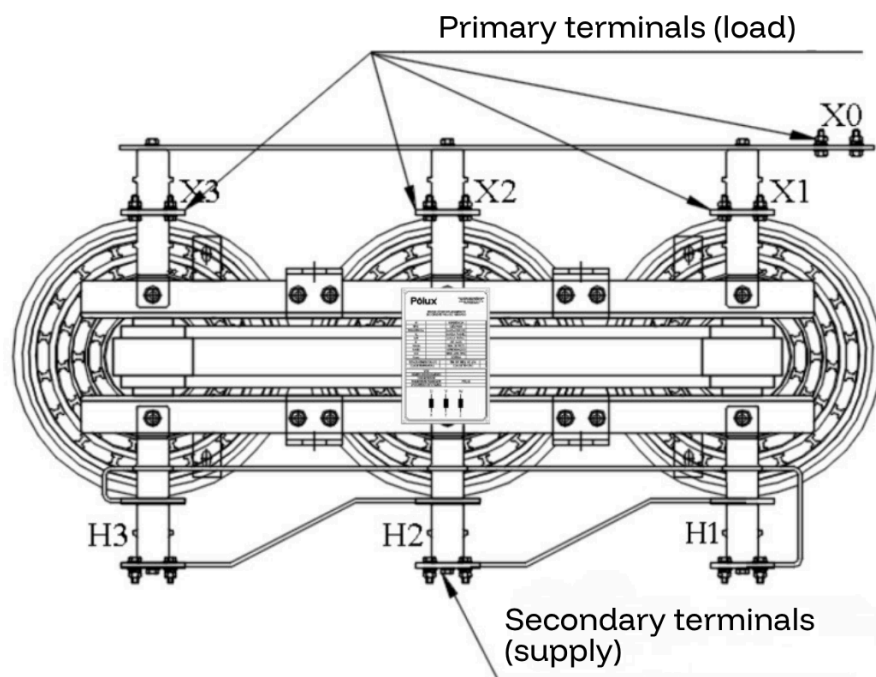
The high and low voltage terminals of the Pólux transformer are made of copper, aluminum, or brass screws and are located at the ends of the coils, closing the connection between the coils. The low voltage terminals are made of aluminum alloy or copper. Before connecting the transformer terminals to your circuits, the following procedures must be followed:

- All terminations must be flexible in order to avoid mechanical stress. These terminations can support considerable conductor weights, but long distances without supports should be avoided.
- The cables or bars must be correctly sized and the connections properly tightened in order to avoid overheating.

All Pólux dry-type transformers have terminal identification in accordance with applicable standards (see figure 9). Before connecting the transformer

terminals to their respective circuits, the following procedures must be followed to prepare their surfaces:

Figure 9 – Terminal identification – Top view of a three-phase transformer.



Source: Pólux Indústria Eletromecânica Ltda

- Protect the transformer so that cleaning residue does not settle on the coils and other parts of the transformer;
- Clean the aluminum surfaces to remove the thin layer of oxide that spontaneously forms from the contact of the conductive material with air. This oxide layer can be removed with very fine sandpaper;
- Apply industrial petroleum jelly or a zinc-rich antioxidant compound to the conductive parts immediately after surface cleaning. Cleaning tin-plated copper connectors should follow the same procedure, taking care not to remove the finishing material;

- In aluminum-copper connections, a copper-aluminum alloy plate (bimetallic element) may be used, not supplied with the transformer unless requested. All connection accessories: screws, nuts, flat, recessed or conical washers, must be made of steel and protected against corrosion (galvanized, cadmium plated, etc.). Details are provided in Figure 10;
- To transmit the correct screw pressure to the contact surface, conical washers should be used that do not undergo permanent deformation and that can accommodate volume changes due to temperature fluctuations;
- The bolts should preferably be tightened using a dynamometer or torque limiting wrench, ensuring even pressure distribution and proper electrical contact;



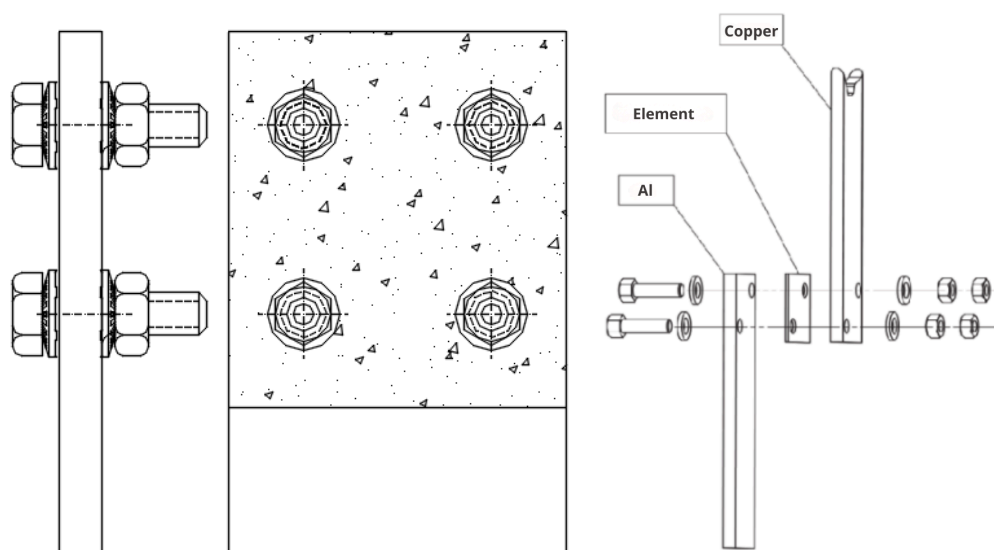
- After the first 24 hours of operation under load, it is recommended to inspect all connections to detect any overheating resulting from loose connections or poorly crimped terminals on the connecting cable. Repeat the inspection every 12 months of operation.
- The recommended torques are shown in Table 2, for both bolted and compression electrical connections:

Table 2 – Nominal tightening torques.

Type of electrical connections (check if necessary)	Torque - Nominal tightening torque (Nm)				
	M6	M8	M10	M12	M16
Hex Head Bolts (Class 8.8)	8	22	43	75	183
Brass Screws	8	22	35	50	120

Source: NBR

Figure 10 - Type of terminals available for connecting the primary/secondary of the transformer with a bimetallic element.



Source: Pólux Indústria Eletromecânica Ltda



To even out any potential settling, Pólux recommends retightening the screws a few weeks after installation. When retightening, the torque applied should not exceed the torque applied during assembly.

3.4. Protection and switching components

Transformers must be protected with protective devices such as fuse switches, circuit breakers, disconnectors, surge arresters, and others, in order to prevent short circuits, overloads, or atmospheric surges. These protections must be correctly sized, supplied, and installed by the customer.

3.5. Temperature monitoring

The monitoring system analyzes temperature variations in the windings and protects the transformer in case of excessive temperature rise, short circuit, or any other anomaly. This protection does not prevent a reduction in

the transformer's lifespan if the cooling air temperatures are not maintained within the specified limits.

The temperature monitoring system for Pólux transformers consists of platinum (PT-100) thermoresistors conforming to IEC 60751, and a monitoring device with contacts for alarm, trip, and serial communication port (when requested), with Modbus protocol, for connection to a supervisory system.

At least one PT-100 thermal resistor is installed in each of the coils on the low-voltage winding. The trip alarm functions are parameterized in the monitoring device. The parameterized values can be found in the protection circuit diagram. By default, the PT-100s are sent in a three-conductor circuit and are fixed to the top of the winding. The transformer's thermal protection system is parameterized at our factory, requiring no field adjustments.

3.6. Minimum distances for energization

An adequate distance must be ensured between the transformer and any surrounding structure/obstacle to allow for safe servicing and to guarantee correct electrical clearances and operation.

Table 3 - Minimum spacing for dry-type transformers.

Transformer voltage class (kV) (effective)	Atmospheric impulse voltage (kV)	Minimum phase-to-ground spacing (mm)	Minimum phase-to-phase spacing (mm)
0.6	-	25	25
1.2	-	25	25
7.2	40	45	60
	60	65	90

Source: NBR ABNT 5356-11

4. Energization

Energizing Pólux transformers is a procedure of fundamental importance and must be performed by a qualified professional, respecting the applicable technical and regulatory standards.

When the transformer is connected to the electrical system, some sparks may be visible near the magnetic core. This physical phenomenon does not affect the correct operation of the transformer and is not related to its quality. If the protection systems are not configured correctly, the energizing current will trip the circuit breaker that protects the transformer. After verifying the installation, some points should be observed, in addition to those indicated in the technical standards and safety regulations before energizing the transformer, namely:

- Confirm that the voltages indicated on the nameplate are indeed those present in the primary and secondary power supply circuits;
- When installing in parallel with other transformers, ensure that the impedance values are equivalent, that the phase connection sequence is correct, and that the transformers are connected to the same tap on the primary winding;
- Verify that all primary and secondary connections have been made correctly and that the cables, busbars, or any connecting element are fixed and properly supported, avoiding mechanical stress on the transformer terminals;
- Check that the taps on the coil tap change panel are firmly and equally connected on all three phases, and that the position corresponds to the transformer's nominal supply voltage;
- Check the connections and tightening torque on the contact screws, as per table 2 of this manual;

- Check the integrity of the temperature sensors and ensure they are correctly connected to the terminals of the protection relay, and that the supply voltage to the protection relay is adequate. If in doubt, consult the catalog of the monitoring device supplied with the transformer.
- Confirm that there are no foreign objects (nuts, bolts, washers, tools, etc.) trapped between the coils, between the coils and the core, or between the transformer and the protective enclosure (when provided);
- In enclosures where cable glands are supplied, check that they are properly tightened until they make contact with the cables passing through them;
- Confirm that the transformer is securely connected to the grounding circuit via the connector installed on its base.



To prevent the formation and circulation of currents in the grounding system, only one point on the transformer should be connected to ground.

After these checks, Pólux recommends measuring the transformer's insulation resistance using a calibrated megohmmeter. Once all the above points and the insulation resistance have been verified, the transformer can be energized following these procedures:

- a. Energize the transformer when it is unloaded;
- b. Measure the voltage on the secondary side using appropriate equipment, ensuring that it is suitable for the voltage required by the load;
- c. Apply the load to the transformer progressively as specified;
- d. Check the temperature readings on the monitoring device (when applicable);
- e. Always keep a safe distance from the energized transformer.



**NEVER TOUCH THE ENERGIZED TRANSFORMER
LIFE-THREATENING!**

5. Maintenance

Pólux dry-type transformers require little maintenance. We recommend a visual inspection every three months, observing the points described in item three of this manual. This timeframe serves as a reference and should be adjusted according to the specific conditions of the installation environment; locations with high concentrations of industrial dust require shorter inspection periods.

5.1. Maintenance items

- Visual inspection of the site;
- General cleaning if necessary;
- Removal of dust and other dirt deposited on the transformer;
- Cleaning the cooling air inlets and outlets;
- Cleaning the ventilation channels between the transformer coils (when applicable);
- Check that there has been no overheating at the connection terminals and at the tap terminals (when applicable);
- Check the torque values of the bolted connections;
- Check the operation of the thermal protection system (when applicable).

WARNING: The items listed above should only be performed with the transformer switched off. For added safety, it is recommended to ground the terminals during maintenance work.

5.2. Cleaning method

Use oil-free compressed air and/or water with a maximum pressure of 5 atm to remove dust deposited in the ventilation ducts, if accessible. A vacuum cleaner can be used as an alternative.

5.3. Main abnormalities and solutions

Table 4 – Operational abnormalities.

Item	Defect	Probable cause	Corrective action
1	Overheating at the terminals of the primary and secondary windings at the connection points or switch panel	Bad connection	- Clean contact areas; - Retighten nuts and screws.
2	Transformer overheating	Supply voltage higher than expected	- Check the voltage.
		Overload exceeding expectations	- Reduce the load; - Increase the refrigeration airflow.
		Insufficient cooling air circulation	- Clean the cooling air ducts.
		Cooling air temperature above the expected temperature	- Reduce the load; - Increase the refrigeration airflow.
3	Relay operation protection (alarm and/or shutdown)	Transformer overheating	- See item 2 above.
		No power supply to the relay	- Check the supply voltage at the relay; - Check that the relay is functioning properly; - Check the protection circuit (relay + temperature sensors).
4	Excessive noise	Uneven installation of the transformer base	- Verify that the transformer is properly secured, which must be done at four points.
		Resonance with surfaces surrounding the equipment	- Check for any loose metal surfaces (panels, cabinets, ducts, doors, etc.) that could cause vibrations.
		Transmitted resonances through the connections	- Installation of flexible components between the transformer terminals and the installation conductors.

Source: Pólux Indústria Eletromecânica Ltda

If the abnormalities persist after applying the suggested corrective actions, or if other abnormalities not described in Table 4 are observed, contact Pólux's after-sales service immediately.



All suggested correction operations should be performed with the transformer switched off and free of residual voltages.

6. Safety and environment

In the manufacturing of our transformers, Pólux is committed to using the most suitable materials, aiming to protect the environment.

When the transformer reaches the end of its useful life or when any of its components need replacing, they must be disposed of following safety and environmental procedures. Similarly, the packaging that protects the transformer during delivery must be disposed of properly. If you have any questions, please do not hesitate to consult our quality engineering department.

Like Pólux, you too should be committed to preserving the environment, preventing contaminating materials and used components from being disposed of improperly, as some materials can be recycled, preventing them from contaminating natural water sources, soil, or even the health of the population.

7. Warranty Terms

Before putting this equipment into operation, commissioning must be carried out, observing the information contained in the project and/or nameplate, in order to check its condition after transport and installation,

retightening all connections and fully reading this warranty document. We are not responsible for damages caused by failure to observe this warning.

- The warranty period for Pólux products will be 12 (twelve) months, starting from the delivery of the product when this is the responsibility of the manufacturer, or starting from the collection of the product at Pólux's premises when it is the responsibility of the customer;
- Any and all repairs should only be carried out at the Pólux factory in Jaraguá do Sul – Santa Catarina or by a qualified technician if previously authorized by the factory;
- All repairs and parts replacements during the warranty period will be performed free of charge by Pólux if a manufacturing defect is proven, with the customer responsible for delivering and collecting the equipment at the factory. Transportation costs or personnel travel expenses in the field are not covered by the warranty and are the customer's responsibility.
- In the event of an anomaly, the equipment must be available for the minimum period necessary to identify the causes and carry out repairs.

7.1 The following equipment will not be covered by the warranty

- That have suffered damage during transport, when this is the customer's responsibility;
- That have been stored or handled improperly or in an unsuitable location;
- Those that are improperly installed, failing to comply with the technical standards applicable to the installation of electrical equipment;
- Whose power supply network conditions are outside the specified limits;
- That they have been assisted by a person who is not qualified and not authorized by Pólux;
- That have undergone some modification by third parties;

- That have suffered overload, short circuit, overvoltage, overcurrent or atmospheric discharges or any other anomaly arising from transport or application;
- That are being misused;
- Whose connection terminals are loose, rusted, or have poor contact;
- That are subject to environmental conditions and aggressive agents not foreseen in the client's specifications;
- That have not undergone periodic preventive maintenance;
- The assessment of these requirements will be the responsibility of Pólux's technical team, based on information obtained from the client and after analysis of the damaged equipment. The client will be subject to charges for the costs involved in the service provided by Pólux.
- The warranty expires after the aforementioned period, with all transportation expenses and risks being the responsibility of the customer.
- This warranty is limited to the equipment supplied, and Pólux is not liable for damages to persons, third parties, other equipment or installations, lost profits, or any incidental or consequential damages;
- This warranty does not cover parts or components subject to normal wear and tear, such as: fuses, lamps, thyristors, power transistors and diodes, varistors, contacts and similar items, as well as components whose lifespan under normal use is shorter than the warranty period;
- Special care should be taken with power factor correction equipment. Measurements are recommended for the correct sizing of this equipment, as well as to verify the presence or absence of network disturbances (harmonics). The warranty will only be granted for installations where the measurement characteristics remain the same as those existing at the time of equipment sizing.

- We emphasize that, when this equipment is not sized by Pólux, our responsibility is limited to manufacturing it according to the specifications in the customer's requirements, commercial proposal, contract, purchase order and/or order;
- Pólux disclaims responsibility for any damage caused to the client's plant, whether it occurs before or after the installation of equipment manufactured by Pólux.



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