



Installation manual

Dry-type reactors.

Pólux®

Congratulations!

You have purchased a dry reactor 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 reactor 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 dry reactors. 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. Safety warning

- Do not lift or move the reactor without proper equipment and experienced personnel;
- Do not unload the reactor until a complete inspection has been completed;
- Do not adjust or remove any accessories or covers while the reactor is energized;
- The reactor must be de-energized and all terminals grounded before any maintenance;
- Make sure all connections are complete and tight before powering up the reactor;
- Do not alter the connections when the reactor is energized.

2. Introduction

This manual aims to provide necessary instructions for users handling, transporting, storing, installing, and maintaining Pólux dry reactors. Following these instructions will ensure optimal equipment performance, as well as the electrical characteristics for which it was designed and specified by the customer.

This manual covers single-phase and three-phase reactors, installed with or without enclosures, establishing the limiting factors for their optimal performance. The information contained herein describes the inspection, proper installation, and maintenance of dry-type reactors.

Pólux reactors are designed and manufactured in strict accordance with the standards in force at the time of their construction. For further clarification, it is recommended to read the following standards:

- NBR 5356-6: Power Reactors – Dry-type reactors – Specification;
- IEC 60076-5: Power transformers - Part 5: Ability to withstand short circuit
- IEC 60076-6: Power transformers - Part 6: Reactors;
- IEC 61558-2-20: Safety of power transformers, reactors, power supply units and combinations thereof – Part 2-20: Particular requirements and test for small reactors;
- IEC 60751:2022: Industrial platinum resistance thermometers and platinum temperature sensors;
- IEEE C57.16-2011: Standard for Requirements, Terminology, and Test Code for Dry-Type Air-Core Series-Connected Reactors.

To ensure the correct installation and operation of the reactor, 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.

3. Three-phase line reactors

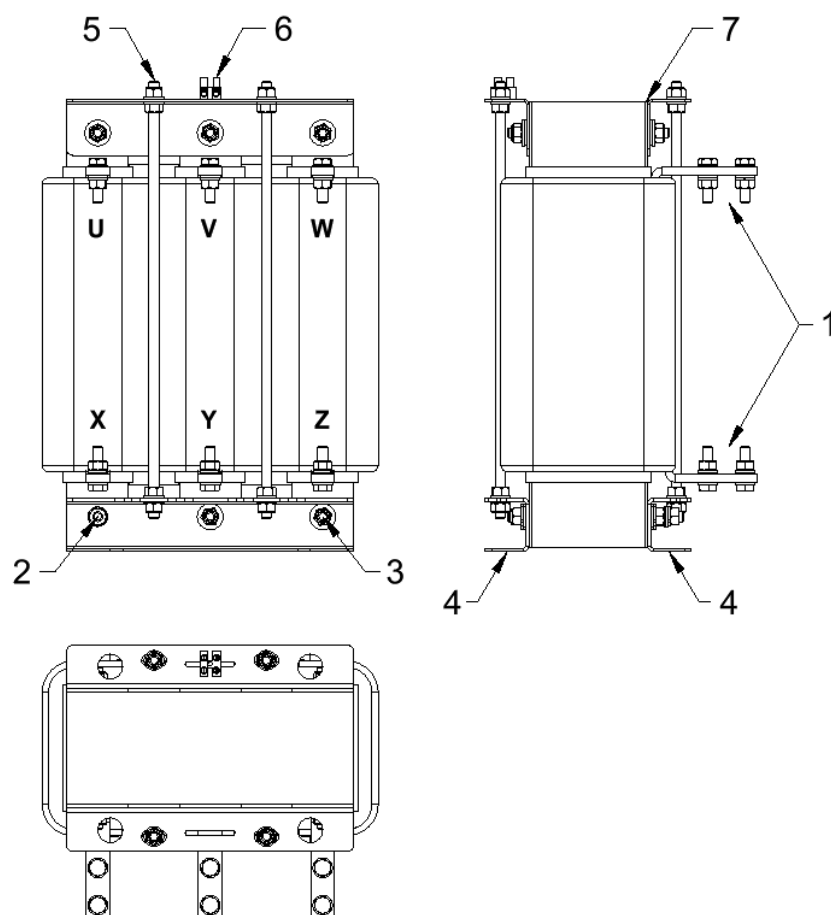
Three-phase line reactor is popularly known as an input and output filter. Its function is to reduce the harmonic distortion of the current, thus preventing voltage deviations in the power supply network and, consequently, damage to installations and their components. The installation of three-phase line reactors promotes improvements in the electrical network, as it brings benefits such as:

- increases the power factor at the inverter input;
- reduces the effective current at the input;
- reduces voltage distortion in the power supply network;
- increases the lifespan of capacitors;
- reduces drive lockup due to overvoltage.

All manufacturers of frequency inverters recommend the use of three-phase line reactors in series, along with the drive.

3.1 Construction Features

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



Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Terminals for connection: retighten all electrical connections;
2. Grounding screw;
3. Horizontal mounting rod: before operating, retighten all mechanical connections;
4. Mounting holes: used for securing the reactor during installation;
5. Vertical mounting rod: before operating, retighten all mechanical connections;
6. Sensor terminals: will be supplied upon customer request;

3.2. Identification

Pollux-produced reactors have a label showing the reactor's nominal values. They are available in two types of materials: polyester or stainless steel.

Figure 2 – Example of a polyester identification plate

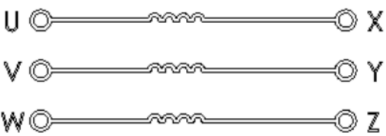
Pólux®		REATÂNCIA DE REDE TRIFÁSICA	
Nº 1129213 / 01		REF.:	
Ln:	In:	U X V Y W Z	
Ls:	Isef:		
CLA. ISOL.:	Vrede:		
CLA. TEMP.:	FREQ.:		
ELEV. TEMP.:	MASSA:		
www.polux.ind.br / (47) 3275-3541 JARAGUÁ DO SUL - SC			

Source: Pólux Indústria Eletromecânica Ltda

Caption:

- REF: Reference;
- Ln: Nominal inductance;
- Ls: Inductance under overload;
- Isef: Overload current;
- CLA. ISOL: Insulation class;
- Vrede: Network voltage;
- CLA. TEMP: Temperature class;
- FREQ.: Frequency;
- ELEV. TEMP.: Elevation of temperature.

Figure 3 – Example of a stainless steel nameplate.

 PÓLUX INDÚSTRIA ELETROMECÂNICA LTDA RUA JOÃO JANNIÃO AYROSO, 800 89.253-100 - JARAGUÁ DO SUL - SC - BR CNPJ 73.363693/0001-29				ELEV. TEMP. (°C)		TENS. SUP. FREQ. IND. (kV)	
				CLASSE TEMPERATURA		CLASSE TENSÃO (kV)	
REATOR PARA SAÍDA DE INVERSOR							
N°		MÊS/ANO		REF.			
FREQ.		REFRIG.		TIPO		FASES	
Ln		In		Ith		GRAU PROT.	
FATOR K		MASSA		Vrede			
TEMP. AMB. MÁX		ALT. MÁX		NORMA			
							

Source: Pólux Indústria Eletromecânica Ltda

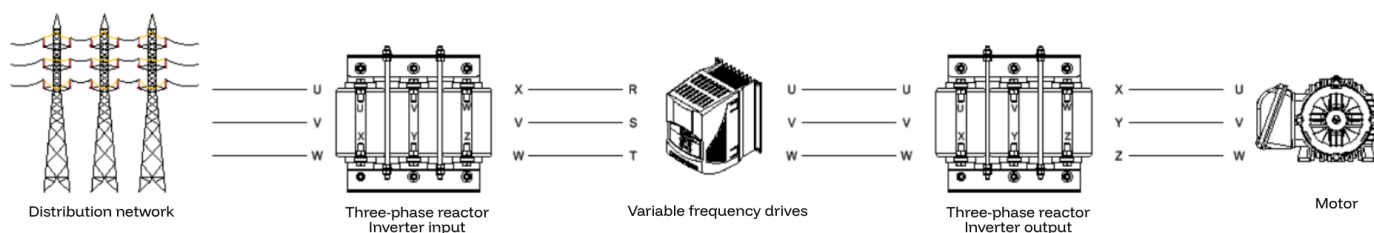
Caption:

- TEMP. AMB. MÁX: Maximum ambient temperature;
- REFRIG.: Refrigeration;
- In: Nominal current;
- ALT. MÁX.: Maximum altitude;
- Ith: Thermal current.

3.3. Application example

For better understanding, Figure 4 illustrates how the three-phase reactor connection should be made; the example uses both the inverter input reactance and the inverter output reactance.

Figure 4 – Example of a three-phase reactor connection.

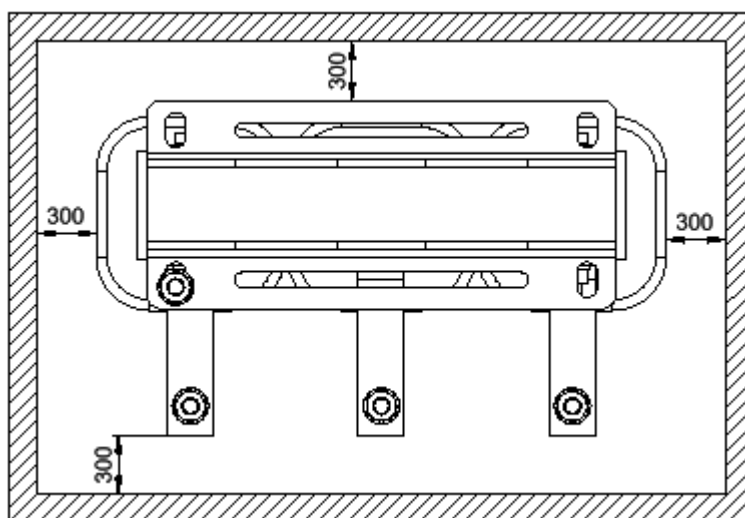


Source: Pólux Indústria Eletromecânica Ltda

3.4. Minimum distance for energization

For silicon core reactors, whether three-phase or single-phase, maintain a minimum distance of 0.3 meters between walls, buildings, and other reactors (if present) to allow for air circulation.

Figure 5 – Minimum spacing for silicon core reactors.



Source: Pólux Indústria Eletromecânica Ltda

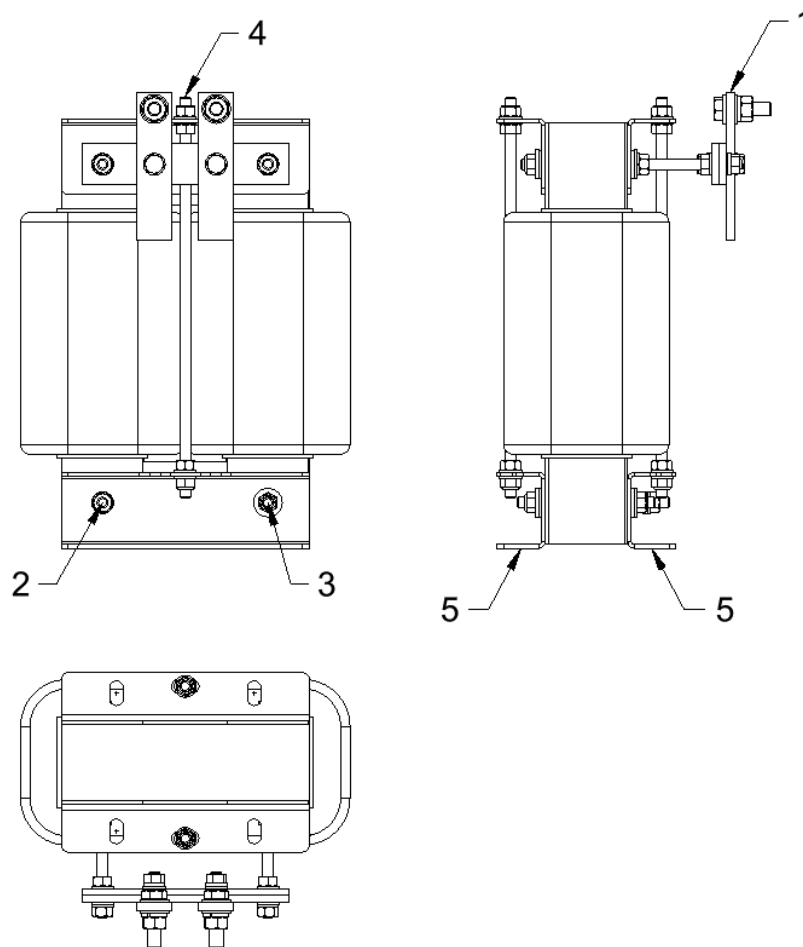
If air conditioning is installed in the electrical room where the reactor is located, do not point the air conditioning equipment directly at the reactor to avoid condensation. This contact with water can cause serious problems and lead to equipment burnout.

4. Single-phase iron core reactor

Single-phase reactors attenuate current transients, help reduce current harmonic distortions, reduce voltage drops in cables, and reduce starting currents of electrical machines, thus extending the service life of cables and electrical machines and reducing maintenance costs.

4.1. Construction Features

Figure 6 – General identification of a single-phase reactor.



Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Terminals for connection: retighten all electrical connections;
2. Grounding screw;
3. Horizontal mounting rod: before operating, retighten all mechanical connections;
4. Vertical mounting rod: before operating, retighten all mechanical connections;
5. Mounting holes: used to secure the reactor during installation.

4.2. Identification

The single-phase reactors produced by Pólux have a label showing the reactor's nominal values. In this case, it is available in polyester material.

Figure 7 – Example of a polyester identification plate.

Pólux®		REATÂNCIA DE DESSINTONIA MONOFÁSICA	
		Código:	Ln.:
Nº 1129107 / 001	Freq.:	In:	Ith:
Vcap:	Fator Dessintonia:		
Vrede:	Massa:		
CL. Isol.:	CL. Temp.:		
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Source: Pólux Indústria Eletromecânica Ltda

Caption:

- Ith: Thermal current;
- Vcap: Capacitor bank voltage;
- Vrede: Network connection voltage.

4.3. Application example

Examples of applications for single-phase iron-core reactors:

- Input and output of frequency inverters;
- Input of Motor Control Centers;
- Input and output of control panels;
- DC bus input reducing capacitor charging current;

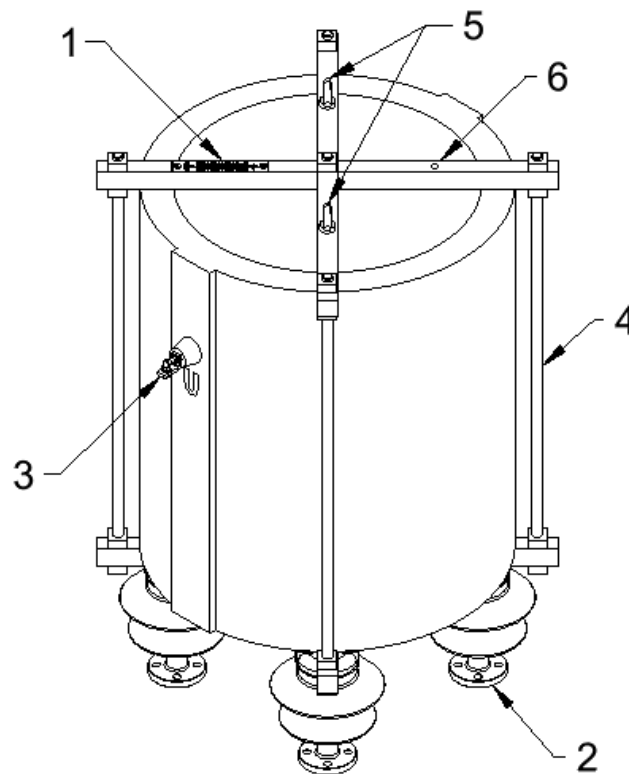
- Other applications where it is desirable to attenuate current transients.

5. Air-core reactor

Air-core reactors have a very similar mechanical design, so their construction characteristics are the same for both current limiting reactors and grounding reactors.

5.1. Construction features

Figure 8 – General identification of an air-core reactor.



Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Identification plate: verify all data before installing;
2. Porcelain pedestal-type insulator;

3. Terminal for connection: retighten all electrical connections;
4. Vertical mounting rod: before operating, retighten all mechanical connections;
5. Lifting lugs;
6. Aluminum crossarms.

5.2. Current limiting reactor

The objective is to limit the system's short-circuit current in the event of faults to a desired current level. These reactors are connected in series with the system, increasing the impedance and consequently enabling the reduction of the short-circuit level of adjacent equipment and reducing stress on insulators, switches, busbars, and other system components.

5.2.1. Identification

Figure 9 – Example of a nameplate for a current limiting reactor.

Pólux®

PÓLUX INDÚSTRIA METROELÉTRICA LTDA
RUA JOÃO JABURÃO ATRIO, 959
17.179-000 - JARDIM DO SUL - SP - BR
CNPJ 07.989917/0001-02

REATOR NÚCLEO DE AR LIMITADOR DE CORRENTE PARA USO ABRIGADO

Nº		REFERÊNCIA	
TIPO		MÊS/ANO	
FREQUÊNCIA		MASSA REATOR	
X_L		MASSA PAINEL	
X/R		MASSA TOTAL	
I_n		ALT. MAX.	
Vrede		GRAU DE PROT.	
FASES		REFRIGERAÇÃO	
lcc		TEMP. AMB. MAX.	
Imec		NORMA	

ELEVAÇÃO TEMPERATURA (°C)		TEN. SUP. FREQ. IND. (KV)	
CLASSE TEMPERATURA		CLASSE TENSÃO	

TAG	
NÚMERO DO DOCUMENTO	
FORNECEDOR	
FORNECEDOR FABRICANTE	PÓLUX
Nº DO PEDIDO DE COMPRA	

Source: Pólux Indústria Eletromecânica Ltda

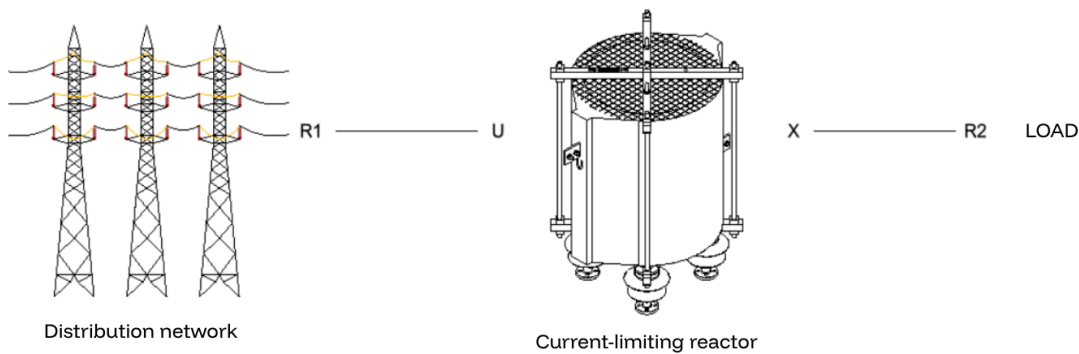
Caption:

- Imec: Mechanical current.

5.2.2. Application example

Below is an illustration showing the connections of a current-limiting reactor.

Figure 10 – Example of a current limiting reactor connection.



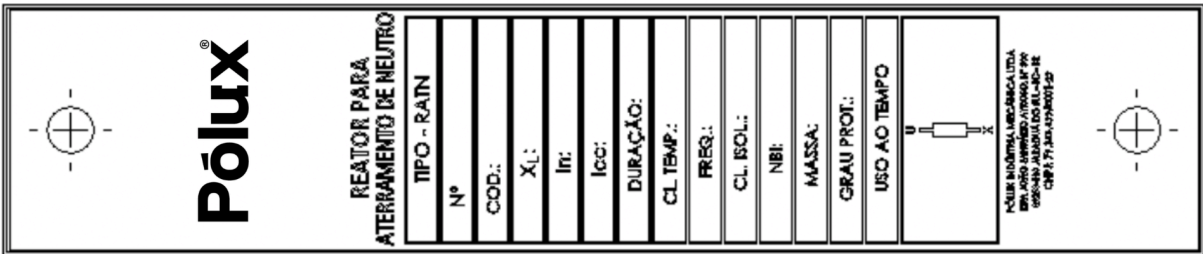
Source: Pólux Indústria Eletromecânica Ltda

5.3. Grounding reactor

The grounding reactor is used in systems where it is necessary to limit the neutral current when there are phase-to-ground faults, limiting the current to a desired level. The main constructive characteristic of this product is its air core, which allows for efficient application, exhibiting low noise levels and low electrical losses. Its design also allows it to be used outdoors.

5.3.1. Identification

Figure 11 – Example of a nameplate for a grounding reactor.



Source: Pólux Indústria Eletromecânica Ltda

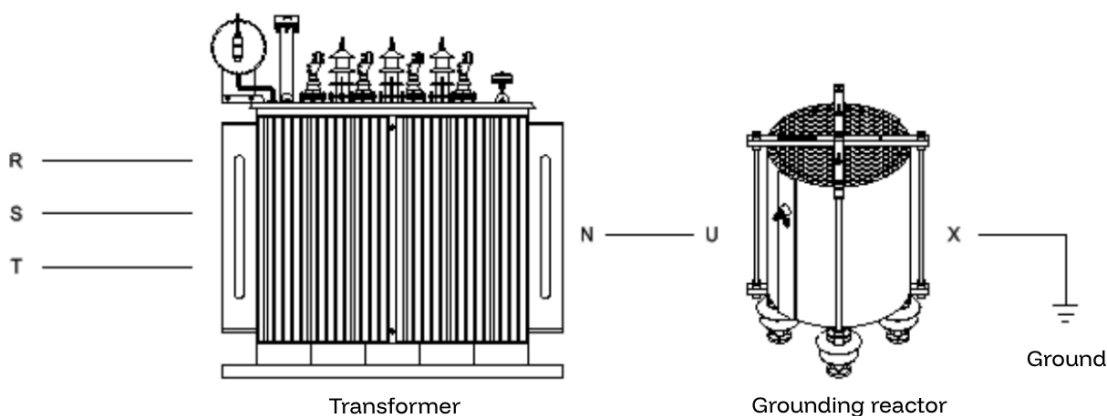
Caption:

- RATN: Neutral grounding reactor;
- X_l : Reactor reactance;
- I_{cc} : Short-circuit current.

5.3.2. Application example

Below is an illustration showing the connections of the ground reactor.

Figure 12 – Example of a grounding reactor connection.



Source: Pólux Indústria Eletromecânica Ltda

5.4. Minimum distance for energization

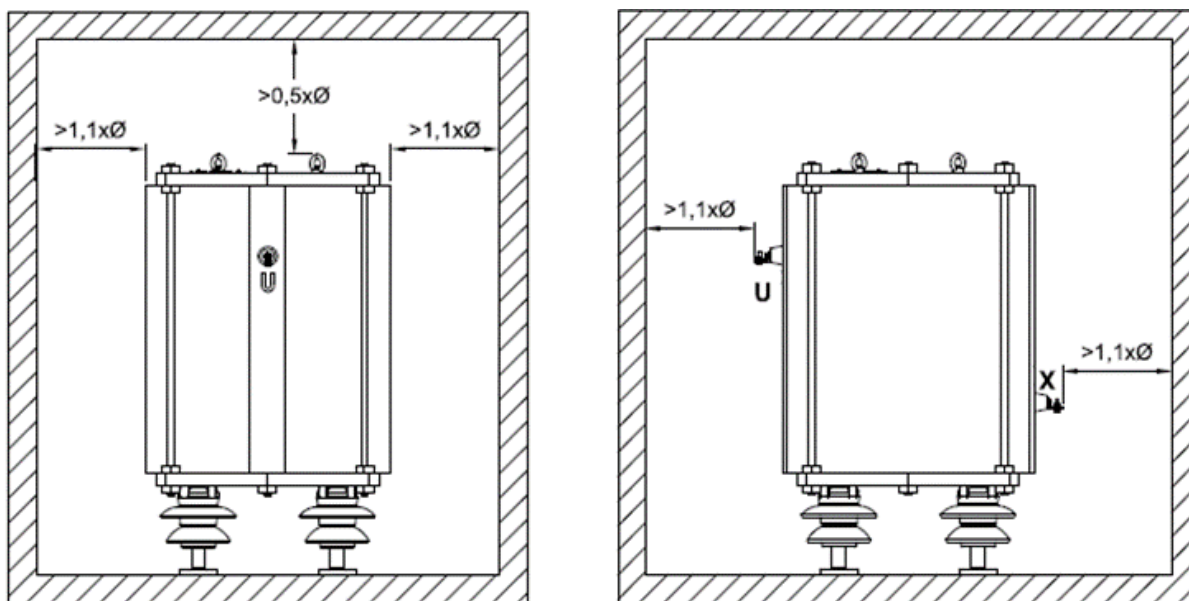
It is essential to ensure adequate distance to allow for any necessary maintenance, prevent electrical arcs and short circuits, and ensure the necessary ventilation for heat exchange between the reactor and the environment, enabling efficient and safe operation.

In air-core reactors, to ensure that tight loops do not form between the reactors and metal structures, the minimum spacing is 1.1 times the outer

diameter of the reactor for the sides of the structure and 0.5 times the outer diameter for the top of the structure.

Figure 13 shows the minimum required distances for air-core reactors:

Figure 13 – Minimum spacing for air-core reactors.



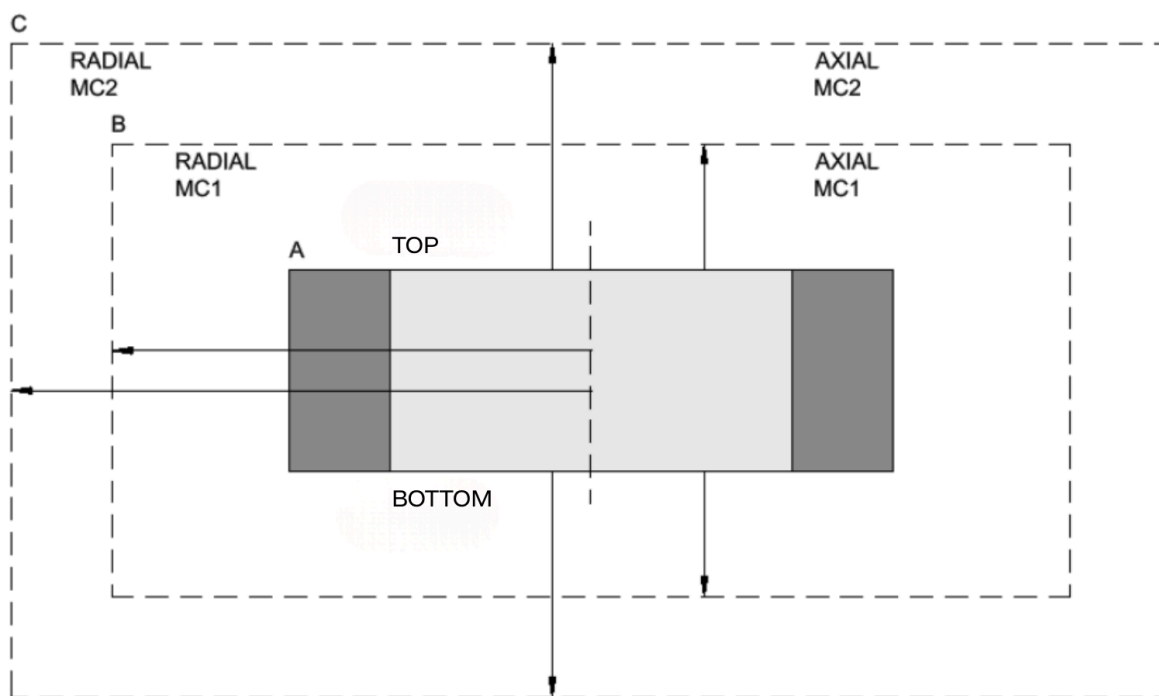
Source: Pólux Indústria Eletromecânica Ltda

The reactor's magnetic field can cause the circulation of induced currents in metallic parts located near the equipment (e.g., grounding grid, foundation reinforcement, metal lifting structures, metal fences, etc.). To avoid excessive heating due to current inductions, the installation of reactors must respect the recommended magnetic distances. Two regions must be respected:

- MC1: Border region for the installation of metal parts without forming closed loops. Within the MC1 region, the installation of any metal part is not recommended, even without forming closed loops. Between the MC1 and MC2 regions, the installation of metal parts without forming closed loops is permitted;

- MC2: Border region for the installation of metal parts with closed loop formation. From the MC2 region onwards, the installation of any metal part is permitted, including those with closed loop formation.

Figure 14 – Magnetic distances MC1 and MC2.



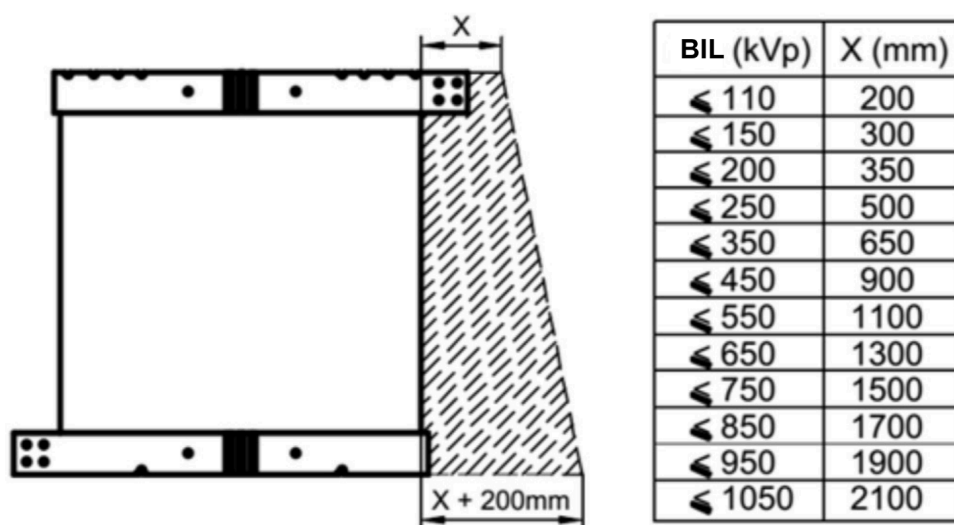
Source: Pólux Indústria Eletromecânica Ltda

If the customer chooses to reinforce the foundation using non-metallic rebar (e.g., fiberglass), and if there are no metallic elements near the reactor (e.g., grounding mesh, etc.), it is possible to place it at a distance less than MC1 from the foundation. However, the minimum axial electrical distance according to the voltage level of the installation must still be respected.

5.4.1. Electrical distance

The connecting cables for air-core reactors must maintain a minimum spacing to avoid dielectric problems. The required distance depends on the basic insulation level (BIL) of the equipment, as shown in the following diagram.

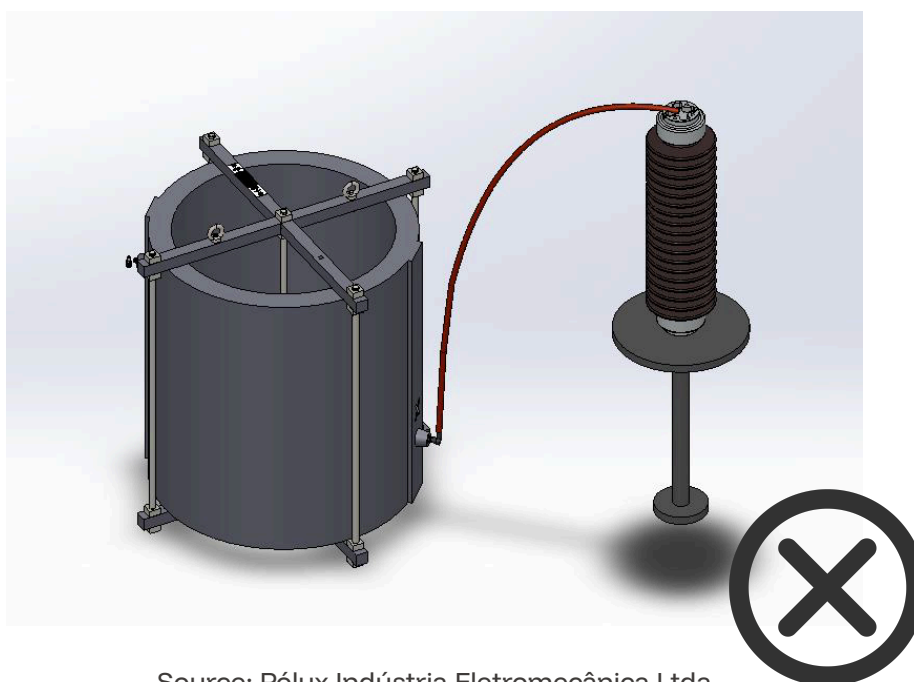
Figure 15 – Minimum distance for connection cables.



Source: Pólux Indústria Eletromecânica Ltda

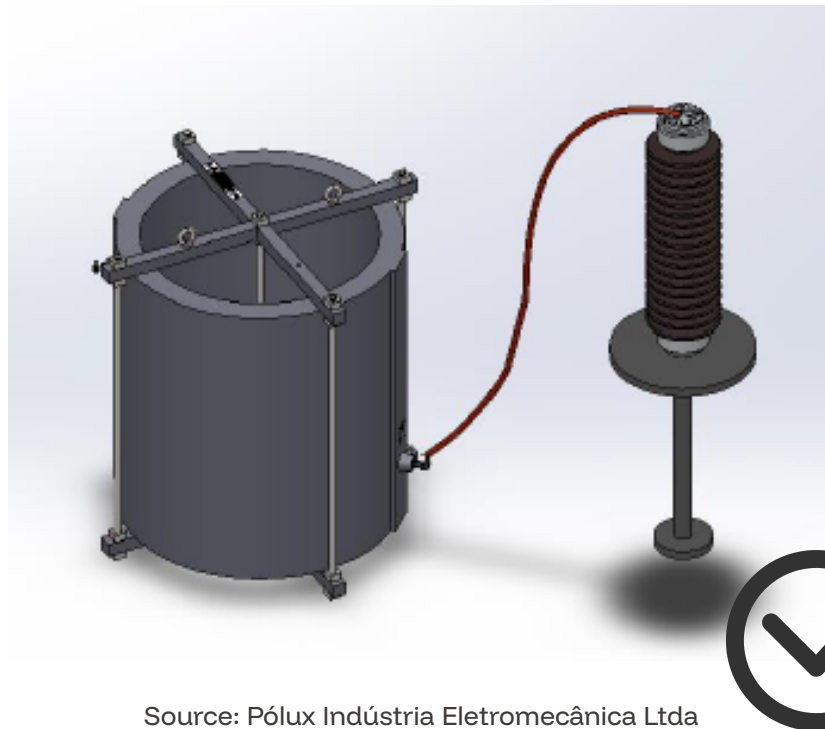
Examples of incorrect and correct ways of connecting links are shown below.

Figure 16 – Example of incorrect connection (cable too close to the equipment surface).



Source: Pólux Indústria Eletromecânica Ltda

Figure 17 – Example of correct connection (cable with appropriate distance from the equipment surface)

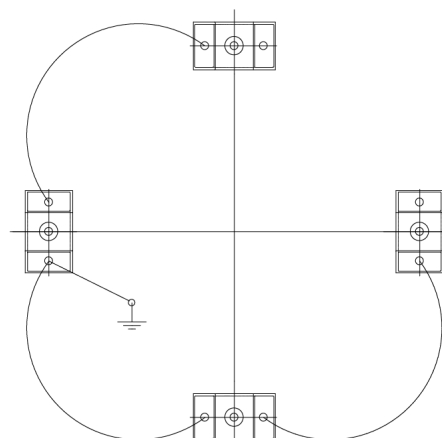


Source: Pólux Indústria Eletromecânica Ltda

5.4.2. Grounding of pedestals and metal structures

The metal parts of the reactor support structure that are at zero potential (floating) must be grounded according to the following instructions:

Figure 18 – Grounding of the base pedestals.



Source: Pólux Indústria Eletromecânica Ltda

1. Ground one of the reactor pedestals by connecting it to the substation grounding grid or, if access to the grounding grid is not possible, using one or more copper rods;
2. Connect the remaining reactor pedestals to the grounded pedestal, leaving at least two pedestals disconnected from each other (to avoid the formation of a closed loop);
3. Alternatively, each reactor pedestal can be grounded individually, connecting them to the substation grounding grid or via one or more copper rods if access to the grounding grid is not possible;
4. Grounding connectors must be specified taking into account the materials of the pedestals and grounding conductors, to avoid galvanic corrosion of the aluminum when placed in contact with copper.

6. Receipt

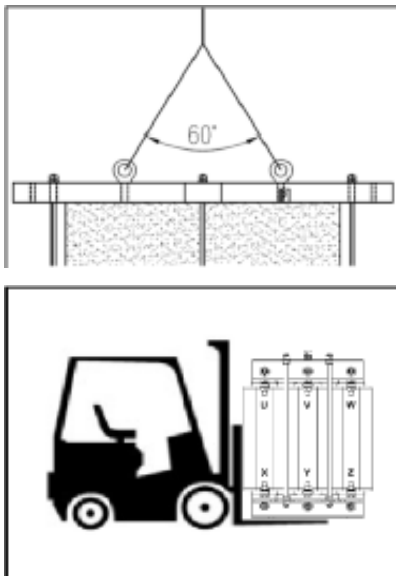
Upon receiving the reactors, it is essential to perform a visual inspection to identify any damage that may have occurred during transport. If any problems or damage are detected, immediately notify the transport company and Pólux before authorizing the unloading of the material. The packaging is properly designed for transport to prevent any accidents with the product.

For handling products exceeding the weight supported by a human, equipment can be supplied with lifting lugs. To avoid excessive stress on any device, it is recommended to use all available lugs on the reactor during lifting. Casters can also be provided to facilitate movement.

Reactors should never be moved by their active parts or connection terminals, as excessive stress in inappropriate locations can cause irreversible damage to the equipment. Lifting should only be carried out with a forklift or

pallet on the underside of the enclosure (when applicable) or by overhead crane, using the internal lifting eyes fixed to the upper structure of the core and coil assembly, ensuring uniform load distribution.

Reactors can be quite heavy and have a relatively high center of gravity, so they must be handled carefully and moved slowly to avoid falling.



- Use all available lifting lugs;
- Do not allow the angle between the lifting cables to exceed 60°.
- Handle the reactor only in an upright position;
- Be very careful when lifting and moving the reactor to avoid tipping it over.

6.1. Place of receipt

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

6.2. Receiving inspection

Upon receipt, it is important to verify that the physical product matches the product invoiced. A visual inspection should also be carried out to check the external condition of the reactor, 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 notified.

A visual inspection should be performed to locate any possible damage or displacement of parts, loose or broken connections, dirt or foreign material, and the presence of water or moisture. Verify that the information on the identification plate installed on the equipment matches the job specifications and ensures proper installation of the reactor.

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

6.3. Storage

If storage is necessary, the reactor must be placed in a clean, dry room where a uniform temperature is maintained. Air circulation through the reactor enclosure must be allowed. The relative humidity to which the insulating materials are exposed must be kept as low as possible. The floor where the inductor will be stored must not allow moisture from the air to enter. Precautions must be taken to protect against water ingress from any source, such as roofs, leaks, water or steam lines, windows, etc.

If storage is prolonged, periodic inspections are recommended to ensure that environmental conditions do not cause damage to the equipment. In cases where the relative humidity during storage is high or unknown, electric resistance heaters should be used inside the enclosure.

Never store the reactor with its base directly on the ground. Suitable supports, appropriate to the environment and the base material (aluminum or stainless steel), should ensure a distance of 10 cm between the ground and the equipment.



If the equipment will be stored, the packaging supplied with the reactor should not be removed.

6.4. Installation

During reactor installation, strictly follow the instructions in the manual and connection diagrams provided. Ensure that all electrical connections are secure and correctly sized as specified. The installation site must be clean and free of obstructions, with sufficient space for adequate ventilation and future maintenance. Additionally, verify that the reactor is properly grounded in accordance with applicable safety standards.

6.5. Security

To ensure the safety of everyone involved in the handling and operation of reactors, it is essential that only authorized and trained professionals perform these activities. All workers must be aware of safety practices, including the use of Personal Protective Equipment, energy source lockout procedures, and the proper use of tools and testing equipment.

Accident prevention is a shared responsibility, and therefore, the presence of firefighting equipment and first aid notices in visible and accessible locations is crucial. Safety must be a priority at every stage of the process, from the acceptance to the continuous operation of the reactors.

6.6. Maintenance

Reactor maintenance must be performed according to a strict schedule, following the manufacturer's recommendations. Regular inspections are necessary to identify signs of wear or damage that could compromise equipment performance. Any intervention must be carried out with the reactor

de-energized and all connections grounded, ensuring the safety of the maintenance technician.

Recording all maintenance activities is essential for monitoring equipment history and proactively planning future interventions. Adherence to these practices will ensure the longevity and efficient operation of the reactors, preventing unscheduled shutdowns and increasing system reliability.

7. Installation and assembly

7.1. General considerations

Pólux low-voltage and medium-voltage dry-type reactors 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 reactor, as operating at temperatures higher than designed 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 for minimum circulation according to Equation 1.

$$F = 2,5 \times P_s$$

Given that:

P_s = reactor loss in kW;

F = Airflow in m³/hour.

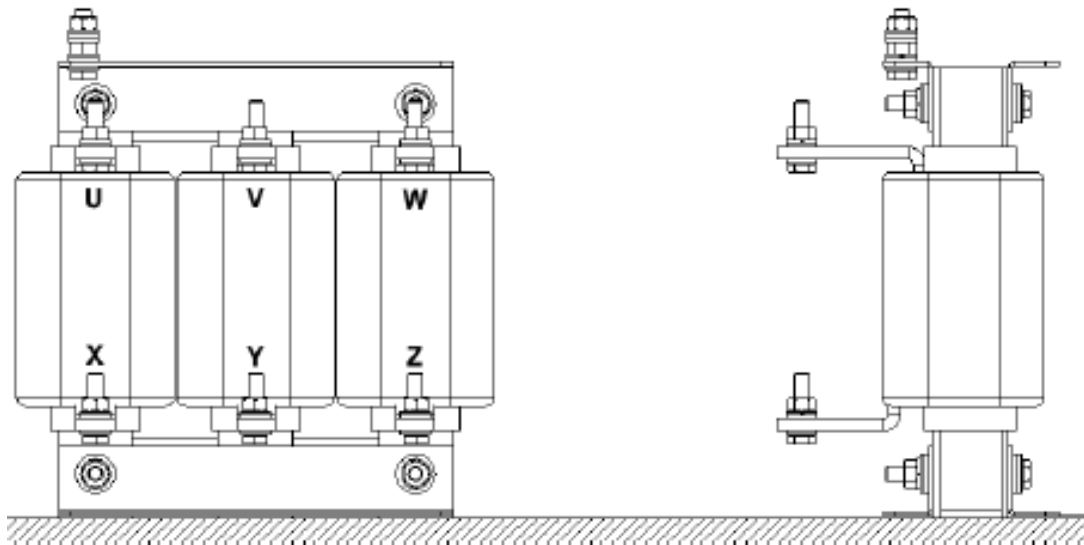
Before installing the reactor, the availability of appropriate tools and equipment, as well as qualified professionals to perform the procedure in accordance with NR 10 - Safety in Electrical Installations and Services, must be verified.

The following factors must be carefully considered when installing reactors:

- Avoid installation on rainy days;
- Perform a visual inspection of the assembly, especially the terminals, connectors, and accessories, to identify any damage resulting from the handling and transport of the reactor;
- Verify that the data on the nameplate is consistent with the system in which the reactor will be installed;
- All Pólux reactors should only be energized after the mains power has stabilized and when the system is unloaded;
- When it is necessary to lift the reactor, the cables used must be attached to the lifting lugs that are provided for this purpose.

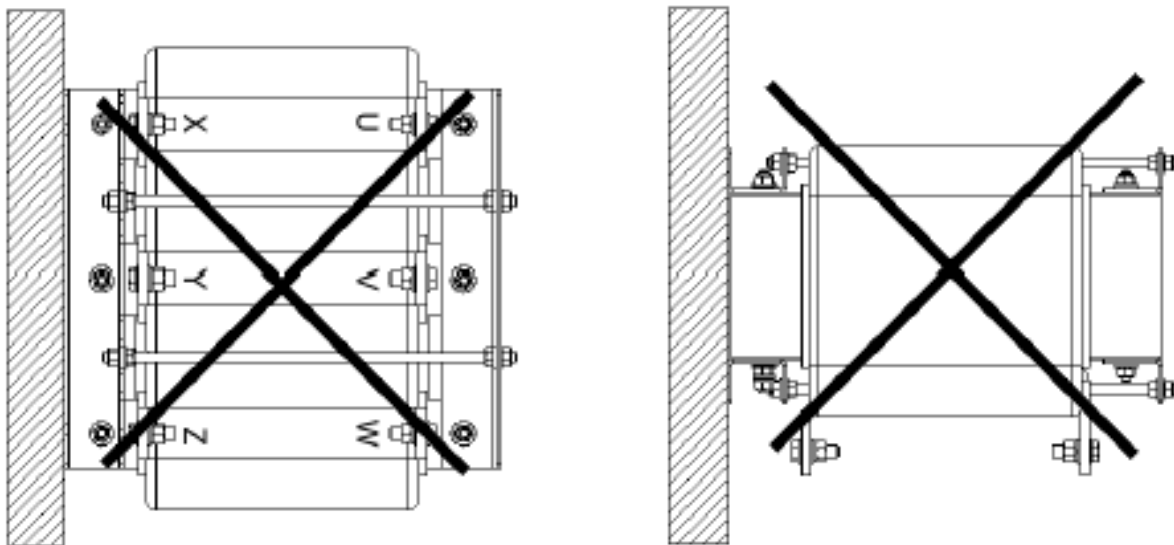
The reactor should be mounted vertically to allow for proper heat dispersion.

Figure 19 – Recommended mounting position.



Source: Pólux Indústria Eletromecânica Ltda

Figure 20 – Prohibited mounting positions.



Source: Pólux Indústria Eletromecânica Ltda

Proper installation of the reactor is crucial for its proper functioning and the safety of the system. Failure to follow installation instructions, including choosing the appropriate 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 reactor installation.

7.2. Special considerations

Special operating, transport, or installation conditions are those that may require special construction, revision of nominal values, or special care during the transport, installation, or operation of the transformer. Examples include:

- Installation at altitudes above 1000 meters above sea level and temperatures above 40 °C;
- Exposure to excessive moisture, saline atmosphere, gases or smoke that are harmful to the equipment;
- Exposure to harmful dust such as iron ore dust, sulfur, etc.;
- Exposure to explosive materials in the form of gases or dust;
- Insulation requirements differ from those specified for the equipment;
- Limited installation space;
- Transportation, installation and storage under precarious conditions;
- Risk of abnormal vibrations, seismic tremors and occasional shocks.

These factors should always be checked in order to obtain optimal performance and as a preventative measure against accidents or damage to the equipment. Exposure to these factors will cause a loss of transformer efficiency, material temperature class, dielectric strength of the insulators, among other issues.

7.2.1. Reactor operating altitude

Pólux low and medium voltage reactors are designed and manufactured according to applicable standards for installations up to 1000 meters above sea level. For higher altitudes, the reactor's operating capacity will be reduced due

to the decrease in the dielectric strength of the air. Therefore, a correction factor must be used (Table 1).

Table 1 – Correction of air dielectric strength by altitude.

Altitude (m)	Correction factor
1000	1.0
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

7.2.2. Connection

It is necessary to check the current and inductance information shown on the nameplate to verify the reactor's specifications and installation requirements.

The input and output terminals of the Pólux reactor are made of copper, aluminum, or brass screws and are located at the ends of the coils. Before connecting the reactor terminals to your circuits, the following steps must be followed:

- All terminations must be flexible in order to avoid mechanical stress.

- These terminals can support considerable driver 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 reactors have terminal identification in accordance with applicable standards. Before connecting the reactor terminals to their respective circuits, the following procedures must be followed to prepare their surfaces:

- Protect the reactor so that cleaning residue does not settle on the coils and other parts;
- 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 reactor unless requested. All connection accessories: screws, nuts, flat, spring or conical washers, must be made of steel and protected against corrosion (galvanized, cadmium plated, etc.).
- To transmit the correct screw pressure to the contact surface, conical washers should be used that do not deform and can accommodate volume variations 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;



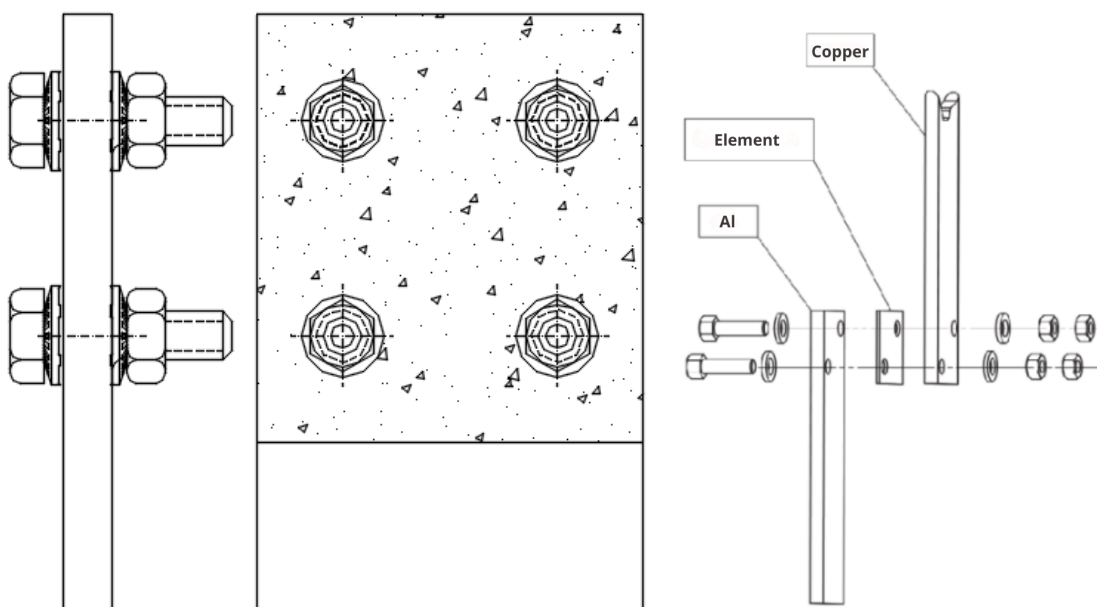
- After the first 24 hours of operation under load, it is recommended to inspect all connections to detect any overheating resulting from loose connections or poorly crimped terminals on the connecting cable. Repeat inspection every 12 months;
- The recommended torques are shown in Table 2 below, for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

Table 2 – Nominal tightening torques.

Type of electrical connections	Torque - Nominal Tightening [Nm]				
	M6	M8	M10	M12	M16
Hex Head Bolts (Class 8.8)	8	22	43	75	183
Brass Screws	8	22	35	50	120
304 Stainless Steel Screws	6.2	15	30	52	130

Source: NBR

Figure 21 - Type of terminals available for connecting the reactor terminals 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.

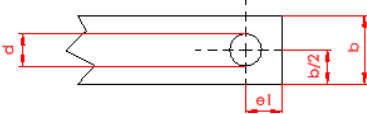
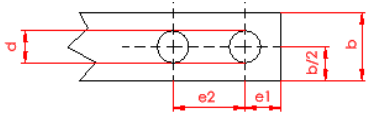
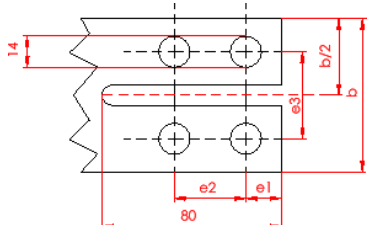
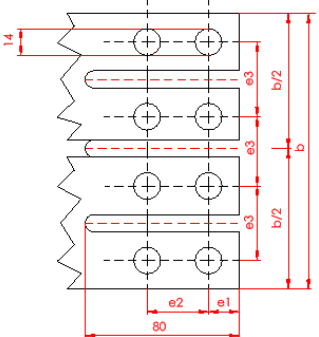
Unless otherwise specified in the electrical design, the measurements from the ends of the bars to the base or ceiling should be followed according to Table 3.

Table 3 – Distances between the connection point and the ceiling/base.

Gauge	1 cable per phase (mm)	2 cables per phase (mm)	3 cables per phase (mm)	4 cables per phase (mm)	5 cables per phase (mm)	6 or 8 cables per phase (mm)
6	100	100	100	-	-	-
10	100	100	100	-	-	-
16	150	150	150	-	-	-
25	150	150	150	-	-	-
35	150	150	150	-	-	-
50	150	150	150	-	-	-
70	150	170	200	-	-	-
95	180	180	215	-	-	-
120	215	215	230	260	-	-
150	255	255	280	305	-	-
185	305	305	330	360	400	450
240	360	360	380	400	450	500
300	380	405	460	480	530	580
400	460	510	560	600	600	600
500	485	560	600	600	600	600

Source: Pólux Indústria Eletromecânica Ltda

Table 4 – Connection layout.

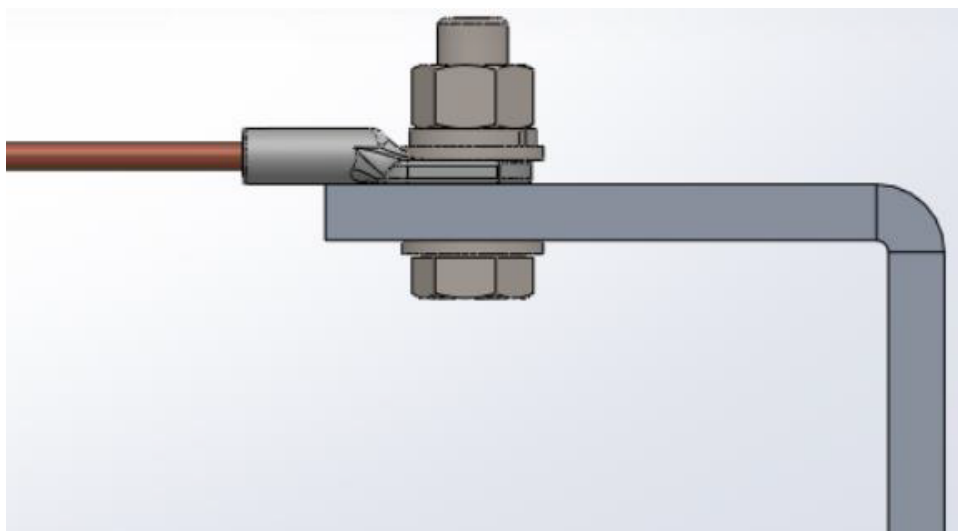
Form	Dimensional figure	b (mm)	d (mm)		Screw	e1 (mm)	e2 (mm)	e3 (mm)
			Through hole	Thread				
1		12	5.5	M5	M5	6	-	-
		15	6.6	M6	M6	7.5		
		20	9.0	M8	M8	10		
		25	11	M10	M10	12.5		
		30	11	M10	M10	15		
		40	14	M12	M12	20		
		50	14	M12	M12	25		
2		25	11	M10	M10	12.5	30	-
		30	11	M10	M10	15	30	-
		40	14	M12	M12	20	40	-
		50	14	M12	M12	20	40	-
		60	14	M12	M12	20	40	-
3		80	14	M12	M12	20	40	40
		100				20	40	50
		120				20	40	60
4		160	14	M12	M12	20	40	40
		200						50

Source: Pólux Indústria Eletromecânica Ltda

The reactor connection can be made using cables, and for this it is necessary to check if the busbar is clean and free of corrosion or oxidation (if necessary, clean the contact areas with a wire brush or a non-abrasive cloth). Ensure that the connection points on the busbar are accessible and prepared to receive the tubular terminal.

Use the torque wrench to tighten the mounting screws, following the torque specified in this manual for each gauge. Figure 22 below shows how the connection between the busbar and the connecting cable should be.

Figure 22 – Demonstration of the reactor busbar connection with a cable.



Source: Pólux Indústria Eletromecânica Ltda

For installation after long periods of storage, the contact surfaces should be polished with a fine steel brush or fine sandpaper along with non-acidic lubricating petroleum jelly, which will also help prevent corrosion of the aluminum.

To connect the reactor, it is essential to use a maximum shielded cable length of 150 meters, and if an unshielded cable is used, the maximum length is

300 meters. For lengths exceeding these values, please consult our line of sinusoidal filters.

7.2.3. Protection and switching components

Reactors 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.

7.2.4. Temperature monitoring

The monitoring system analyzes temperature variations in the winding and protects the reactor in case of excessive temperature rise due to overload, short circuit, or any other anomaly. It is important to note that this protection does not prevent a reduction in the reactor's lifespan if the cooling air temperatures are not maintained within the specified limits.

The temperature monitoring system for Pólux reactors consists of platinum (PT-100) thermistors, in accordance with the IEC 60751:2008 standard, and a monitoring device with contacts for alarm, shutdown and serial communication port (when requested), using the Modbus protocol for connection to a supervisory system.

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

If the customer prefers, a temperature control relay can be installed to protect the reactor against high temperatures. The thermal protection relay

used is the EP3 manufactured by Electron, which monitors up to 3 temperature channels; in the case of a three-phase reactor, it monitors the temperature of all 3 coils.

7.2.5. Reactors installed in metal cubicles

For reactors installed in enclosed substations (masonry rooms) or metal cubicles, the following procedures must be followed:

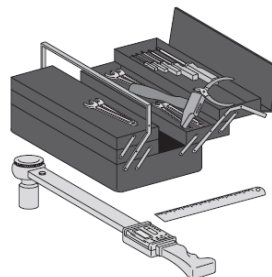
1. Air inlets should be considered in the upper and lower thirds of the side and front walls of the cubicle.
2. The minimum internal dimensions of measurements indicated in the dimensions and/or specific technical documentation of the reactor must be respected.
3. To prevent the formation of tight spaces between the sheets, it is recommended to electrically insulate the spaces between the sheets with insulating material and insulating anchors on the screws at the joints.



8. Tools

Below are the general tools for handling, installation, and maintenance:

- 75 Nm torque wrench;
- Bushing ratchet;
- Bushing of 13 and 17;
- Clamp for spinal alignment;
- Rubber mallet;
- Hydraulic jack which can operate in a horizontal position;
- Axle wrench;
- Extra-thin latch adapter;



- Extra-thin 13 and 17 mm socket.

9. Energization

Energizing Pólux reactors is an extremely important procedure and must be carried out by a qualified professional, respecting all applicable technical and regulatory standards. Before energizing the reactor, in addition to verifying the installation according to safety standards, the following points must be observed:

- **Connections and fastening:** Check that all connections have been made correctly and that cables, busbars or any connecting elements are fixed and properly supported, avoiding mechanical stress on the reactor terminals;
- **Screw torque:** Check the connections and torque of the contact screws according to Table 2 of this manual;
- **Temperature sensors:** Check the integrity of the temperature sensors (when applicable) and ensure they are correctly connected to the terminals of the protection relay. Confirm that the supply voltage to the protection relay is adequate. If in doubt, consult the monitoring device catalog supplied with the reactor;
- **Foreign objects:** Ensure that there are no foreign objects (nuts, bolts, washers, tools, etc.) trapped between the coils, between the coils and the core, or between the reactor and the protective housing (when provided);
- **Cable glands:** In enclosures with cable glands, check that they are properly tightened until they make contact with the cables passing through them;
- **Grounding connection:** Confirm that the reactor is securely connected to the grounding circuit via the connector installed on its base.

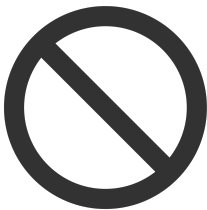


To prevent the formation and circulation of currents in the grounding grid, only one point of the reactor should be connected to ground.

After verifying all the points above, the energizing of the Polux reactor must follow these procedures:

- a. Energize the reactor when it has no load;
- b. Check temperature readings on the monitoring device (when installed);
- c. Always keep a safe distance from the energized reactor.

Strictly following these procedures will ensure the safety and proper performance of the reactor during operation.



NEVER TOUCH THE ENERGIZED REACTOR

Life-threatening danger!

10. Maintenance

Dry reactors manufactured by Pólux are designed to require little or no maintenance. However, to ensure optimal performance and extend their service life, we recommend conducting periodic visual inspections every twenty-four months.

10.1. Maintenance items

- **Visual inspection of the site:** Conduct a thorough visual inspection of the environment where the reactor is installed. Check for signs of

deterioration, dust accumulation, or other contaminants that could affect the reactor's operation;

- **Inspection of torque seals:** Visually check the torque seals on the connecting bolts. Ensure that all bolts are securely tightened and that there are no signs of loosening or corrosion;
- **Cleaning the ventilation channels:** Regularly clean the ventilation channels between the reactor coils, especially for reactors with silicon cores. Obstruction of these channels can lead to overheating and compromise reactor performance;
- **Terminal inspection:** Use a thermal imaging camera to inspect the temperature at the terminals. Early detection of hot spots can prevent major failures. Check that the terminals are free of oxidation and properly connected;
- **Thermal protection system operation:** Test the thermal protection system, when applicable, to ensure it is operating correctly. Check the temperature sensors and protection circuits. Any anomalies should be corrected immediately;
- **Electrical connections:** Ensure all electrical connections are secure and free from corrosion. Inspect cables and busbars for signs of wear or damage;
- **Mechanical components:** Check all mechanical components, such as supports and fasteners, to ensure they are secure and show no signs of excessive wear;
- **Maintenance documentation:** Keep a detailed record of all inspections and maintenance performed. This includes date, time, points checked, actions taken, and observations. This record is crucial for tracking reactor performance over time and planning future preventive maintenance.

Following these recommendations will help ensure that Pólux reactors continue to operate efficiently and safely. If you have any questions or require

technical assistance, please contact Pólux technical support for expert guidance.

10.2. Main abnormalities and solutions

Table 5 – Operational abnormalities.

Item	Defect	Probable cause	Corrective action
1	Overheating at the HV and LV terminals, connection points, and switch panel	Bad connection	- Clean contact areas; - Retighten nuts and screws.
2	Reactor 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)	Reactor 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).

If the abnormalities persist after applying the suggested corrective actions, or if other abnormalities not described in Table 5 are observed, contact Pólux's after-sales service immediately.

10.3. Paint touch-ups

If touch-ups are needed on the paintwork, the following procedures should be followed:

1. Using adhesive tape, mark off the area of the reactor surface that will be touched up;
2. Using fine sandpaper, remove the paint from the outlined area;

3. To remove the RTV, use a plastic brush;
4. Clean the area with solvent or alcohol;
5. Dry the area to be touched up;
6. Apply a coat of finishing paint, as specified by Pólux, using a brush or air gun;
7. If the equipment is outdoors, cover it with plastic to protect it from sun or rain for 24 hours to ensure the paint dries properly.
8. Silicone paint repair (RTV):
 - a. Using a paintbrush or roller, apply a coat of RTV paint, duly approved by Pólux;
 - b. If the equipment is outdoors, cover it with plastic to protect it from sun or rain for a minimum of 72 hours to ensure the paint dries properly.

Note: The drying times indicated above assume an ambient temperature of 20°C and use materials recommended by Pólux. For paints from other brands, consult the supplier's technical data sheet.

11. Safety and environment

Pólux is committed to protecting the environment, using the most suitable materials in the manufacture of our reactors and transformers. When a reactor reaches the end of its useful life or when any of its components need to be replaced, it is essential that disposal is carried out in accordance with current safety procedures and environmental regulations. Similarly, the packaging that protects the reactor during transport must be disposed of appropriately.

If you have any questions about proper disposal, please consult our quality engineering department for detailed guidance.

Pólux believes that we should all share the commitment to preserving the environment. It is crucial to prevent contaminating materials and used components from being improperly disposed of, as many of these materials can be recycled, preventing the contamination of natural water and soil sources and protecting public health.

Furthermore, we emphasize the importance of adopting sustainable practices throughout the entire reactor lifecycle. This includes reducing resource waste during manufacturing, optimizing energy use, and implementing environmental management systems that ensure compliance with environmental legislation and industry best practices.

Pólux encourages its customers and partners to actively engage in sustainability initiatives, promoting the reuse of materials and recycling whenever possible. Furthermore, it is recommended to conduct periodic training on environmental and safety practices for all employees involved in the handling, installation, and maintenance of reactors, ensuring they are aware of best practices and procedures to follow.

By adopting these measures, we are not only fulfilling our legal and ethical responsibilities, but also contributing to a more sustainable and healthy future for generations to come. Together, we can make a difference in preserving our planet.

12. Warranty Terms

Before putting this equipment into operation, it is essential to perform commissioning, according to the information contained in the project and/or nameplate. This procedure aims to verify the condition of the equipment after transport and installation, ensuring that all connections are tightened and

that this warranty document is read in its entirety. Failure to observe this warning exempts us from any liability for resulting damages.

- 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 repairs can only be carried out at the Pólux factory in Jaraguá do Sul – SC, or by a qualified technician previously authorized by the company.
- During the warranty period, all repairs and parts replacements will be carried out free of charge by Pólux if a manufacturing defect is proven. The customer is responsible for delivering and collecting the equipment at the factory. Transportation costs or personnel travel to the site are not covered by the warranty and are the customer's responsibility.

12. 1. The following equipment is not covered by the warranty

- That suffered damage during transport, when this is the customer's responsibility;
- That have been stored or handled improperly or in an unsuitable location;
- They were poorly installed, not following the technical standards applicable to the installation of electrical equipment;
- Whose power supply network is not within the specified limits;
- Which were repaired by a person who was not qualified and not authorized by Pólux;
- That have been modified by third parties;
- That have been overloaded, suffered short circuits, overvoltages, overcurrents, lightning strikes, or any other anomaly during transport or application;
- That are being used inappropriately;

- Whose connection terminals are loose, oxidized, or have poor contact;
- That are in environmental conditions or exposed to aggressive agents not foreseen in the client's specification;
- That have not undergone regular preventive maintenance.

The assessment of these requirements rests with Pólux's technical team, based on information provided by the client and after analysis of the damaged equipment. The client may be held liable for the costs involved in the service provided by Pólux.

After the warranty period ends, all transportation expenses and risks are the customer's responsibility.

This warranty applies only to the equipment supplied, and Pólux is not liable for damages to persons, third parties, other equipment or facilities, lost profits, or any other incidental or consequential damages.

This warranty does not cover parts or components subject to normal wear and tear, such as fuses, lamps, thyristors, transistors, power diodes, varistors, contacts and similar items, as well as components whose lifespan under normal use is shorter than the warranty period.

Power factor correction equipment requires special care. Measurements are recommended for proper sizing and to check for disturbances (harmonics) in the network. The warranty will only be granted if the installations maintain the same measurement characteristics as at the time the equipment was sized.

When this equipment is not sized by Pólux, the company is only responsible for manufacturing it according to the specifications provided by the client in the commercial proposal, contract, purchase order, and/or request.

Pólux is not responsible for any damage caused to the customer's plant before or after the installation of equipment manufactured by the company.



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